Endocrine System

Overview

Hormones

Endocrine Organs
Endocrine vs. Exocrine Gland

Secretes hormones
Ductless gland
Injects tissue

sweat & saliva
has ducts
duct is filled
Chemistry of Hormones & Physiology

- 3 types of stimuli triggers:
  - humoral, neural & hormonal
- Primarily works with Negative Feedback Mechanism
- Duration of hormonal activity can vary (minutes to days)
Pituitary Gland- pg 602

1. ‘Master’ gland- controls activities of the endocrine organs
2. Hormonal Stimuli (except TSH)
3. Anatomy: Anterior and Posterior
4. Hormones manufactured from Anterior: GH, TSH, ACTH, FSH, LH, PRL
5. Hormones manufactured from Posterior: oxytocin, ADH
ANTERIOR PITUITARY

1. GH- growth hormone
2. ACTH- adrenocorticotropic hormone (stress)
3. LH- luteinizing hormones (sex hormones & lactation preparation)
Pituitary Gland: Anterior

4. PRL- prolactin (lactation)

5. FSH-follicle-stimulating hormone (sperm/egg)

6. TSH- thyroid-stimulating hormone (regulate Ca in blood & metabolism)
Posterior Pituitary Hormone

7. Oxytocin (milk letdown & contraction)

8. ADH- anti-diuretic hormone aka vasopressin (water balance)
Homeostatic Imbalance of the Pituitary Gland

Gigantism: (pg 604) hypersecretion of GH that target epiphyseal plates

- Normal body proportions

Acromegaly: hypersecretion of GH after epiphyseal plates are closed

- Enlarged hands, feet and face
Homeostatic Imbalance of Pituitary Gland

Dwarfism: hypossecretion of GH; slow bone growth

- 4 ft tall
- Normal body proportions
- Some cases, $<GH \rightarrow <TSH \& <Gonadotropins$
  - Malproportioned & limited pubescent stages

TREATMENT: hormone replacement
Homeostatic Imbalance of Pituitary Gland

Diabetes Insipidus: hyposecretion of ADH due to:

1. Head injury
2. Malformed urinary system anatomy
3. ADH destroyed by a placental enzyme
Excessive testosterone leads to:

- Older females attraction
- Extra-marital affairs
- More predators
- Decrease in immunity

*EVOLUTION at work!*

The dark-eyed junco

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*Photo credits: Terry Selk*
Thyroid

- Butterfly-shaped
- Cervical region
- 2 lateral lobes connected by *isthmus*
- Largest pure endocrine gland
Thyroid and Parathyroid, pp 609-613

T4: (4 iodine atoms) Thyroxin & T3: Tri-iodothyronine - (metabolism)

Calcitonin (lowers calcium in blood)

PTH: Parathormone (increases calcium in blood)
## IODINE Rich Foods: seafood and soil

<table>
<thead>
<tr>
<th>Food</th>
<th>Serving</th>
</tr>
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<tbody>
<tr>
<td>Salt (iodized)</td>
<td>1 gram</td>
</tr>
<tr>
<td>Cod</td>
<td>3 ounces*</td>
</tr>
<tr>
<td>Shrimp</td>
<td>3 ounces</td>
</tr>
<tr>
<td>Fish sticks</td>
<td>2 fish sticks</td>
</tr>
<tr>
<td>Tuna, canned in oil</td>
<td>3 ounces (1/2 can)</td>
</tr>
<tr>
<td>Milk (cow’s)</td>
<td>1 cup (8 fluid ounces)</td>
</tr>
<tr>
<td>Egg, boiled</td>
<td>1 large</td>
</tr>
<tr>
<td>Navy beans, cooked</td>
<td>1/2 cup</td>
</tr>
<tr>
<td>Potato with peel, baked</td>
<td>1 medium</td>
</tr>
<tr>
<td>Turkey breast, baked</td>
<td>3 ounces</td>
</tr>
<tr>
<td>Seaweed</td>
<td>1/4 ounce, dried</td>
</tr>
</tbody>
</table>

*A three-ounce serving of meat is about the size of a deck of cards.*
HUMORAL STIMULUS

- Released in response to blood level changes

Calcitonin&PTH: calcium is found in BONE; essential for:

1. Bones & teeth
2. Nerve function
3. Muscle contraction
4. Blood clot
5. Cardiac muscle contraction
Homeostatic Imbalance of the Thyroid Gland

- **Myxedema**: full-blown hypothyroid syndrome in adults

- **Endemic goiter**: myxedema results from lack of iodine (doesn’t use T3&T4) creating an atrophied gland
  - Treatment: iodine supplements or hormone replacement therapy
Homeostatic Imbalance of the Thyroid Gland

- Cretinism: hypothyroidism in infants; causes mental retardation, thick tongue & neck

