

Ch 14: Endocrine Physiology

PowerPoint updated 2/17/25

Objectives

1. Review endocrine glands of body.
2. Understand how hypothalamus controls endocrine system & sympathetic epinephrine response.
3. Learn anterior pituitary hormones & their effects on glands of body.
4. Understand some endocrine disorders.

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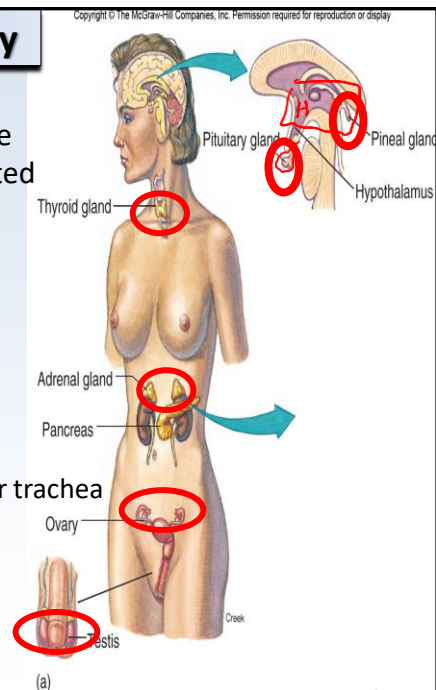
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1. Endocrine Glands of the Body

Endocrine System = system involving regulation of body functions through use of chemical messengers (hormones) secreted by glands.

Endocrine glands of body:

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



****Most of these glands controlled by hypothalamus!**

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2. Hypothalamus controls endocrine system!

> Hypothalamus part of both nervous & endocrine systems

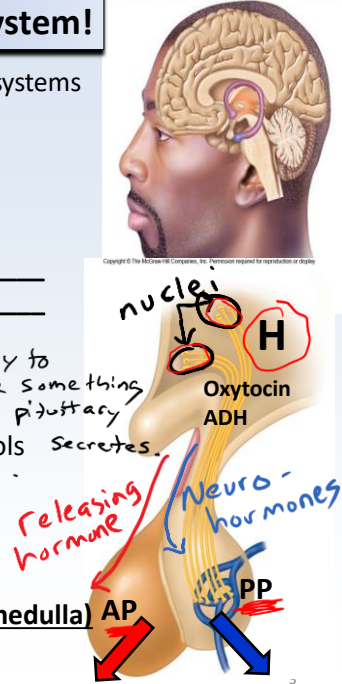
Controls endocrine system 3 ways:

1. **Hypothalamic nuclei** secrete neuro-hormones through posterior pituitary. Pg 266-267 Wiki text

- > Supraoptic nucleus secretes ADH
- > Paraventricular nucleus secretes Oxytocin

2. **Hypothalamus** secretes Releasing hormones (RH) & Inhibiting hormones (IH) which controls anterior pituitary. - tell pituitary to secrete something & inhibits pituitary secretes.

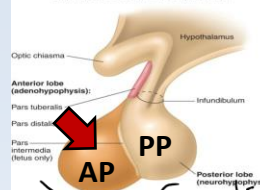
3. **Hypothalamus** controls autonomic sympathetic secretion of epinephrine by the Adrenal glands (medulla)



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Hypothalamus Directs Anterior Pituitary Secretions

Know hypothalamic hormone (acronym) and what it causes anterior pituitary to secrete!
Pg 267 Wiki text.



Hypothalamus secretes:

Releasing hormones (RH)

1. Gonadotropin releasing hormone (GnRH) → Gonads
2. Growth hormone releasing hormone (GHRH)
3. Corticotropin releasing hormone (CRH)
4. Thyrotropin releasing hormone (TRH)
5. Prolactin releasing hormone (PRH)
Pro = For lactin = lactation

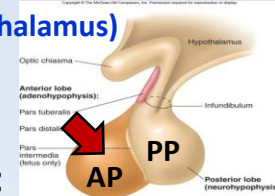
Inhibiting hormones (IH)

6. Growth hormone inhibiting hormone (GHIH)
7. Prolactin inhibiting hormone (PIH)

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Anterior Pituitary Secretions (in response to hypothalamus)

