Endocrine 2
Endocrine glands

E. Endocrine System
The hypophysis (pituitary)

Pituitary (Hypophysis)

Location

Interior to the hypothalamus, in the sella turcica.

Remember: the hypothalamus serves as a bridge between the “mind and the body.”

Infundibulum

A stalk of tissue which joins the hypothalamus to the hypophysis.
Contains blood vessels and nerves.

E. Endocrine System
The hypophysis (pituitary)

2 major parts
1) Adenohypophysis, anterior pituitary
7 different hormones are made and secreted here.

2) Neurohypophysis, posterior pituitary (Pars nervosa)
Hormones secreted here are made in the hypothalamus.

E. Endocrine System
The hypophysis (pituitary)

Adenohypophysis
Structure

a) Hypothalamic-hypophysial portal system
Network of small veins.
Carry blood from the hypothalamus.
Delivers hormone control factors.

b) 3 parts of the adenohypophysis
i) Pars tuberalis
A tube-like structure around the infundibulum.
Connects to the adenohypophysis.
Adenohypophysis
Structure
b) 3 parts of the adenohypophysis
ii- Pars distalis
Main bulk of the adenohypophysis.
Makes and releases 6 hormones.

iii- Pars intermedia
Limited in humans.
Makes Melanocyte-stimulating hormone (MSH).
Not a significant hormone in humans.

E. Endocrine System  The hypophysis (pituitary)

Hormones of the adenohypophysis (7)
Control of the pituitary
The adenohypophysis is controlled by the hypothalamus.
This releases stimulating and inhibiting factors.

Tropins
Are hormones which control other endocrine glands.
Example:
TSH or thyroid stimulating hormone.
Also called thyrotropin.

1) Human growth hormone (hGH), somatotropins
   a) Control factors from the hypothalamus
      Growth hormone releasing hormone (GHRH)
      Growth hormone inhibiting hormone (GHIH)
      These control factors stimulate or inhibit the release of hGH
      from the adenohypophysis.
   b) Function
      i) Stimulates body growth- by 2 mechanisms
         1- somatomedins (insulin-like growth factors)
            Made by the liver.
            Stimulate protein synthesis in a number of cells, muscle.
         2- cell differentiation
            Cause stem cells to develop into different types of cells; cells “mature” or differentiate.
E. Endocrine System  The hypophysis (pituitary)  
Adenohypophysis

b) Function
   ii) Metabolic effects
      1- Glucose sparing effects
         GH causes fat to break down and release fatty acids.
         Cells use fatty acids instead of glucose.
         With GH, tend to lose fat stores.
      2- Diabetogenic effects
         GH also causes the release of glucose from glycogen in the liver.
         Creates a “diabetic-like” elevation of blood glucose levels.
         Have similar health risks as those associated with diabetes mellitus.

c) Disorders of GH
   ii) Hypersecretion
      1- gigantism
         Increases in height, weight and muscle mass. >7 ft
      2- acromegaly
         Continued hypersecretion after epiphyseal plate fusion.
         Increased thickness in bones and cartilage.
         Abnormal jaw, skull, hands, feet, etc.
5) Luteinizing hormone (LH) *lutropin* see reproduction

- Induces ovulation and stimulates the secretion of ovarian hormones.
- In males, stimulates production of testosterone.

6) Prolactin (PRL) *mammotropin* see reproduction lactogenic hormone

- Stimulates milk production in mammary tissue.

7) Melanocyte-stimulating hormone (MSH), melanotropin made by the pars intermedia

- In humans, the pars is indistinct and MSH has very little effect.
- melanocytes

- In other animals, melanocytes (pigment cells) are sensitive to MSH and cause changes in the skin color.

---

1) Oxytocin (OT) *see reproduction

- Produced in the hypothalamus.
- Released in the neurohypophysis.
- Stimulates smooth muscle contraction in mammary glands.
- Triggers milk ejection.

