

Bio217: Pathophysiology Class Notes
Professor Linda Falkow

Unit V: Endocrine System Disorders

Chap. 17: Mechanisms of Hormonal Regulation
Chap. 18: Alterations of Hormonal Regulation

Mechanisms of Hormonal Regulation

Chapter 17

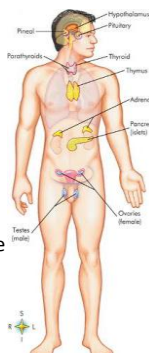
The Endocrine System

• Components

– Glands located around the body that secrete chemical messengers (_____)

• Functions

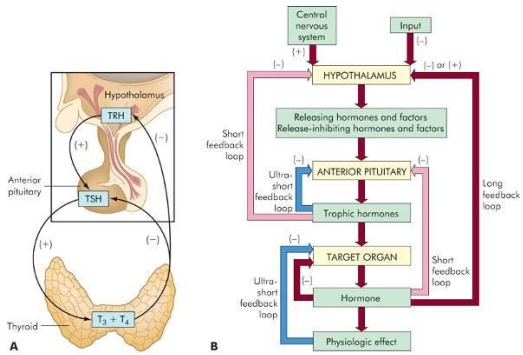
– Works with _____ to regulate and integrate metabolism and maintain homeostasis



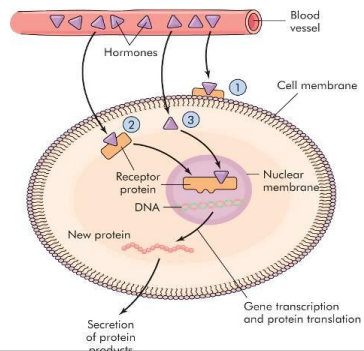
Hypothalamus (“heart of the endocrine system”)

- Center for integrating endocrine and ANS
- Regulates endocrine glands via _____ and _____ pathways
- **Posterior Pituitary** (neural pathways)
 - ADH (antidiuretic hormone)
 - Oxytocin
- **Anterior Pituitary** (hormonal control)
 - ACTH (adrenocorticotropic horm.)
 - TSH (thyroid stim. hormone)
 - LH (luteinizing hormone)
 - FSH (follicle stim. hormone) also GH (growth horm.) and PRL (prolactin)

Negative Feedback- regulates the endocrine system by _____ overproduction of hormones



Lipid-Soluble Hormones



Hormone Binding at Target Cell

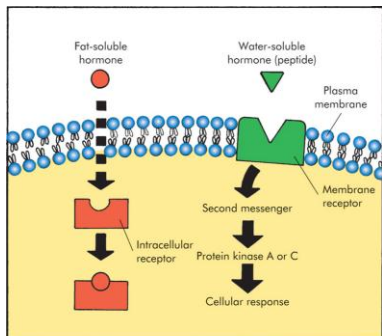
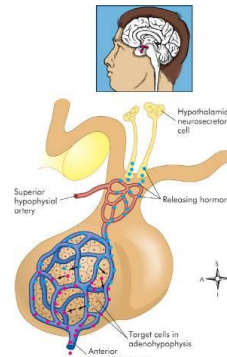


Fig. 17-4 Hormone Binding at Target Cell

Anterior Pituitary Hormones



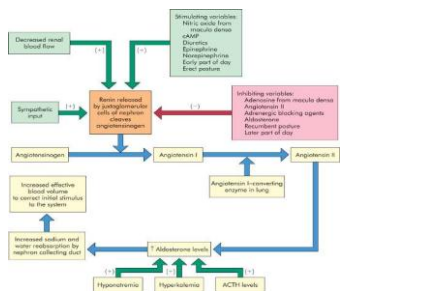
Endocrine disorders

- May be caused by
 - Hypersecretion or hyposecretion of hormones
 - Hyporesponsiveness of hormone receptors
 - Gland inflammation
 - Tumors of glands

Adrenal glands

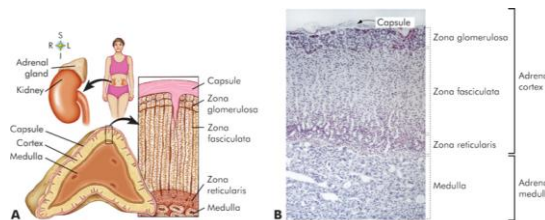
- Embedded in fat superior to each kidney
- **Adrenal cortex:**
 - 1. **Aldosterone** (_____)
 - regulates Na⁺ reabsorption & excretion of K⁺
 - 2. **Cortisol** (_____)
 - stimulates gluconeogenesis
 - protein breakdown and fatty acid mobilization
 - suppression of immune system
 - increased stress response
 - maintains BP and CV fcn.
 - 3. **Adrenal androgens & estrogens** (_____)