Pg 267 Wiki text



Hypothalamic hormones

Anterior Pituitary Response:

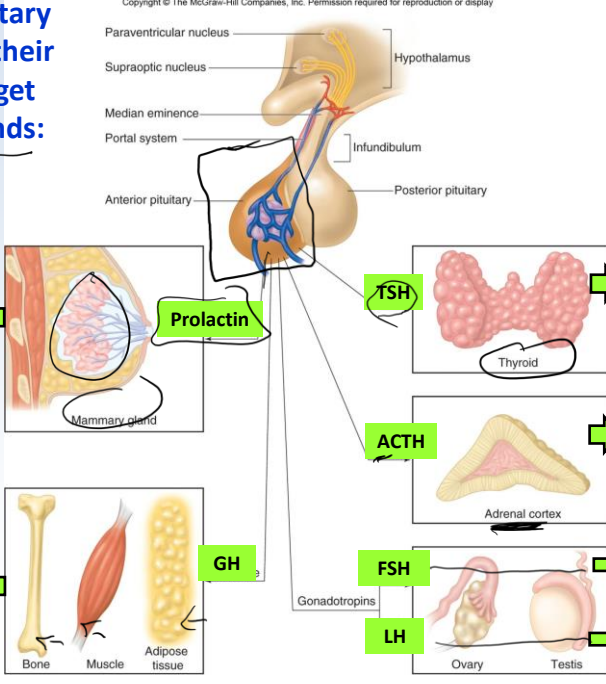
- GnRH** → Luteinizing hormone (LH)
Follicle stimulating hormone (FSH)
- GHRH** → Growth hormone (GH)
- CRH** → Adrenocorticotropic hormone (ACTH) → adrenal cortex.
- TRH** → Thyroid stimulating hormone (TSH)
- PRH** → Prolactin
- GHIH** → Stop secreting Growth hormone.
- PIH** → Stops secreting prolactin

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Anterior Pituitary secretions & their effects on target organs or glands:

Pg 262 – 263 Wiki text



Effects:

- Prolactin**: Stimulates mammary glands to make milk (lactation)
- TSH**: Produce T3 & T4 to regulate metabolism (Thyroid)
- ACTH**: Produce Sex steroids - Cortisol (Adrenal cortex)
- FSH**: Mature eggs & sperm (Ovary, Testis)
- LH**: Produce estrogen & testosterone, ovulation (Ovary, Testis)
- GH**: Stimulates body tissues to grow! & repair. (Bone, Muscle, Adipose tissue)

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Practice Endocrine Blank Flow Chart!
Found on online syllabus. Key also found there.

HYPOTHALAMUS SECRETES: 5 Releasing hormones & 2 inhibiting hormones	ANTERIOR PITUITARY RESPONSE:	↓ BODY'S RESPONSE:
1. _____ RH	1. _____	_____
2. _____ RH	2. _____	_____
3. _____ RH	3. _____	_____
4. _____ RH	4. _____	_____
5. _____ RH	5. _____	_____
6. _____ IH	6. _____	_____
7. _____ IH	7. _____	_____

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Endocrine hormone regulation is through negative feedback.

Pg 265 – 266
 Wiki text

If blood levels of a hormone are too low, hypothalamus increases RH secretion & pituitary increase its hormone secretions.

If blood levels of a hormone are too high, hypothalamus decreases RH secretion & increases IH secretion, then the pituitary decreases its hormone secretions.

Ques:

Can you think of a hormone that is not regulated through negative feedback, but by positive feedback??

Oxytocin

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How hypothalamus & neg. feedback regulates anterior pituitary secretions:

QUES:

If the hypothalamus "senses" GH in blood is too high what does it do? stops GHRH

What happens to anterior pituitary secretions of GH? Stop GH secretion

If GH in blood is too low, hypothalamus does what? increase GHRH

What does pituitary then do? ↑ GH secretion.

If hypothalamus "senses" high estrogen or ^{Progesterone} testosterone in blood it ↓ GnRH

What does pituitary then do? stop LH & FSH secretion.

