Pharmacology 2

S.Y. 2026 - 2027 | 1ST SEMESTER | ENDOCRINE SYSTEM

ENDOCRINE SYSTEM

LESSON OUTLINE

I. Endocrine System
   A. Functions of the Endocrine System
   B. Parts of the Endocrine System
   C. Hypothalamic Hormones
II. Anterior Pituitary Hormones
   A. Corticotropin and Related Drugs
   B. Growth Hormone and Related Drugs
   C. Gonadotropins and Related Drugs
   D. Prolactin
III. Posterior Pituitary Hormones
   A. Vasopressin
   B. Oxytocin

1.0 Endocrine System

ENDOCRINE SYSTEM

★ It consists of the tissues (mainly **glands**) that create and release hormones.
   ○ **Hormones** are chemicals that coordinate different functions in your body by carrying messages through your blood to your organs, skin, muscles and other tissues. These signals tell your body what to do and when to do it.

1.1 FUNCTIONS OF THE ENDOCRINE SYSTEM

★ The main function of your endocrine system is to release hormones into your blood while continuously monitoring the levels.
★ Hormones deliver their messages by locking into the cells they target so they can relay the message.
★ You have more than 50 different hormones, and they affect nearly all aspects of your health — directly or indirectly.
★ Some examples include:
   ○ **Metabolism** - Blood pressure regulation, blood sugar regulation, fluid and electrolyte balance, and body temperature.
   ○ **Homeostasis** (balance)
   ○ **Growth and development**
   ○ **Sexual function**
   ○ **Reproduction**
   ○ **Sleep-wake cycle**
   ○ **Mood**

1.2 PARTS OF THE ENDOCRINE SYSTEM

★ Your endocrine system consists of three (3) type of tissues:
   ○ **Endocrine glands**
   ○ **Organs**
   ○ **Endocrine-related tissues**

ENDOCRINE SYSTEM GLANDS

★ Glands are special tissues in your body that create and release substances.
★ Endocrine glands make and release hormones directly into your bloodstreams.

★ The endocrine glands in your body from head to toe include:
   ○ **Pineal gland** - Thisis a tiny gland in your brain that's beneath the back part of your

corpus callosum. It makes and releases the hormone *melatonin*.

- **Pituitary gland** - This is a small, pea-sized gland at the base of your brain below your hypothalamus. It releases eight hormones, some of which trigger other endocrine glands to release hormones.
- **Thyroid gland** - This is a small, butterfly-shaped gland at the front of your neck under your skin. It releases hormones that help control your *metabolism*.
- **Parathyroid gland** - These are four pea-sized glands that are typically behind your thyroid. Sometimes they exist along your esophagus or in your chest (ectopic parathyroid glands). They release parathyroid hormone (PTH), which controls the level of *calcium* in your blood.
- **Adrenal glands** - These are small, triangle-shaped glands on top of each of your kidneys. They release several hormones that manage bodily processes, like metabolism, blood pressure, and your stress response.

★ You have other glands in your body that aren't endocrine glands, such as sweat glands (a type of exocrine gland).

ENDOCRINE SYSTEM ORGANS

Hypothalamus	- This is a structure deep within your brain. - It's the main link between your endocrine system and your nervous system. - It makes two hormones that your pituitary gland stores and releases (oxytocin and vasopressin) and makes and releases two hormones directly (**dopamine** and **somatostatin**).
Pancreas	- This organ is in the back of your abdomen (belly). - It's both an organ and a gland and is also part of your digestive system. - It releases two hormones that are essential to maintaining healthy blood sugar levels: **insulin** (busog) and **glucagon** (gutom).
Adipose tissue (body fat)	- This is a connective tissue that extends throughout your body. - It's found under your skin (as subcutaneous fat), between your internal organs (as visceral fat) and in the inner cavities of bones (as bone

	marrow adipose tissue). - Adipose tissue releases many different hormones, including **leptin**, **adinopectin**, and **angiotensin**.
Ovaries	- These are small, oval-shaped glands located either side of your **uterus**. - They produce and store over and make sex hormones that control your menstrual cycle and pregnancy.
Testicles (testes)	- These are small, round organs underneath your penis in your strotum. - They make sperm and sex hormones, particularly **testosterone**.

1.3 HYPOTHALAMIC HORMONES

- ★ Corticotropin releasing hormone → **Adrenocorticotropic hormone** - cortisol (stress)
- ★ Growth hormone releasing hormone → (+) **Growth hormone/Somatomedins**
- ★ Growth hormone inhibiting hormone (**Somatostatins**) → (-) GH
- ★ Thyrotropin releasing hormone → **Prolactin** and **Thyroid-stimulating hormone (TSH)** → T3 and T4
- ★ Gonadotropin releasing hormone → (+) **Follicle stimulating hormone (FSH)** and **Luteneizing hormone (LSH)**
- ★ Prolactin inhibiting hormone (**Dopamine**) → (-) Prolactin

2.0 ANTERIOR PITUITARY HORMONES

Corticotropin and Related Drugs
- ★ Corticotropin Preparations
- ★ Growth Hormone and Related Drugs
- ★ Gonadotropin and Related Drugs
- ★ Prolactin

CORTICOTROPIN PREPARATIONS

- ★ "preparations" - when drugs mimic natural chemicals.
  - **Porcine corticotropin** - from pigs
  - **Cosyntropin** - synthetic human corticotropin (preferred) to diagnose adrenal insufficiency (Addison's disease).

