THE ENDOCRINE SYSTEM~ ~ TOP TEN

FUNCTIONS: Hormone regulation, production

- differentiation of reproductive and central nervous systems in developing fetus
- stimulation of growth and development during childhood and adolescence
- coordination of male and female reproductive systems, allowing for sexual reproduction
- maintenance of an optimal internal environment throughout lifetime
- initiation of corrective and adaptive responses when emergencies occur

1. HOW HORMONES EFFECT TARGET ORGANS

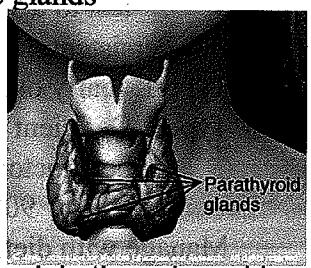
a. Intracellular receptors (Lipid-soluble hormones)

- Transduces a signal within a cell
- Directly triggers response as transcription factor (cause change in gene expression)
- Located in nucleus
- Same hormone may cause different responses based on differing receptors
  - EX: Testosterone & Estrogen

b. Cell surface receptors (Water-soluble hormones)

- Embedded in plasma membrane
- Signal transduction pathway:
  - o Initiated when hormone binds to receptor
  - o Converts extracellular chemical signal to intracellular response: Activation of enzyme, Change in molecule uptake or secretion, Rearrangement of cytoskeleton
  - o Activates proteins in cytoplasm which move to nucleus Directly or indirectly regulate transcription of genes
  - EX: Changing of frog skin color: Melanocyte concentration determines tone; denser concentration=lighter, dispersed concentration=darker Melanocyte-stimulating hormone controls arrangement
  - Binding of Epinephrine to live cells causes a reaction that leads to conversion of glycogen to glucose.
- Same hormone may cause different responses based on differing receptors, can also effect one tissue, most tissues (sex hormones) and other endocrine glands

2. THYROID:



- Location/shape: two lobes located on ventral surface of trachea
- Hormones: Two similar hormones from Amino Acid Tyrosine
  - Triiodothyronine (T3, three Iodine atoms)
  - Tetraiodothyronine (T4, four Iodine atoms)

Mammals mostly secrete T4 BUT target cells convert it to T3 (though both are bound by the same receptor protein located in the nucleus) Receptors have greater affinity to T3.

- Control: Hypothalamus and anterior pituitary control secretions of the thyroid.
- What it does: Maturation and Development in vertebrates.

•Required for bone forming cells and branching during embryo development.

Hyperthyroidism: High blood pressure, profuse sweating, weight loss, irritability and high body temperature.

EX: Graves Disease

Hypothyroidism (opposite): Cretinism (inherited) in infants, Weight gain, lethargy and intolerance to cold in adults

3. PARATHYROID AND CALCITONIN (antagonize each other to maintain blood calcium at set level ~ 10mg/100ml) (Ca2+ is critical for normal function of cells)

Ca2+ fall too low: Causes Tetany (Tetanus is fatal if not corrected.)

- Parathyroid: produced by the parathyroid gland, is released causing:
  Bones: Causes osteoclasts to decompose the mineralized matrix and release Ca2+
- Kidneys: Promote conversion of vitamin D (synthesized in skin) Activation begins in liver and completed in kidneys.
  Vitamin D acts directly on the intestines to stimulate the intake of ca2+

Rise of C2+:

- Calcitonin: is released from the thyroid gland
  Bones: Lowers Ca2+ by

4. PANCREAS: Considered a major endocrine gland though only 1-2 % of weight

Hormone: (are made from two types of cells in the Islets of Langerhans)

a. Beta Cells= Insulin- puts away glucose when there is too much in the blood stream by stimulating all the body cells except the brain to take up glucose. (brain can take up glucose without insulin)

b. Alpha Cells= glucagon- Stimulates liver to release glucose (glucose originates from break down glycogen & conversion of amino acids & fatty acids in liver)

Diabetes Mellitus

Caused by deficiency of insulin or decreased response to insulin in target tissues

Excrete glucose because exceed reabsorption capacity of kidneys. Common test is a urine test to test for glucose.

S/S Persistent thirst, and a lot of urine

Type 1. (early onset diabetes) rare. Treatment is insulin injections

Type 2 Deficient of insulin but most often reduced response of target cells. Heredity can be a factor. Excessive weight and lack of exercise

90% of all cases of diabetes

Manage with diet, exercise and some may need drug therapy.