If hypothalamus "senses" low thyroid hormones it ↑ TRH

What does pituitary then do? ↑ TSH

Clinical Apps: synthetic testosterone

[Anabolic steroid abuse & negative feedback](#)

[Corticosteroid use & negative feedback](#)

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Review

- Endocrine glands of body
 - Pituitary, adrenals, thyroid, parathyroids, gonads, pineal gland, pancreas, GI tract, pancreas, liver.
- Hypothalamic controls endocrine system
 - Nuclei secrete ADH & oxytocin
 - 5 Releasing hormones (CRH, GnRH, TRH, GHRH, PRH)
 - 2 Inhibiting hormones (PIH, GHIH)
 - Controls adrenal medulla secretion of epinephrine
- Anterior pituitary secretions & their target organs
 - ACTH, TSH, GH, FSH, LH, PRL
- Negative feedback regulation of endocrine system

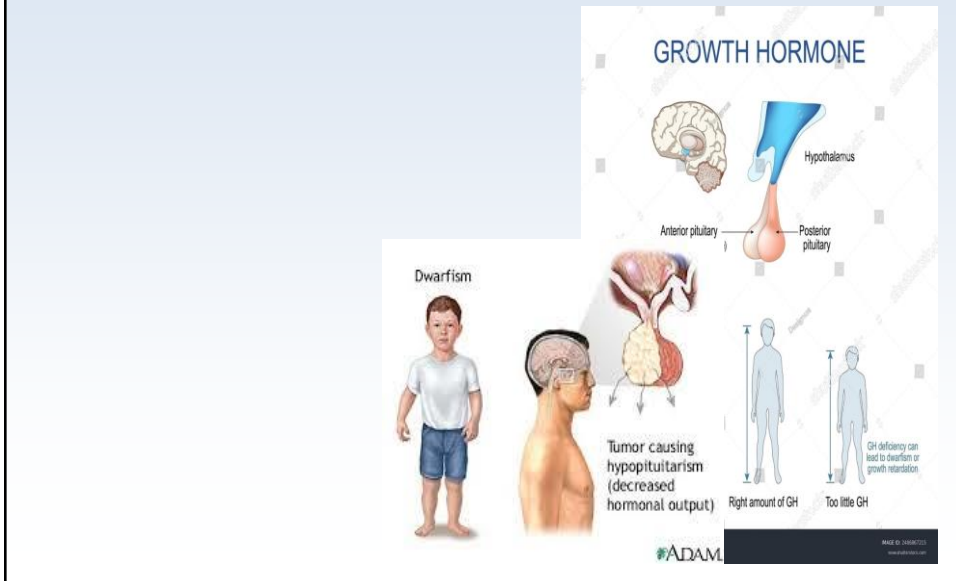
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Growth Hormone (GH) Disorders: Clinical App [ONLINE](#)

1. Insufficient GH = insufficient body growth

> Pituitary dwarfism



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Growth Hormone (GH) Disorders: Clinical App [ONLINE](#)

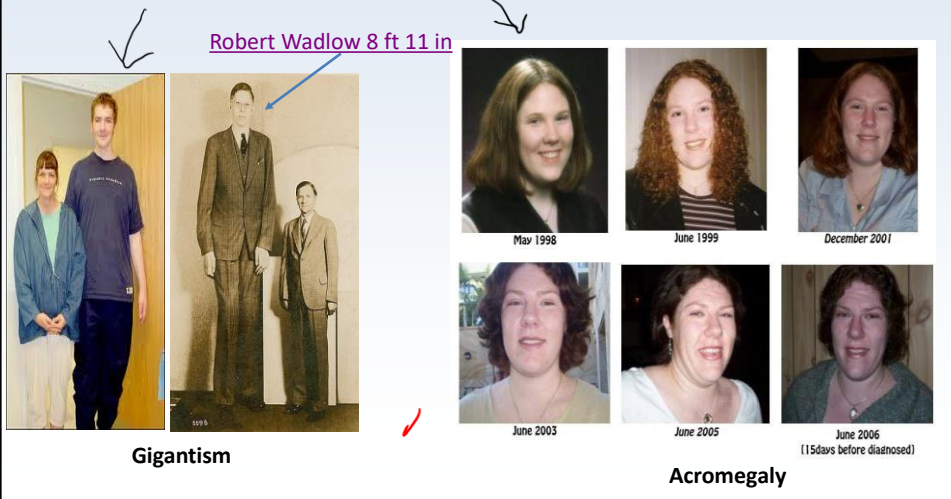
2. Excessive GH – excessive body growth

> Gigantism – when onset in childhood

→ Possible pituitary problem (ex. tumor)

