Chapter-22

CHEMICAL COORDINATION AND INTEGRATION

POINTS TO REMEMBER

Endocrine glands : These are ductless glands which secrete hormones directly into the blood stream.

Hormones : Non-nutrient chemicals, synthesised in trace amounts, acts as intracellular messengers and are specific in their action.

Hypothalamus :

- It is basal part of diencephalon.
- Has neurosecretory cells called nuclei which produce hormones to regu late the synthesis and secretion of pituitary gland hormones.
- Two types of hormones released are :

Releasing hormones : Stimulate secretion of pituitary hormones, *e.g.,* Gonadotropin releasing hormone stimulates pituitary gland to synthesise gonadotrophins.

Inhibiting hormones : Inhibit secretions of pituitary hormones, *e.g.,* Somatostatin inhibits secretion of growth hormone.

Pituitary Gland :

- Located in bony cavity called as sella tursica.
- Attached to hypothalamus by a stalk.
- Divided anatomically into : Adenohypophysis and Neurohypophysis.
- Hormones released from hypothalamic neurons reach anterior pituitary through portal system.
- Direct neural regulation by hypothalamus occurs in posterior pituitary.

(a) PITUITARY GLAND :

Adenohypophysis :

Pars intermedia : Produces only one hormone melanocyte stimulating hormone.

Pars distalis : • Growth hormone (GH) : Oversecretion leads to gigantism and low secretion causes dwarfism.

- **Prolaction (PRL) :** Growth of mammary glands and formation of milk in them.
- **Thyroid stimulating hormone (TSH) :** Stimulates synthesis and secretion of thyroid hormones from thyroid gland.
- **Adrenocorticotrophic hormone (ACTH) :** Stimulates synthesis and secretion of steroid hormones called glucocorticoids from adrenal cortex.
- **Luteinizing hormone (LH) :** Synthesis and secretion of hormones called androgens in males, and helps in ovulation and maintenance of corpus luteum in females.
- **Follicle stimulating hormone (FSH) :** Regulate spermatogenesis in males, and growth and development of ovarian follicles in females.

Neurohypophysis : Pars Nervosa :

- **Oxytocin** helps in contraction of uterus during child birth and milk ejection from mammary gland in females.
- **Vasopressin :** Acts on kidney and stimulates reabsorption of water and electrolytes by distal tubules to reduce water loss through urine. It is also called as Anti Diuretic Hormone (ADH).

(b) PINEAL GLAND :

- Located on dorsal side of forebrain.
- Secretes melatonin to regulate 24-hour rhythm, sleep-wake cycle, menstrual cycle, pigmentation etc.

(c) THYROID GLAND :

- Has two lobes on either side of trachea interconnected by isthmus (connective tissue).
- Composed of follicles and stromal tissues.
- Follicular cells synthesise thyroxine (T_4) and triiodothyronine (T_3).
- Iodine is necessary for normal functioning in of thyroid.
- **Goitre (Hypothyrodism) :** Enlargement of thyroid gland. Hypothyrodism may lead to mental retardation and stunted growth (cretinism) in the baby if it occurs during pregnancy.
- **Hyperthyroidism :** Occurs due to cancer or due to development of nodules in thyroid glands. Effects body physiology as abnormal high levels of thyroid hormones is synthesised.

- Also secretes a protein hormone called Thyrocalcitonin (TCT) which regulates blood calcium level.

(d) PARATHYROID GLAND :

- Present on back side of thyroid gland. Each lobe of thyroid gland has its one pair.
- Secrete peptide hormone called parathyroid hormone (PTH) which increases calcium levels in blood so called **hypercalcemic** hormone.
- PTH stimulates bone resorption, and reabsorption of calcium from blood and reabsorption of calcium by renal tubules.

(e) THYMUS GLAND :

- Located on dorsal side of heart and aorta.
- Secrete peptide hormones called thymosins which play role in differentiation of T-lymphocytes (help in cell mediated immunity).
- Thymosins also produce antibodies and provide humoral immunity.
- Immunity of old people usually becomes weak as thymus gets degenerated with age.

(f) ADRENAL GLAND :

- Located at anterior part of each kidney.
- Has centrally located adrenal medulla and at periphery is adrenal cortex.
- Adrenal medulla secretes adrenaline (epinephrine) and nor adrenaline (norepinephrine), commonly called as catecholamines or emergency hormones or hormones of flight and fight.
- These hormones increase heart beat, rate of respiration, breakdown of glycogen thus increase blood glucose level, breakdown of lipids and proteins, alertness, raising of hairs, sweating etc.
- Adrenal Cortex (3 layers) : Zona reticularis (inner layer)
  Zona fasciculata (middle layer)
  Zona glomerulosa (outer layer)
- **Adrenal cortex secretes :**

  Androgenic steroids :
- Secreted in small amounts.
- Play role in growth of axial pubic and facial hair during puberty.

Glucocorticoids :
- Involved in carbohydrate metabolism.
- Stimulates gluconeogenesis, lipolysis and proteolysis.
- *e.g.,* Cortisol which is also involved in cardio-vascu lar and kidney functions.
- It also suppresses immune response and stimulates RBC production.

Mineralocorticoids :
- Regulate balance of water and electrolytes in body.
- *e.g.,* Aldosterone which also helps in reabsorption of Na^+ and water excretion of K^+ and phosphate ions from renal tubules.