Aldosterone

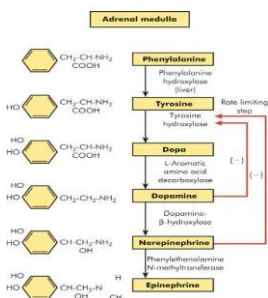


– Adrenal medulla

- Epinephrine & Norepinephrine (catecholamines)
 - produce VC
 - _____ response (“fight or flight”)



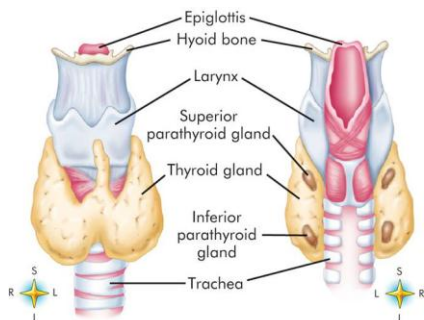
Catecholamines



Thyroid and Parathyroid Glands

- **Thyroid gland**
 - Located in anterior neck ; two lobes lie on either side of the trachea
 - Secrete iodine – containing hormones
 - _____ – nec. for growth & dev.; increase metabolism
 - _____ – regulates blood Ca⁺⁺ levels
- **Parathyroid glands**
 - 4 glands located on posterior aspect of thyroid
 - Secrete _____
 - Regulates blood Ca⁺⁺ levels

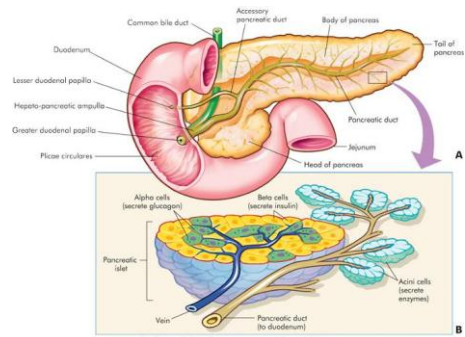
Thyroid and Parathyroid Glands



Endocrine Pancreas

- The pancreas is both an _____ and _____ gland
- Contains pancreatic islets (of Langerhans)
 - Secretion of glucagon and insulin
 - Cells
 - Alpha—glucagon (nec. when fasting → _____ BG)
 - Beta—insulin (released after a meal → _____ BG, stim. protein syn. and fatty acid uptake & storage)

Endocrine Pancreas



Concept Check

1. Organs that respond to a particular hormone are called:
 - A. target organs
 - B. integrated organs
 - C. responder organs
 - D. hormone attach organs
2. The hypothalamus controls the anterior pituitary by:
 - A. Nerve impulses
 - B. PG
 - C. Regulating hormones
 - D. None of the above

3. In a negative feedback mechanism controlling thyroid hormone secretion, which is the nonregulatory hormone?

- A. TRH C. thyroxine
- B. TSH D. All of the above are regulatory for thyroid hormone secretion

Matching:

- | | |
|------------------|-------------------|
| ___ 4. ACTH | a. Mammary glands |
| ___ 5. TSH | b. Adrenal cortex |
| ___ 6. TRF | c. Thyroid gland |
| ___ 7. prolactin | d. Ant. pit. |

Matching:

- | | |
|---------------------------|---|
| ___ 8. Epi | a. Influence inflam. response |
| ___ 9. Glucocorticoids | b. Causes fight or flight response |
| ___ 10. Mineralcorticoids | c. Controls Na ⁺ , H ⁺ , K ⁺ |
| ___ 11. Gonadocorticoids | d. Act as minor sex hormones |

Alterations of Hormonal Regulation

Chapter 18

Elevated or Depressed Hormone Levels

- Failure of feedback systems
- Dysfunction of an endocrine gland
- Secretory cells are unable to produce, obtain, or convert hormone precursors
- The endocrine gland synthesizes or releases excessive amounts of hormone
- → abnormal hormone levels

Endocrine Disorders

- Pituitary disorder of water metabolism (diabetes insipidus)
- 3 Thyroid gland disorders (goiter, hyperthyroidism, hypothyroidism)
- Pancreatic disorder (diabetes mellitus: type 1 and type 2)
- 2 Adrenal disorders (Addison's and Cushing's syndrome)