> Acromegaly – when onset in adulthood

Click [HERE](#) to read more (not required)



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Pg 272 – 274 Wiki text

Pituitary ACTH stim. Adrenal Cortex to make:

Under sympathetic response - hypothalamus stimulates Adrenal Medulla to make

1. Sex steroids

Ex. - Estrogen and testosterone

Epinephrine

2. Glucocorticoids

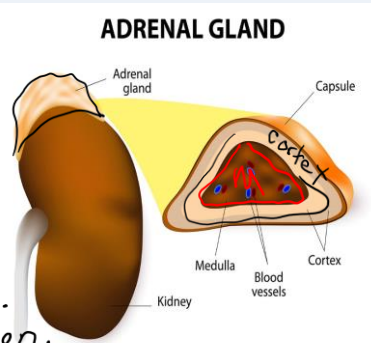
Ex. Cortisol

Clinical App ONLINE
 Exogenous glucocorticoids and negative feedback on adrenal cortex
 natural anti-inflammatory

Adrenal cortex also makes Mineralcorticoids, but stimulus for secretion is low blood pressure NOT ACTH

Ex. - Aldosterone

(tells kidney tubules to increase salt, & then water retention)
 ↑ salt retention.
 ↑ water retention.



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Adrenal Cortex Disorders:

A. Cushing's Disease ("hypercortisolism") – Excess Cortisol

Clinical App ONLINE

Causes:

- Excess hypothalamic CRH or pituitary ACTH
- Adrenal gland tumor

Clinical Presentation:

- Hyperglycemia = high blood glucose
- Hyperlipidemia = high blood fats.
- Hypervolemia = ^{blood volume} high blood volume (retain fluids)
- Hypertension =



People
 Amy Schumer Says Comments About Her 'Moon Face' Led to Cushing Syndrome Diagnosis: 'I Wouldn't Have Known'

Click HERE to read more (not required)

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Adrenal Cortex Disorders:

B) Addison's Disease – Low Aldosterone & Low Cortisol

Often called "adrenal insufficiency"

Clinical App [ONLINE](#)

Click [HERE](#) to read more (not required)









Causes:

- ↓hypothalamic CRH or pituitary ACTH.
- Adrenal cortex tumor or autoimmune disorder

Clinical Presentation:

- ^{low}Hyponatremia = ^{low blood} ^{low blood} ^(salt) sodium.
(pee it out)
- ^{K+}Hyperkalemia = high blood potassium.
- Hypovolemia = low blood volume
(pee out body water)
- Hypotension = Low BP
- Anorexia = loss body weight
- Skin bronzing
- Hypoglycemia - low blood glucose
(low cortisol)

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CUSHING'S vs ADDISON'S	
Mnemonics created by: ♥ NURSE SARAH	
Cortisol secretion HIGH It's a STRESS hormone!	Cortisol and Aldosterone secretion LOW They're STEROID hormones!
Causes:  tumors within the pituitary or adrenal glands • corticosteroids	Causes:  <ul style="list-style-type: none"> • autoimmune damage to adrenal cortex • cancer/infection • trauma to adrenal cortex
Signs & Symptoms: "STRESSED"	Signs & Symptoms: "STERIODS"
<p>Skin fragile (thinner)</p> <p>Truncal obesity →  "Buffalo Hump"  "Moon Face"</p> <p>Reproductive issues → amenorrhea, erectile dysfunction</p> <p>Elevated BP</p> <p>Striae on extremities/abdomen → </p> <p>Sugar high; polyuria/polydipsia</p> <p>Sexcessive body hair</p> <p>Depleted potassium (hypokalemia)</p>	<p>Salt hunger due to hyponatremia </p> <p>Tired and weak</p> <p>Elevated potassium (hyperkalemia)</p> <p>Reproductive issues (hormone imbalances)</p> <p>Onset of hypotension</p> <p>Increased skin pigmentation </p> <p>Depression </p> <p>Sugar low (hypoglycemia)</p>
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Adrenal Cortex Disorders:

