Endocrine System

Chapter 17

Hormones – information molecules

Ductless glands = endocrine glands; Hormones are the secretions of endocrine glands.
Endocrine glands lack anatomical continuity of other systems and are scattered widely in whole body. All hormones have one common feature – all travel through blood to the Target Cells.

Specificity: Only target cells have receptors to bind with hormone and only target cells show cellular changes on the attachment of the hormone.

Main Endocrine Glands

Main endocrine glands: Pituitary gland – inferior to hypothalamus in brain, Thyroid – a bilobed gland just inferior to larynx in throat, Parathyroid – 2 pairs of small glands embedded on posterior side of thyroid lobes, Adrenal – 2 glands lie superior to kidneys, Thymus – most active in childhood – lies superior to heart.

Dual functional endocrine glands = Hypothalamus – part of brain and secretes many hormones, Pancreas – lies in the fold of duodenum secretes digestive enzymes through duct = exocrine and also secretes hormones = endocrine, Gonads – testes in males and ovaries in females produce sperms or eggs carried by ducts and produce hormones.

Hormones are chemicals

Chemistry of Hormones – hormones belong to 2 major categories;

Amino acid based – amino acid derivatives like thyroxin; peptides like Insulin, Oxytocin; protein like Growth hormone

Steroids – synthesized from cholesterol by gonads or adrenal cortex. Testosterone

Mechanism of Hormonal Action – Peptide/Protein (hydrophilic) hormones bind with a membrane receptor stimulate a membrane enzyme

Mechanism of Hormonal Action – Steroid/Thyroid (hydrophobic) hormones diffuse into the cells bind to a receptor protein mostly inside nucleus.

Endocrine Gland Stimulus: 3-kinds

Humoral – changes in body fluids composition like fall in Ca²⁺ stimulate parathyroid glands to secrete PTH

Neural – nerve impulses stimulate adrenal medulla to secrete Epinephrine

Hormonal – hormones of hypothalamus stimulate anterior pituitary body to secrete its hormones.

Hypothalamus regulates hormone secretion by other endocrine glands by 3 mechanisms.

It secretes hormones to regulate anterior pituitary’s hormones. The vein collecting blood from hypothalamus supplies the blood to Anterior Pituitary. This vein is Hypophysial Portal vein and delivers the regulatory hormones of hypothalamus to Anterior Pituitary. This ensures fast delivery.

Neurons present in hypothalamus secrete hormones Oxytocin and ADH are directly released into posterior lobe of Pituitary gland.

Hypothalamus controls secretions of adrenal medulla through preganglionic nerve fibers of sympathetic nerve fibers and results in secretion of norepinephrine and epinephrine.

Pituitary Gland

Pituitary gland = Hypophysis lies in sella turcica of Sphenoid bone. Anterior Lobe – glandular part secretes hormones for 6 targets; Posterior Lobe – neural part secretes 2 hormones, produced by axons of hypothalamus; Infundibulum = stalk – neural tissue hangs pituitary gland from hypothalamus.
Posterior Pituitary stores and releases 2 hormones produced by hypothalamus 1. ADH 2. Oxytocin

Thyroid Gland
Thyroid Gland: secretes Thyroxin = T4 and Triiodothyronine = T3 hormones having similar influence. These hormones have wide range of effects. Main influences include – 1 Basal Metabolic Rate = favors increased oxygen consumption and production of calories 2 promotes normal development of brain 3 promotes normal activity of heart, digestive system, skin and female reproductive system.

Hypossecretion of Thyroxine in adults causes Myxedema = low metabolic rate, feeling chilled, edema, lethargy; Hypossecretion due to Iodine deficiency leads to enlargement of thyroid = Endemic Goiter; Hypersecretion of thyroxin causes Exophthalmic Goiter; Calcitonin – secreted under high Ca2+ level in blood and inhibits osteoclasts and favors bone growth and lowers the calcium level in blood. Calcitonin is antagonist to PTH.

Parathyroid Glands
Parathyroid – secrete Parathyroid Hormone PTH under low Ca2+ levels and raise it by stimulating osteoclasts that break bone structure and transfer calcium to blood.

Adrenal Glands – stress management
Adrenal Glands (Stress hormones) – adrenal cortex = outer part is glandular and Medulla = inner part is a knot of parasympathetic nervous tissue; Adrenal Cortex secretes corticoid hormones 1 Mineralocorticoids – Aldosterone is most potent, stimulates kidneys to absorb more Na+ and excrete more K+ and help to maintain ionic balance of extracellular fluids 2 Glucocorticoids – influence the energy metabolism of most cells, stimulated by ACTH of anterior pituitary. 3 Sex Corticoids – influence secondary sex characters. Adrenal Medulla secretes 2 hormones – Norepinephrine under normal conditions and Epinephrine under emergency conditions; both have similar effects; promote and activate Fight or Flight status; make body cope with short term stresses but the adrenal cortex hormones prepare the body to cope with long term stresses.

Pineal Gland
Pineal Gland – lies in the epithalamus
It secretes Melatonin hormone – a powerful antioxidant it controls the daily rhythms like activity or drowsiness. Its hormonal influences are not yet fully understood.

Interaction between Hormones
Antagonistic hormones have opposite actions. Examples are Glucagon and Insulin, Calcitonin and PTH
Synergistic hormones have additive effect. Examples are GH, insulin and sex hormones favor bone formation

Recap 1 Endocrine System
1. All hormones travel through -------- to their -------- cells.
2. All hormones are present in blood but act only their target cells due to presence of -------- -----.
3. Anterior pituitary secretes -------- for thyroid; -------- hormone for adrenal gland; --------, and ------- hormones for gonads; ------ for body; and ------- hormone for breasts.
4. Hypothalamus secretes -------- to promote secretion of GH; and -------- to inhibit secretion of GH.
5. Hypothalamus indirectly controls secretion of hormones by anterior pituitary gland by sending releasing hormones through ------------- portal vein. Hint: Pituitary gland = Hypophysis
6. Hypothalamus directly controls secretion of hormones by posterior pituitary gland by releasing
hormones through its --------------.
7. Hypothalamus directly controls secretion of hormones by adrenal medulla through ---------- nerve fibers.
8. Chemically 2 main groups of hormones are -------------- and --------------.
9. Gonadotropin hormone is produced by -------------- --------------.
10. Gonadotropin RH is produced by --------------.
11. High level of Ca\(^{2+}\) in plasma causes release of --------------.
12. Low level of Ca\(^{2+}\) in plasma causes release of --------------.
13. Hormone secreted during short term stress is ------; and secreted during long-term stress is ------.
14. Oxytocin is secreted by --------------; and functions include --------------.
15. 2 functions of ADH/Vasopressin are -------------- and --------------. Hint: indicated by its 2 names.
16. Only 1 hormone, -------------- secreted by anterior pituitary gland is not a tropic hormone = does not result in secretion by other endocrine gland.
17. --------------→ ACTH → --------------; --------------→ TSH → --------------.
18. Name the antagonist hormone; insulin = --------------; -------------- = calcitonin;
19. -------------- and -------------- are hormones with iodine.
20. Hypersecretion of GH before puberty causes --------------; after puberty causes --------------.
21. Enlargement of thyroid gland called goiter can be produced by --------------deficiency.