- Grave’s disease: hyperthyroid autoimmune disease. Protruding eyeballs
  - Treatment: Thyroidectomy
Homeostatic Imbalance of the Parathyroid Gland

- Hyperparathyroidism: Ca+ leached from bone which susceptible to fractures; >Ca+ in blood results in:
  - Weak skeletal muscles & nervous system
  - Kidney stones
  - Metastatic calcification: Ca+ in soft tissue impairs vital organ function

- Hypoparathyroidism: tetany (loss of sensation, muscle twitches & convulsions); without treatment → resp paralysis → fatal
Adrenal Gland, pg 615

- Aka suprarenal gland (supra=above)
- hat -like structure for kidney
- Is made up of 2 endocrine glands:
  - Adrenal cortex
  - Adrenal medulla
  - 1 function: help cope with stressful situations
Adrenal Cortex-

3 types of CORTICOSTEROID hormones:

A. Mineralcorticoid: (electrolyte balance) reabsorbs Na+ in kidney, perspiration & saliva
   - water influences bp
   - LOW BP = >aldosterone
   - HUMORAL stimulus
B. Glucocorticoid: help cope w/ stress

- Keeps blood glucose levels constant, maintaining bp
- glucocorticosteroids = hemorrhage, infection, trauma
- Ex. of glucocorticoids: cortisol, cortisone
- Works w/ ACTH
- Cortisol levels similar to metabolism
  (hi = am and decreases = pm)

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dear stress,
let’s break up.
C. Gonadocorticoid: weak androgens & estrogens

- > during puberty
- in males and females
- Females: affect libido and estrogen source > menopause
- Males: n/a
Homeostatic Imbalance of Adrenal Cortex

Aldosteronism: hypersecretion results from adrenal tumors; symptoms- hypertension, edema

Addison’s disease: hyposecretory disease of the gluco & mineralcorticoids; symptoms- weight loss, dehydration, hypotension (bp=<90/60)
Homeostatic Imbalance of the Adrenal Cortex

Cushing’s Syndrome: hypersecretion from tumor or being prescribed high doses of glucocorticoids

- symptoms: muscle & bone loss, high blood glucose levels (steroid diabetes), edema, hypertension, swollen face and buffalo hump traits

Treatment: remove tumor and stop using meds
Adrenal M(iddle)edulla

- Neural Stimuli
  - Sympathetic NS

- 2 types of catecholamines
  - Epinephrine
  - Norepinephrine
Other Endocrine Glands

- **Pineal Gland**
  - Located in the brain
  - Secretes melatonin

- **Pancreas**
  - endo/exo-crine gland
  - Regulates blood glucose levels by secreting
    - Alpha cells (glucagon)
    - Beta cells (insulin)
Homeostatic Imbalance of the pancreas

- Diabetes Mellitus - hyposecretion of insulin
  - Glycosuria - Excess glucose spills over to urine
  - Lipidemia - high fatty acid levels in blood

  Ketones form and deposit in the urine, cause electrolyte imbalance
3 signs of diabetes mellitus

1. Polyuria- urine output $\rightarrow$ <blood volume + dehydration

2. Polydipsia- excessive thirst is stimulated by dehydration

3. Polyphagia- excessive hunger; body will use fat & protein
Diabetes 1 vs Diabetes 2

- Diagnosed in childhood
- Body doesn’t produce insulin
- Insulin & other injectables

*Diagnosed in adulthood
* body doesn’t provide enough insulin
* Bariatric surgery
Cognition affected by Diabetes- Harvard Study: Sugar on the Brain

- Brain needs glucose for energy
- $< \text{glucose} = < \text{functioning neurotransmitters}$
- Diabetes accelerates aging of the brain
  - $> \text{the progression of functioning decline}$
How does Diabetes affect blood flow?

- Glucose-rich blood = high viscosity
- Blood flow is decreased
- Circulation problems
- Neuropathy (nerve damage)
Activity - Viscous Blood Simulation

- Work in groups of 4
- Complete the activity
  - Follow procedures
  - Complete data
  - Answer questions
Homeostatic Imbalance of the pancreas

Hyperinsulinism - low glucose levels (hypoglycemia) cause anxiety, nervousness, tremors and weakness.

<glucose to the brain $\rightarrow$ disorientation, convulsion, unconsciousness
Thymus- (immune function)

- Located in the sternum
- Large in size, diminishes as we age to adipose & connective tissue
- Secretes thymosins
- Develop T-lymphocytes (cellular immunity)
More endocrine glands.....

- **Gonads**
  - male&female steroid sex hormones released by gonadotropins
    - Female: estrogens and progesterone
    - Male: testosterone

- **Placenta**
  - Temporary organ
  - Secretes hormones thru pregnancy