5. PITUITARY GLAND (located at base of Hypothalamus)

Anterior Pituitary:

a. Growth Hormone (GH)

• Derived from same ancestor as PRL (structurally similar)

- Both tropic and nontropic effects
- Raise blood glucose
- Signals release of Insulin-like growth factors, (IGFs)
  - o IGFs (Released by liver& circulates in blood): Stimulate bone/cartilage growth

Lack of GH stops skeletal growth
- Abnormal GH production in humans
  - o Hypersecretion (too much): Gigantism in children, Acromegaly in adults (stimulates growth in few still responsive tissues)
  - o Hyposecretion (too little): Retards bone growth/leads to dwarfism in children (Can be treated young w/GH)

Posterior Pituitary: (neurohypophysis)
Extension which grows downwards toward mouth during embryo development
Stores/secretes two hormones made by neurosecretor cells in hypothalamus: antidiuretic hormone (ADH) and oxytocin
- ADH

o acts on kidneys by increasing water retention and decreasing urine, Regulates osmolarity in blood (negative feed back)
- Oxytocin: Induces cells in uterine muscles to contract in birth, Causes mammary glands to eject milk in nursing (Positive feedback)

6. MELATONIN AND BIORHYTHMS
Pineal gland (small mass of tissue near the center of the mammalian brain)
Melatonin (modified amino acids) regulates functions related to light and to seasons marked by changes in day length. Primarily functions in relation to biological rhythms associated with reproduction. Melatonin is secreted at night (amount secreted depends on the length of the nig

7. ADRENAL HORMONES
Adrenal Glands: Adjacent to kidneys; each is a fused endocrine and neuroendocrine gland
TWO different cell types
Adrenal Cortex (outer portion) consists of true endocrine cells
Adrenal Medulla (central portion) secretory cells derive from the neural crest during embryonic development

FIGHT or FLIGHT (Class: Catecholamines) Epinephrine and norepinephrine (also known as adrenaline and noradrenaline)
Synthesized from amino acid tyrosine.
Hormones act directly on target tissues to give a rapid bioenergetic boost by:
Increasing glycogen breakdown in liver and skeletal muscles, stimulate release of fatty acids from fats. All is released into the bloodstream and used as fuel.
In Addition: Effects on respiratory and cardiovascular systems
Increase the rate and stroke volume of heartbeat, dilate the bronchioles in the lungs to increase oxygen delivery to the cells.
Catecholamines also cause smooth muscles of some of the blood cells to contract and the vessels to relax, decreasing blood flow to all organs except heart and brain. (blood goes to these organs)

8. Steroid Hormones (not water soluble)

Hormones long distance chemical regulators via the blood stream to target cells

Local regulators- send info to the cells nearby

Three major classes of Molecules: Protein Peptides. Amino acids and steroids

Three key events: 1.Reception (molecule binds to specific receptor), 2.Signal transduction and 3. Response

*Signals and receptors have specific shapes like key and lock (like enzymes!)

9. POSITIVE & NEGATIVE FEED BACK in the regulation of Homeostasis

K LOOPS:

Occurs in response to an alteration of cellular environment or in process of maintaining regulated level of certain hormones or substances

• triggered by change in levels of circulating substances (chemical stimulus), electricity (electrical stimulus), etc.

Endocrine regulation – occurs when a hormone regulates its own secretion (secretory cells sensitive to concentration in plasma and secrete enough to maintain certain level)

(Example) Insulin:

- secreted in response to glucose levels (chemical stimulus)
- secreted in response to direct simulation to insulin-secreting cells of pancreas by nervous system (electrical stimulus)
- involved in secretion of cortisol by adrenal medulla (endocrine regulation)

Negative feedback – rising hormone level negates initiating change that triggers release of hormone

Endocrine: secreted into extracellular space and enter circulatory system

Exocrine: discharge secretions into ducts

Positive feedback – a change in some variable triggers mechanisms that amplify that change

Incase you didn't know....

Endocrine: secreted into extracellular space and enter circulatory system

Exocrine: discharge secretions into ducts

10. PARACRINE signaling by local Regulators

o Conveys messages between neighboring cells

o Faster than hormones; response occurs in seconds or milliseconds

o Includes cytokines, growth factors, prostaglandins, (PGs) and Nitric oxide, (NO)

Cytokines

• Immune responses, Growth factors, Stimulate cell proliferation and differentiation , Necessary for cells to grow, divide, and develop

EX: (NO)

• Activates enzyme which relaxes smooth muscle cells

o Improves blood flow tissues

• Secreted by white blood cells to kill bacteria and cancer cells