Hypothalamic Control of Posterior Pituitary

- Paraventricular nucleus
- ADH and oxytocin produced here
- Supraoptic nucleus
- Optic chiasma
- Hypothalamus
- Infundibulum
- Hypothalamo-hypophyseal tract
- Posterior pituitary
- ADH and oxytocin released
- Anterior pituitary
Hypothalamic Control of Anterior Pituitary

Axons to primary capillaries
Primary capillaries
Portal venules
Releasing hormones
Secondary capillaries
Releasing hormones
Anterior pituitary
Trophic hormones
Cell body
Median eminence
Pituitary stalk
Posterior pituitary
Anterior Pituitary Hormones

- Paraventricular nucleus
- Supraoptic nucleus
- Median eminence
- Anterior pituitary
- Hypothalamus
- Portal system
- Infundibulum
- Posterior pituitary

Hormones:

- Thyroid: TSH
- Mammary gland: Prolactin
- Adrenal cortex: ACTH
- Melanocytes: MSH
- Bone, Muscle, Adipose tissue
- Ovary, Testis

Gonadotropins: FSH, LH
Hormones from Hypothalamus

- TRH (Thyrotropin-releasing hormone)
- PRH (Prolactin-releasing hormone)
- PIH (Prolactin release-inhibiting hormone)
- CRH (Corticotropin-releasing hormone)
- GnRH (Gonadotropin-releasing hormone)
- GHRH (Growth hormone-releasing hormone)
- SS (Somatostatin)

Hormones from Anterior Pituitary

- TSH (Thyroid-stimulating hormone)
- PRL (Prolactin)
- ACTH (Adrenocorticotropic hormone)
- LH (Luteinizing hormone)
- FSH (Follicle-stimulating hormone)
- RH (Growth hormone)

Target Organs:
- Thyroid
- Mammary gland
- Adrenal cortex
- Ovary
- Testis
- Bone
- Muscle
- Adipose tissue

Hormones and Their Target Organs
Thyroid Hormones

Thyroxine, or tetraiodothyronine (T₄)

Triiodothyronine (T₃)
Thyroid Hormones

Thyroxine, or tetraiodothyronine ($T_4$)

Triiodothyronine ($T_3$)
Goiter Formation

Hypothalamus → TRH → Anterior pituitary → TSH → Thyroid

If iodine inadequate: Low T₃ and T₄ → Low negative feedback → Excess TSH → Hypertrophy—produces goiter

If iodine adequate: T₃ and T₄ → Negative feedback → Normal thyroid

Enlarged thyroid (goiter)
Thyroid and Parathyroid Glands — Posterior

- Pharynx
- Thyroid gland
- Parathyroid glands
- Left common carotid artery
- Esophagus
- Trachea
**Action of PTH**

- Decreased blood calcium stimulates PTH secretion.
- Increased blood calcium inhibits PTH secretion.

**Bloodstream**

- PTH stimulates bone to release calcium ($Ca^{+2}$).
- PTH stimulates kidneys to conserve calcium ($Ca^{+2}$).
- PTH stimulates intestine to absorb calcium ($Ca^{+2}$).
PTH and Intestinal Calcium Absorption

Cholesterol

Obtained from foods

Intestinal enzymes

Provitamin D

Ultraviolet light in skin

Vitamin D (Cholecalciferol)

Also obtained directly from foods

In liver

Hydroxycholecalciferol

In kidney

Dihydroxycholecalciferol (active form of vitamin D)

Controls absorption of calcium in intestine

\[ \text{Ca}^{+2} \]
Adrenal Gland Structure

Adrenal gland
Kidney
Adrenal cortex
Adrenal medulla

Surface of adrenal gland
Adrenal capsule

(a) Gross structure
Zona glomerulosa
Zona fasciculata
Zona reticularis

(b) Histological structure
Cortisol and Aldosterone Structure

Cortisol

Aldosterone
(1) Decreasing blood pressure and/or sodium ion concentration stimulate secretion of the enzyme renin

(4) Blood pressure and/or sodium ion concentration return toward normal, inhibiting further secretion of renin

(3) Aldosterone acts on the kidney to conserve sodium ions and (by osmosis) water

Kidney

Bloodstream

Renin → Angiotensinogen → Angiotensin I → Angiotensin II

Angiotensin-converting enzyme (ACE)

(2) Angiotensin II stimulates adrenal cortical cells to secrete aldosterone

Aldosterone

Aldosterone Effects
Cortisol and Aldosterone Structure
Addison’s disease

• **Hyposcretion** of adrenal cortex.
  – Hyposcretion of gluco & mineralocorticoids

• **Weight loss**
  – Plasma glucose and sodium drops
  – Potassium levels rise
  – Severe dehydration

• **JFK**
  – Aldosterone & cortisol treatments
Adrenal Cortex Layers

Surface of adrenal gland

Cortex

Zona glomerulosa

Zona fasciculata

Zona reticularis

Medulla
Norepinephrine and Epinephrine Structure

Norepinephrine

Epinephrine
Pancreas and Pancreatic Islets

- Gallbladder
- Common bile duct
- Duodenum
- Duodenal papilla
- Body of pancreas
- Pancreatic islet
- Alpha cell (produces glucagon)
- Beta cell (produces insulin)
- Spleen
- Tail of pancreas
- Pancreatic duct
Insulin and Glucagon Secretion

- Insulin:
  - Promotes movement of glucose into certain cells
  - Stimulates cells to polymerize glucose into glycogen

- Rise in blood glucose stimulates insulin secretion from beta cells

- Drop in blood glucose stimulates glucagon secretion from alpha cells

- In response to insulin, blood glucose drops toward normal (and inhibits insulin secretion)

- In response to glucagon blood glucose rises toward normal (and inhibits glucagon secretion)

- Glucagon:
  - Stimulates cells to break down glycogen into glucose
  - Stimulates cells to convert noncarbohydrates into glucose
Diabetes Mellitus

• Hyposcretion OR hypoactivity of insulin
• Link between diabetes & insulin discovered in 1921
• Signs
  – 3 P’s
    • Polyuria, Polydipsia, Polyphagia
  – Ketoacidosis
Types of Diabetes Mellitus

• Type I diabetes mellitus (insulin-dependent diabetes mellitus)
• Type II diabetes mellitus (non-insulin-dependent diabetes mellitus)
Secretion of Melatonin

Suprachiasmatic nucleus (the "biological clock")

Day

Night

Inhibition

Stimulation

Retinohypothalamic tract

Pineal gland

Sympathetic neurons

Superior cervical ganglion

Melatonin
Other Hormone Glands

- Gonads
- Heart
- GI tract
- Placenta
- Kidney
- Skin