GROWTH HORMONE AND RELATED DRUGS

- ★ Secretion is stimulated by **GHRH**
- ★ Secretion is inhibited by **GHIH**

Growth Hormone Agonists	Natural: Somatropin Now: Recombinant Somatropin (Somatrem) Use: **Dwarfism** Mecasermin - a recombinant form of human IGF-1 (somatomedin C)

	○ tx of growth failure in children with severe IGF-1 deficiency ○ AE: Hypoglycemia
Growth Hormone Antagonists	Somatostatin (GHIH) Octreotide (and Lanreotide) ○ (+) dopamine agonist decreases circulating levels of growth hormone and prolactin ○ tx of tumors: **Insulinoma, Glucagonoma, Carcinoid tumors**
Growth Hormone Receptor Antagonists	Pegvisomant ○ Use: acromegaly (if unresponsive or unable to tolerate somatostatinsb analogs

GONADOTROPINS AND RELATED DRUGS

★ Follicle stimulating hormone (FSH)
★ Luteneizing hormone (LH)

FSH	• **Female:** - Ovarian follicle maturation - Estrogen production • **Male:** Spermatogenesis
LH	• **Female:** - Induces ovulation - Assist FSH in follicle development - Progesterone and androgen production • **Male:** - Testosterone production

GONADOTROPIN PREPARATIONS

★ treatment of **infertility** and **hypogonadism** in men and women

LH only	• **hGH** • **Lutropin** • **Choriogonadotropin**
FSH only	• Follicle a/B • Urofollitropin
Both LH and FSH	• Menotropin

hCG

★ pregnancy test
★ primarily used to induce ovulation in women and support fertility treatments, including assisted reproductive technologies like IVF.
★ used to increase testosterone production and sperm count, treating conditions such as hypogonadism and delayed puberty.
★ can help descend undescended testicles when administered between ages 4 and 9.

LUTROPIN

★ recombinant form of human luteinizing hormone (LH) used to stimulate ovulation and treat female infertility.

CHORIOGONADOTROPIN

★ an analogue of luteinizing hormone (LH) that binds to LH/hCG receptors on ovarian granulosa and theca cells.
★ stimulates late follicular maturation, resumption of oocyte meiosis, and rupture of the pre-ovulatory follicle, effectively inducing ovulation in the absence of a natural LH surge.

FOLLITROPIN a/B

★ recombinant human FSH that mimics the natural hormone produced by the pituitary gland.
★ stimulated the growth and development of ovarian follicles, preparing eggs for ovulation.
★ promotes spermatogenesis in cases of low sperm count due to hypogonadism.

UROFOLLITROPIN

★ highly purified preparation of FSH.
★ unlike menotropins, which contain both FSH and luteinizing hormone (LH), urofollitropin contains FSH only, making it more targeted for ovulation induction.

MENOTROPIN

★ also known as human menopausal gonadotropin (hMG).
★ hormonally active medication extracted from urine od postmenopausal women, which naturally contains high levels of FSH and LH due to the hypergonadotropic state of menopause.
★ It is primarily used to treat female infertility by stimulating the ovaries to mature multiple follicles, and in some cases, it is used in hypogonadal men to stimulate sperm production.

GONADOTROPIN-RELEASING HORMONE ANTAGONISTS

★ **Goserelin**
- synthetic analog of gonadotropin-releasing hormone (GnRH, luteinizing hormone-releasing hormone, gonadorelin); used as an antineoplastic agent and for its endocrine effects (prostate cancer, endometriosis, breast cancer); preferred (Tamoxifen)

★ **Nafarelin**
- primarily used to treat endometriosis, precocious puberty, uterine fibroids, and to manage hormone levels in certain reproductive and transgender therapies.

★ **Leuprolide**

Pulsatile Release	- rapid and transient release - mimics the natural secretion of GnRH - use: stimulates the release of FSH and LH
Non-pulsatile release	- continuous release - leads to down-regulation (desensitization) - result: decreased release of FSH and LH - uses: 1. tx of endometriosis

	2. precocious puberty 3. advanced prostate and breast cancer

★ **Ganirelix, Cetrorelix, Abarelix**
- competitive antagonists at GnRH receptors in the pituitary gland
- uses:

1. ovarian stimulation as an infertility treatment (**pulsatile** administration)
2. advanced **prostate** cancer in men
3. breast cancer (preferred tx: **Tamoxifen**)
4. endometriosis

PROLACTIN

★ target: **mammary gland**
★ promote **milk** secretion (and production)
★ Hyperprolactinemia leads to:
- Galactorrhea: production of milky nipple discharge unrelated to pregnancy or breastfeeding
- Infertility
- Hypogonadism
- tx: Dopamine agonist (Bromocriptine) = prolactin-inhibiting hormone

2.1 POSTERIOR PITUITARY HORMONES

VASOPRESSIN

★ aka ADH (**antidiuretic hormone**), AVP (**arginine vasopressin**), or B-hypophamine
★ secreted in response to a decrease in extracellular fluid volume
★ receptors:
- V1: blood vessel constriction
- V2: water reabsorption

★ Low ADH = Central diabetes insipidus
★ High ADH = SIADH

Central Diabetes Insipidus	- decreased in ADH, resulting in excessive urination and dehydration - tx: • fluid intake to maintain hydration • first-line drug: **Desmopressin** (synthetic ADH)
Nephrogenic Diabetes Insipidus	- kidneys are unresponsive to ADH (even if present) - first-line: thiazides (HCTZ), Amiloride • produces a paradoxical effect (increase water reabsorption)
SIADH (Syndrome of Inappropriate Antidiuretic Hormone)	- increased ADH resulting in dilutional hyponatremia - mx: • fluid restriction • increase water excretion (e.g., Tolvaptan and Demeclocycline)

OXYTOCIN

★ increases the strength of uterine contraction
★ causes milk ejection (milk let-down)

1. Synthetic oxytocin (Syntocinon)
- DOC for labor
- prevents postpartum uterine bleeding
- stimulates milk let-down in nursing mothers