2) Antidiuretic hormone (ADH) *see urinary vasopressin

- Causes the kidneys to retain water.
- Helps produce a small volume of concentrated urine.
- diabetes insipidus

- Hyposecretion causes excessive urine output.
- This also results in a loss of electrolytes, which may lead to shock or death.
**The Thyroid Gland**

**Location**
Ant. To the trachea.
Inf. To the larynx.

**Structure**
lateral lobes
2 lateral lobes.
Connected by a narrow...

**Follicles**
The thyroid is made of many follicles:
The cell layer is a simple cuboidal epithelium.
The internal space is filled with a proteinaceous material called...

**Colloid**
Which consists of the protein thyroglobulin.

How thyroid hormones (TH) are made.
Thyroglobulin is iodinated; I\(^-\) is added to the tyrosine residues (amino acids)

\[ T_4 \]
A type of TH with 4 I\(^-\) per molecule: inactive form. 90% of TH is secreted as T_4.

\[ T_3 \]
3 I\(^-\) per molecule: active form. 10% of secreted TH.
How thyroid hormones (TH) are made.

**Thyroglobulin**

- **TSH** Stimulates I- transport, increases TH synthesis and secretion
- T4 is converted to T3

In the peripheral tissues, TH becomes active. It is turned on and increases the basal metabolic rate.

**Function**

results in increase of basal metabolic rate (BMR)

- The rate of many metabolic functions increase.
- This causes increased use of glucose and oxygen for cell respiration.
- Body temp rises and more carbon dioxide is produced.
- Also, heart rate and blood pressure rise.

**Effect on carbohydrate metabolism**

- Carbo metab increases to generate more glucose for ATP synth.
- Carbo levels in the body decline.
- Blood glucose levels rise.

**Effect on fat metabolism**

- Fat metab also increases.
- Fat stores are broken down to fatty acids, which are used by cells to generate ATP.

**Disorders**

- **Cretinism** hypothyroidism during development
  - “low thyroid”
  - failure of growth and mental retardation

- **Myxedema**
  - Hypothyroidism in the adult.
  - Symptoms: lethargy, low BP, low body temp.
  - In some cases a goiter forms (next page).
F. Endocrine System  The Thyroid Gland

Hypothyroidism
In this condition, defective or low TH causes the BMR to fall. The thyroid increases in size as it tries to make more TH.

Goiter
Also called thyromegaly.
Generally two types of goiter:
Simple hypothyroidism
Caused by a lack of iodine, produces a simple (enlarged thyroid) goiter.
Exophthalmic (toxic)
...goiter is caused by a thyroid making too much TH, when stimulated by too much TSH or when antibodies mimic TSH. This causes inc heart rate, BP, body temp and protruding eyes (exophthalmosis.)

F. Endocrine System  The Parathyroid Glands

Parafollicular cells
...or C cells are found between the thyroid follicles. Make the hormone...
Calcitonin
...which lowers blood Ca^{2+}
This is not a major Ca^{2+} regulation mechanism.
Parathyroids (next page) have a stronger effect.

F. Endocrine System  The Parathyroid Glands

Parathyroids!
Anatomy
Parathyroids are located within the lateral lobes of the thyroid. 3-4 on either side.
Hormones
parathyroid hormones (PTH)
PTH raises blood calcium levels.
Increases osteoclast activity and bone erosion.
F. Endocrine System  The Parathyroid Glands

Homeostasis of Ca\(^{2+}\) and phosphate!

PTH raises calcium and lowers phosphate levels in the blood and bone

1) Osteoclasts
   - Which erode bone and release calcium, are stimulated by PTH.

2) Osteoblasts
   - Which build bone and absorb calcium, are inhibited by PTH. Hypersecretion can cause osteoporosis.

3) Blood Ca\(^{2+}\)
   - Calcium diffuses into the blood from bone and is used to regulate cell signaling.

4) Urinary Ca\(^{2+}\)
   - Levels fall as calcium is reabsorbed back into the blood.

---

Disorder

A thyroidectomy (surgical removal of the thyroid) can cause damage to the parathyroids. This may cause a drop in PTH levels and then a fall in blood calcium.

tetany

- Occurs when calcium falls too low to regulate proper nerve transmission to muscles.
- The muscles then contract uncontrollably, causing tetany.