(g) PANCREAS :

- Has both exocrine and endocrine function.
- Contains about 1-2 million islets of langerhans which has glucagon secreting α-cells and insulin secreting β-cells.
- **Glucagon :** Peptide hormone, stimulates glycogenolysis by acting on liver cells. Also, stimulates gluconeogenesis. Hence called hyperglycemic hormone.
- **Insulin :** Peptide hormone, acts on hepatocytes and adipocytes to enhance cellular glucose uptake, stimulates conversion of glucose to glycogen (glycogenesis), so decreases blood glucose level called hypoglycemic hormone.
- Deficiency of insulin causes diabetes mellitus in which loss of glucose occurs through urine.

(h) TESTIS :

- A pair of testis composed of seminiferous tubules and interstilial cells is present in the scrotal sac of males.
- Leydig cells (interstitial cells) produce androgens (mainly testosterone) which regulate development and maturation of male accessory sex organs, formation of secondary sex characters and play stimulatory role in spermatogenesis. Male sexual behaviour (libido) is influenced by androgens.

(i) Ovary : • Aair of ovaries which produce one ovum in each menstrual cycle are present in abdomen in females.

- Ovary composed of ovarians follicles and stromal tissue.
- Estrogen synthesised by growing ovarian follicles helps in stimulation of growth of female secondary sex organs, female behaviour, mammary gland development and female secondary sex characters.
- Ruptured follicle forms corpus luteum which secretes progesterone. Progesterone supports pregnancy and stimulates alveoli formation and milk secretion in mammory glands.

Hormones secreted by tissues which are not endocrine glands :

(a) Heart : Atrial wall secrets Atrial Natriuretic factor (ANF) which decreases blood pressure by dilation of the blood vessels.

(b) Kidney : Juxtaglomerular cells secretes erythropoietin which stimulates erythropoiesis (RBC formation).

(c) Gastro-intestinal tract : It secrets four peptide hormones.

- **Gastrin :** Acts on gastric glands and stimulates secretion of hydrochloric acid and pepsinogen.
- **Secretin :** Acts on pancreas and stimulates secretion of water and bicarbonate ions.
- **Cholecystokinin (CCK) :** Acts on pancreas and gall bladder to stimulate secretion of pancreatic juice and bile juice respectively.

Gastric inhibitory peptide (GIP) : Inhibits gastric secretion and motility.

Mechanism of hormone action : By hormone receptors of two kinds, *i.e.*,

(a) Located on membrane of target cell

- These are membrane bound receptors.
- Form hormone receptor complex .

↓

Leads to biochemical changes in tissue.

↓

Release of second messengers like (cyclic AmP, IP_3, Ca^{2+} etc.) which regulate cellular metabolism.

(b) Located inside the target cell

- These are intracellular receptors.
- Hormones (steroid hormones, iodothyronines etc.) interact with them and cause physiological and developmental effects of regulating gene expression.

QUESTIONS

Very Short Answer Questions (1 mark each)

1. Which two systems coordinate and regulate physiological functions of our body ?
2. What is the role of melanocyte stimulating hormone ?
3. Name the hormones which act antagonistically in order to regulate calcium levels in the blood.
4. Give the names of any one glucocorticoid and one mineralocorticoid.
5. How does artrial natriuretic factor decreases blood pressure ?
6. Which structure is formed from ruptured follicle in females ? What is its role ?
7. Immunity of old persons becomes very weak. Give reason.

Short Answer Questions-II (2 marks each)

8. What happens if a person suffers from prolonged hyperglycemia ?
9. What are the two modes through which the hypothalamus causes the release of hormones by pituitary gland ?
10. Androgens regulate the development, maturation and other important functions in human male. List them.

Short Answer Questions-I (3 marks each)

11. Define hormone and classify them on basis of their chemical nature.
12. How do oxytocin, progesterone and estrogen differ from each other ?
13. What are the disorders caused and the effects produced due to malfunctioning/ improper secretion from thyroid gland ?

Long Answer Questions (5 marks each)

14. 'The master gland regulates a number of physiological functions in our body.' Give reasons and explain.
15. Explain the mechanism of hormone action which helps in various physiological and development effect ? Also, define the role of second messenger in this process.

ANSWERS

Very Short Answers (1 mark)

1. Neural system and endocrine system.
2. Acts on melanocytes and regulates pigmentation of skin.
3. Thyrocalcitonin (TCT) and parathyroid hormone (PTH).
4. Glucocorticoid - Cortisol; Mineralocorticoid - Aldosterone.
5. By dilation of the blood vessels.
6. Corpus luteum which secrets progesterone.
7. Thymus gland degenerates with age.

Short Answers Questions-II (2 marks)

8. Gets affected by diabetes mellitus which causes loss of glucose through urine and formation of harmful ketone bodies.
9. Through hypothalamic neurons control anterior pituitary gland. Through neural regulation controls posterior pituitary gland.
10. Refer Points to Remember.

Short Answers Questions-II (2 marks)

11. Refer Points to Remember and page no. 338, NCERT, Text Book of Biology for class XI.
12. Oxytocin causes milk ejection and contraction of uterus at time of child birth.

    Progesterone-causes milk secretion and maintains pregnancy.

    Estrogen : Refer Points to Remember.
13. Refer Points to Remember.

Long Answers (5 marks)

14. Explain the role of pituitary gland + Refer Points to Remember.
15. Refer Points to Remember+ NCERT, Text Book of Biology for Class XI.