Ch. 14: Endocrine System (updated 3/8/21)

Objectives:

1. **Review anatomy - endocrine glands of body.**
2. **Understand how hypothalamus**
   - **Controls the endocrine system by controlling the pituitary gland.**
   - **Controls the sympathetic (fight/flight) response.**
3. **Learn anterior pituitary hormones & their effects on other glands of body.**
4. **Understand some common endocrine disorders.**

2. **Endocrine system = system involving regulation of body functions through use secretory glands & chemical messengers (hormones)** Endocrine glands of body

- **Pituitary** = master endocrine gland
- **Pineal gland** = located in posterior diencephalon
- **Adrenal glands** = located above kidneys
- **Thyroid** = located on anterior trachea
- **Parathyroid glands** = located on posterior thyroid
- **Gonads** = ovaries & testes
- **Pancreas** = secrete insulin and glucagon
- **GI tract**

3. Hypothalamus controls the pituitary gland and sympathetic response

> Controls endocrine system 3 ways:

1) paraventricular nucleus secrete **Oxytocin** & supraoptic nucleus secretes ADH, both released by posterior pituitary.
2. Hypothalamus secretes **5 releasing hormones** & **2 inhibiting hormones,** which control anterior pituitary.
3. Controls autonomic sympathetic secretion of epinephrine by the adrenal medulla.

4. Hypothalamic hormones: **RH** stands for releasing hormone, and **IH** stands for inhibiting hormone.

See online practice flow diagram for hypothalamic hormones, pituitary hormones, and what target glands do!

1) Gn**RH** (gonadotropin-releasing hormone) – will affect gonads (testes & ovaries) *Gn stands for gonad!*
2) GH**RH** (**g**rowth **h**ormone releasing hormone) – will affect cell growth
3) C**RH** (**c**orticotrophin releasing hormone) – will affect a **c**ortex (adrenal **c**ortex)
4) T**RH** (**t**hyrotropin releasing hormone) – will affect **t**hyroid gland
5) PRH (prolactin releasing hormone) – stimulates mammary glands to make milk
6) GH**IH** or somatomedin (growth hormone inhibiting hormone) – inhibits growth hormone
7) P**IH** (prolactin inhibiting hormone) – does what it says. Inhibits prolactin secretion from pituitary, so mammary glands WON'T produce milk.

5. **Anterior pituitary response to hypothalamic releasing or inhibiting hormones:**

Hypothalamic hormone	Pituitary hormone
GnRH	secretes LH & FSH (luteinizing & follicle-stimulating hormone) – stimulates gonads
GHRH	secretes GH (growth hormone)
CRH	secretes ACTH (adrenocorticotropic hormone) – will stimulate adrenal cortex
TRH	secretes TSH (thyroid stimulating hormone) – does what it says
PRH	Prolactin
GHIH	inhibits GH secretion
PIH	inhibits prolactin secretion

6. **Figure of pituitary hormones & effect on target tissues** (review of earlier slides)

TSH – tells thyroid to produce T3 & T4, which regulate body metabolism
ACTH – tells adrenal cortex to make cortisol (stress hormone) & little bit of sex steroids
FSH – tells ovaries or testes to mature eggs & sperm
LH – tells ovaries or testes to make estrogen or testosterone, & ovaries to ovulate an egg
Prolactin – tells mammary glands to make milk
GH – tells body tissues to grow/repair

7. **Figure of whole system, at a glance (hypothalamic & pituitary hormones, and target organs response.**

8. **A practice blank flow diagram (and KEY) are found on the online syllabus** 8. **Regulation of these hormones is through negative feedback loop**.

> If blood level of any of the target gland hormones gets too high, it tells hypothalamus and pituitary to inhbit their secretions of stimulating hormones.

> If blood level of target gland hormones gets too low, hypothalamus & pituitary increase secretion of their stimulating hormones.

9. **Review slide**

10. **Pituitary disorders involving growth hormone**

> Pituitary dwarfism = decreased growth from low GH
> Gigantism = increased growth from excess GH (onset in childhood)
> Acromegaly = increased growth from excess GH (onset in adulthood)

11. **Pituitary ACTH stimulates adrenal glands:**

> Adrenal cortex to make:

- **sex steroids (T & E2)** in small amounts. Disorder of this is ***Congential Adrenal Hyperplasia (CAH)*** – intersex child.
- **Mineralcorticoid** (it affects minerals or SALTS) **Aldosterone** = ↑Na+ readsorption in kidney nephrons to control water retention. (Notice the word **al**do**st**erone has the letters for salt in it!)
- **Glucocorticoid** (it affects blood glucose) **Cortisol**, which ↑ blood glucose during stress, and acts as natural anti-inflammatory

> Adrenal Medulla to make:

- **epinephrine** in response to hypothalamic autonomic sympathetic stimulation

12. **Clinical App online** - synthetic "glucocorticoids" = ***prednisolone & dexamethasone*** – used for anti-inflammatory BUT prolonged use can cause adrenal atrophy – so use in decreasing amts. They decrease body's production of cortisol by negative feedack. When blood levels of synthetic glucocorticoid ↑ the hypothalmus shuts down CRH & pituitary shuts down ACTH. This makes adrenal gland atrophy from lack of stimulation.

