Peptide Hormones

Peptide hormones are proteins involved in endocrine system signaling. Peptide hormones are derived from multiple amino acids, and cannot travel through the cell membrane because they tend to be large and charged. They bind to cell membrane receptors, which stimulate secondary messengers, like cAMP, to induce enzymatic changes in the cell. The effects are short-lived because the secondary messenger systems are short-lived and responsive, but are also fast- acting, because the effects do not rely on DNA transcription to occur. Examples of peptide hormones include insulin, parathyroid hormone, vasopressin and oxytocin.

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Characteristics

Fast-Acting and Short-Lived

Quick and Young Rabbit

Peptide hormones act within seconds to minutes because they work through signaling cascades rather than gene transcription. Because they bind only to the cell surface and affect change through secondary messengers, peptide hormones can cause the intended change in physiology relatively rapidly. The effects of peptide hormones are short-lived because they only temporarily induce secondary messengers, but do not affect long-term processes like translation or transcription.

Water Soluble

Water

Being hydrophilic, peptide hormones dissolve easily in plasma and circulate without carrier proteins. This contrasts with steroid and thyroid hormones, which are lipophilic and protein-bound.

Bind To Cell Membrane Receptors

Receptor on the Membrane

They cannot cross the lipid bilayer, so they bind to receptors on the cell surface (e.g., GPCRs or receptor tyrosine kinases) rather than on intracellular receptors.

Stimulate Secondary Messengers

Messenger-pigeon in a (2) Tutu

Signal transduction occurs via intracellular second messengers such as cAMP, IP3/DAG, calcium, or JAK/STAT pathways. This amplification allows small amounts of hormone to generate large effects.

Amino Acid-Derived

A-mean-ol' Acidic-lemon-Driver

Peptide hormones are derived from many amino acids and are processed in the endoplasmic reticulum. Peptide hormones are synthesized in the rough ER as preprohormones are derived from many amino acids, cleaved to prohormones, packaged into vesicles, and stored until secretion.

Important Peptide Hormones

Oxytocin

Octopus-toe

Oxytocin is a peptide hormone and a neuropeptide. It functions to allow the milk-letdown reflex and stimulates breastfeeding. Additionally, it increases uterine contraction. It also has functions in selective social bonding and sexual pleasure.

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Growth Hormone

Giant

Secreted by the anterior pituitary. Stimulates growth and metabolism via the JAK/STAT pathway. Increases IGF-1 (somatomedin C) from the liver, promotes protein synthesis, and increases lipolysis. Excess GH will cause acromegaly/gigantism, while deficiency causes growth failure.

Insulin

Insect-syringe

Insulin is a peptide hormone produced by the beta cells of the pancreas. It promotes glucose uptake from the bloodstream into muscle and adipose tissue via GLUT-4 translocation. In the liver and pancreatic ?-cells, glucose transport occurs through GLUT-2, which is insulin-independent, but insulin enhances hepatic glucose utilization and storage by stimulating glycogen synthesis and inhibiting gluconeogenesis. Insulin also promotes lipogenesis and protein synthesis while inhibiting lipolysis. Deficiency of insulin or resistance to its effects leads to diabetes mellitus.

Calcitonin

Cow-throne

Secreted by thyroid parafollicular C cells when calcium is high. Inhibits osteoclast bone resorption to lower serum calcium. Not essential for calcium homeostasis, but high-yield in medullary thyroid carcinoma (tumor marker).

Prolactin

Lactating-gnome

Secreted by the anterior pituitary. Stimulates milk production and breast development. Its secretion is inhibited by dopamine and increased by TRH. Hyperprolactinemia suppresses GnRH, leading to infertility, galactorrhea, and amenorrhea.

Glucagon

Glue-king-kong

Released from pancreatic ?-cells during hypoglycemia. Acts via cAMP (Gs receptor). Stimulates glycogenolysis, gluconeogenesis, lipolysis, and ketone production. Opposes insulin.

Parathyroid Hormone (PTH)

Parachuting-thigh-droid with Harmonica

Secreted by parathyroid glands when calcium is low. Increases osteoclast activity (indirectly via osteoblasts), increases renal calcium reabsorption, decreases phosphate reabsorption, and activates 1-? hydroxylase to increase calcitriol (vitamin D).

Vasopressin

Vase-present

Vasopressin, which is also called antidiuretic hormone, is released from the posterior pituitary during hyperosmolar states or hypovolemia. It acts on V2 receptors in the kidney collecting ducts to insert aquaporin-2 channels, promoting water reabsorption, and on V1 receptors to cause vasoconstriction. Deficiency results in central diabetes insipidus, while resistance at the level of the kidney causes nephrogenic diabetes insipidus.

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