Elevated or Depressed Hormone Levels

- Increased hormone degradation or inactivation
- Ectopic hormone release

Diseases of the Posterior Pituitary

- **Diabetes insipidus**
 - Deficiency of _____ (aka vasopressin)
 - Polyuria (4-16 L/day) and polydipsia
 - Partial or total inability to concentrate urine
 - **Causes:** drugs or injury to posterior pituitary; lesions in hypothalamus, infundibulum or post. pit.
 - Normally ADH is syn. in hypothalamus and stored in post. pit. ADH is released when plasma osmolality increases → increased permeability to dct and cd in kidney → increased reabsorption of water.
 - **When ADH is missing:** results in increased excretion of water → large amt. of dilute urine

Diabetes Insipidus

- **Pathophysiology:**
 - Patients not able to concentrate urine
 - Deficiency of ADH → _____ vol. of dilute urine
 - → _____ if fluids are not replaced
- Treatment: replacement of ADH

Alterations of Thyroid Function

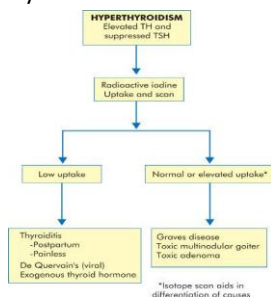
- **Goiter** = enlargement of thyroid gland
 - not due to inflammation or neoplasm
- Classified as:
 - nontoxic (increased demand for TH during adolescence, pregnancy or menopause) and
 - toxic (due to long term nontoxic, occurs in elderly)
- Please pass the iodine
 - Endemic goiter due to insufficient dietary iodine → insufficient production of TH
- Too much of a good thing
 - Sporadic goiter due to ingestion of goitrogenic foods* (inhibit thyroxine) or drugs

Goiter

- **Pathophysiology**
- Decreased iodine plus impaired synthesis of TH → responsiveness of thyroid to TSH
- Increased mass and cell activity may overcome mild thyroid impairment (Patient has goiter but normal fcn.)
- If severe impairment → goiter and hypothyroidism

Alterations of Thyroid Function

- Hyperthyroidism



Hyperthyroidism or thyrotoxicosis (Graves Disease)



Graves' Disease

- **How grave is Graves' disease?**
- Graves' disease is most common type
- Autoimmune, 30-60 years old, family history of thyroid abnormalities
- Thyroid-stimulating antibodies bind to TSH receptors
- Thyroid storm (thyrotoxic crisis)
Overproduction of T3 and T4 → increased SNS activity
(tachycardia, vascular collapse, hypotension, coma, death)

Graves' disease

- **Signs & Symptoms**
- Enlarged thyroid
- Exophthalmos (_____)
- Nervousness, weight loss w/ increased appetite
- **Treatment**
- Antithyroid drugs (propylthiouracil, methimazole)
- ^{131}I (radioactive iodine therapy)
- Surgery

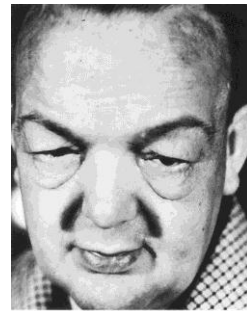
Alterations of Thyroid Function

- **Hypothyroidism**
 - Thyroid deficiency (decreased T3 and T4) → metabolic processes slow (may be problem with thyroid, pituitary, or hypothalamus)
 - **Primary hypothyroidism** – due to disorder of thyroid
 - **Secondary hypothyroidism** – due to failure to stimulate thyroid
 - **Causes:** thyroidectomy, radiation, not enough TSH (from pituitary) or TRH (from hypothalamus)
 - **Symptoms:** fatigue, wt. gain, facial puffiness, dry skin, bleeding tendencies

Pathophysiology

- Loss of thyroid tissue → decreased TH, increased TSH and goiter (primary)
- Decreased TSH from pituitary most commonly due to tumors (secondary)
- Myxedema- composition of dermis is changed (puffiness)
- Myxedema coma - depressed respiratory system , decreased cardiac output, bradycardia & hypotension
- Treatment: TH replacement gradually (levothyroxine)

Hypothyroidism



Diabetes Mellitus

- Body does not produce or use _____ properly
- Results in hyperglycemia
- Type 1 (IDDM = insulin-dependent)
- Type 2 (NIDDM = non-insulin-dependent)