13. **Adrenal Cortex Disorders**

A) ***Cushing's Syndrome*** (hypercortisolism) = excess **C**ortisol (excess hypothalamic CRH or pituitary ACTH)
↑ blood glucose (hyperglycemia), ↑ blood lipids (hyperlipidemia), abdominal fat
↑ fluid retention (moon face), hypervolemia (high blood volume), hypertension, muscle weakness.

14. B) ***Addison's disease*** = insufficient **A**ldosterone & (and to some extent low Cortisol)
    - ↓ **Na+ retention by kidneys, excess K+ retention**- **Hyponatremia =** low blood sodium (Na+)
    - **Hyperkalemia** = high blood potassium (K+)
    - **Hypovolemia** = low blood volume (retaining water)
    - **Hypotension** = low blood pressure (from retaining water)
    - **Anorexia** = usually loss of body water
    - **Hypoglycemia** - too little cortisol
    - skin bronzing

15. C) **Conn's Syndrome** (hyperaldosteronism) = excess aldosterone, excess salt & water reabsorption. Hypertension.
    - ↑ **Na+ retention by kidneys, excess K+ excretion in urine**
    - **Hypernatremia =** high blood sodium (Na+)
    - **Hypokalemia** = low blood potassium (K+)
    - **Hypervolemia** = low blood volume (retaining water)
    - **Hypertension** = low blood pressure (from retaining water)
    - **weight gain** = usually retaining body water

16. ***Pheochromocytoma*** = excessive epinephrine/norepinephrine **(Clinical App Pg 340)**
    - hypertension, hyperglycemia, increased metabolism, nervousness, sweating.

17. **Thyroid Gland = responds to pituitary TSH**
    1) **T4 (thyroxine)**
    2) **T3** – tri-iodothyronine [both T3 & T4 Requires iodine to be produced]
        - Regulates body metabolism and growth
    3) **Calcitonin** = Decreases blood calcium concentrations

    Parathyroid glands – produce parathyroid hormone to ↑ blood Ca+2 (by increasing intestinal absorption and pull of Ca+2 from bones).

18. **Thyroid Disorders**
    A) ***Hyperthyroidism*** – too much T3 & T4. Metabolism on hyperdrive.
    Caused by: tumor or
    Graves Disease - autoimmune attack on thyroid overstimulates receptors causing it to swell.
    Presentation:
    - High metabolism & anxiety
    - Intolerant to heat (sweating)
    - Tachycardia
    - Hypertension
    - ↑ fluid behind eyes ***("exopthalmos")***

    B) ***Hypothyroidism*** – too little thyroxine. Metabolism depressed If occur <6 mos age = "***cretinism***" – dwarfism
    Causes: thyroid tumor, goiter, insufficient dietary iodine
    Presentation:
    - Low metabolism, depression
    - Intolerance to cold, dry skin,
    - Enlarged thyroid gland
    - When in children called **"cretanism"**

19. ***Goiter*** – can't make thyroxine due to iodine deficient diet.

20. **Gonads (Testes and Ovaries)**

Testes > respond to FSH by sperm production (by sertoli cells in seminiferous tubules)
> respond to LH by producing **testosterone** (by leydig cells in seminiferous tubules)

Ovaries > respond to FSH by developing new eggs (within follicles)
> respond to LH by producing **estrogen**, and LH at day 14 of 28 day menstrual cycle causes ovulation.
> respond to FSH by maturing an egg each month.

<u>Disorders</u>

21. ***Kallman's Syndrome (Hypogonadism)*** = insufficient hypothalamic GnRH. ↓ LH/FSH = ↓ T = feminized male (intersex)
22. ***Androgen Insensitivity Syndrom (AIS)*** = tissues don't respond to T (DHT). Feminized male (intersex)

23. Pineal Gland – makes **melatonin** , regulates circadian rhythm**.** In diencephalon & regulated by hypothalamic suprachiasmatic nucleus.

24. Pancreas

> beta cells make **insulin**. Causes tissues take up blood glucose (↓blood glucose), & glycogenesis in liver & muscle
> Alpha cells make **glucagon.** Causes glycognolysis in liver (↑ blood glucose)

26. GI Tract

> Gastrin (stomach) = stimulates HCL production (by parietal cells)
> Secretin (sm. intestine) = stimulate water and bicarbonate secretion from pancreas
> Cholecystokinin (sm. intestine)
- stimulates gallbladder contraction (get bile into duodenum)
- stimulates pancreatic enzyme secretion

> Gastric inhibitory peptide (sm. intestine) = inhibits gastric motility (slow down) & stimulates pancreatic insulin.