Type 1 diabetes

- **Pathophysiology (Type 1)**
 - Islet cell (beta cell) destruction → no insulin production
 - Autoimmune (genetic & environmental)
 - Nonautoimmune (idiopathic)
- **Symptoms**
 - Lack of insulin → _____ occurs w/ 89-90% destruction of beta cells; excess glucagon by alpha cells
 - Glucosuria, polyuria, polydipsia
 - **Ketoacidosis** due to fat and protein metabolism → DKA coma
- **Treatment:** Insulin, meal planning and exercise, Hb A1C

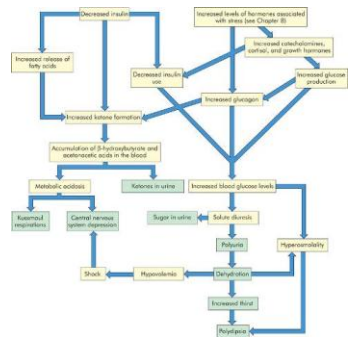
Type 2 diabetes mellitus

- **Pathophysiology**
 - Idiopathic, genetic and environmental factors
 - Insulin resistance in target tissues
 - Overproduction of glucose via gluconeogenesis
 - Obesity
- **Symptoms**
 - Recurring skin infections
 - Visual changes (blurred vision, retinopathy)
 - Paresthesias
 - Fatigue (poor eating)
- **Treatment**
 - Personalized meal plan & exercise

Acute Complications of Diabetes Mellitus

- Hypoglycemia (insulin shock- decr. BG levels)
- Diabetic ketoacidosis _____ – dec. insulin levels → elevated BG levels → fat mobilized
- Somogyi effect – hypoglycemia followed by hyperglycemia (rebound)
- Dawn phenomenon – early morning elevated BG

Diabetic Ketoacidosis



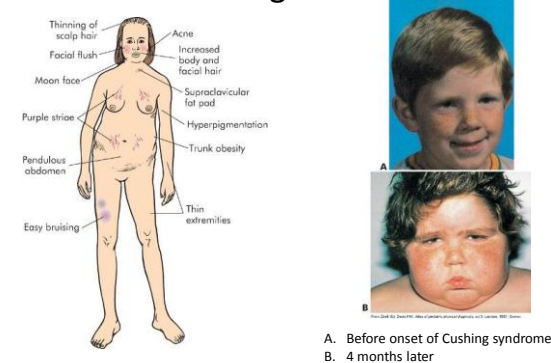
Chronic Complications of Diabetes Mellitus

- Hyperglycemia
- Microvascular disease
 - Retinopathy
 - Diabetic nephropathy
- Macrovascular disease
 - Coronary artery disease
 - Stroke
 - Peripheral arterial disease
- Diabetic neuropathies
- Infection

Alterations of Adrenal Function

- Disorders of the adrenal cortex
 - **Cushing disease**
 - Excessive anterior pituitary secretion of _____
 - Cushing syndrome
 - Cluster of abnormalities due to excessive levels of cortisol (glucocorticoid)
 - Wt. gain, muscle weakness, fatigue, buffalo hump, thin extremities, bruise easily
- Treatment:
 - Radiation, drugs, surgery depending on cause

Cushing Disease



• Addison's disease

- (adrenal insufficiency or hypofunction)
- _____ mineralcorticoid, glucocorticoid, and androgen secretion
- Cause – usually from autoimmune process
 - Idiopathic, TB, removal of adrenals, neoplasms, infections
- Adrenal crisis
 - Inadequate or nonresponsive hormone therapy
 - Extreme stress
 - → hypoglycemia, hypotension → coma → death

Concept Check

- 1. Which clinical symptoms are shared by DM and diabetes insipidus?
 - A. Elevated blood and urine glucose levels
 - B. Inability to produce ADH
 - C. Inability to produce insulin
 - D. Polyuria
- 2. Graves disease is:
 - A. Hyperthyroidism
 - B. Associated with autoimmunity
 - C. Characterized by ophthalmopathy
 - D. All of the above

- 3. A 24-year old female with a history of “juvenile onset” diabetes is found in a stupor. She has cold, clammy skin, what is most likely the cause of her condition?
 - A. Hyperglycemia
 - B. Insulin shock
 - C. Renal failure
 - D. retinopathy
- 4. Common signs and symptoms of DM include all of the following except:
 - A. Hyperglycemia
 - B. Blurred vision
 - C. Increased muscle anabolism
 - D. polyuria

Matching:

- ___ 5. Cushing disease A. Excess cortisol
- ___ 6. Goiter B. Enlarged thyroid
- ___ 7. Addison disease C. Adrenal hypofunction