C) Conn's syndrome (hyperaldosteronism)

high aldosterone

Causes:

- usually adrenal cortex tumor

Clinical Presentation:

- Hypernatremia = high blood salt (retain salt)^{Na⁺}
- Hypokalemia = low blood potassium
- Hypervolemia = high blood volume (retain water)
- Hypertension = high BP
- Weight gain = retained water

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Adrenal Medulla Disorders:

Pheochromocytoma = excessive norepinephrine/epinephrine

Clinical App [ONLINE](#)

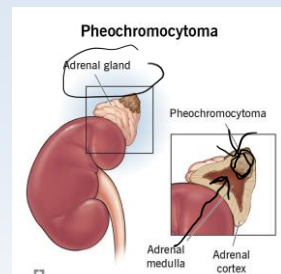
Causes:

- adrenal medulla tumor

Clinical Presentation: "fight or flight" symptoms

- Tachycardia ~ high heart rate
- Hypertension
- Hyperventilation ~ rapid breathing.
- Hyperglycemia
- Hyperlipidemia
- sweating,
- Nervousness, anxiety or panic attack

Click [HERE](#) to read more (not required)



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Thyroid Gland Pg 269 – 270 Wiki text

Produces:

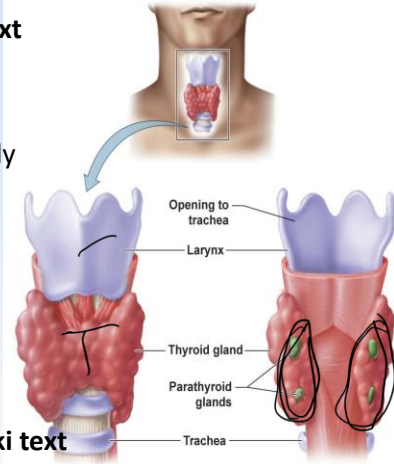
1. T₃ (tri-iodothyronine)
 2. T₄ (thyroxine)
- } Increase body metabolism

3. Calcitonin - ↓ blood Ca²⁺

Parathyroid Glands Pg 270-272 Wiki text

Produce:

Parathyroid hormone - ↑ blood Ca²⁺



Front view Back view
(a) The thyroid gland lies over the trachea, just below the larynx.

Anterior View of thyroid

Posterior View of parathyroids

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Thyroid gland disorders – Clinical App ONLINE

A. **Hyperthyroidism** = excessive thyroid hormones (T₃ & T₄)
(click [HERE](#) to read more)

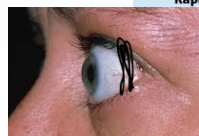
Causes:

- thyroid tumor
- **Graves disease** = autoimmune attack, over-stimulates thyroid receptors.

About 1% of people globally. It occurs More often in women.

Clinical presentation:

- High metabolism & anxiety
- Intolerant to heat (sweating)
- Tachycardia
- Hypertension
- ↑ fluid behind eyes ("**exophthalmos**") eyes protrude



Some symptoms of hyperthyroidism



Cleveland Clinic

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Thyroid gland disorders – Clinical App [ONLINE](#)

low T₃, T₄

B. Hypothyroidism = insufficient thyroid hormones (click [HERE](#) to read more)

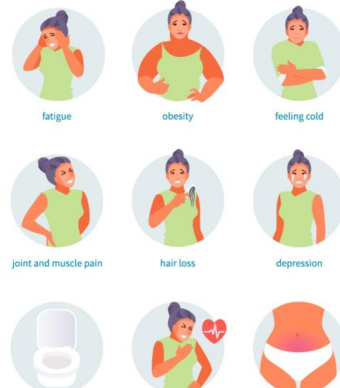
Causes: thyroid tumor, goiter, insufficient dietary iodine.

5 / 100 people in US. Occurs more often in women.

Clinical presentation:

- Low metabolism, depression
- Intolerance to cold, dry skin,
- Enlarged thyroid gland
- When in children called **“cretanism”**
- reduced growth

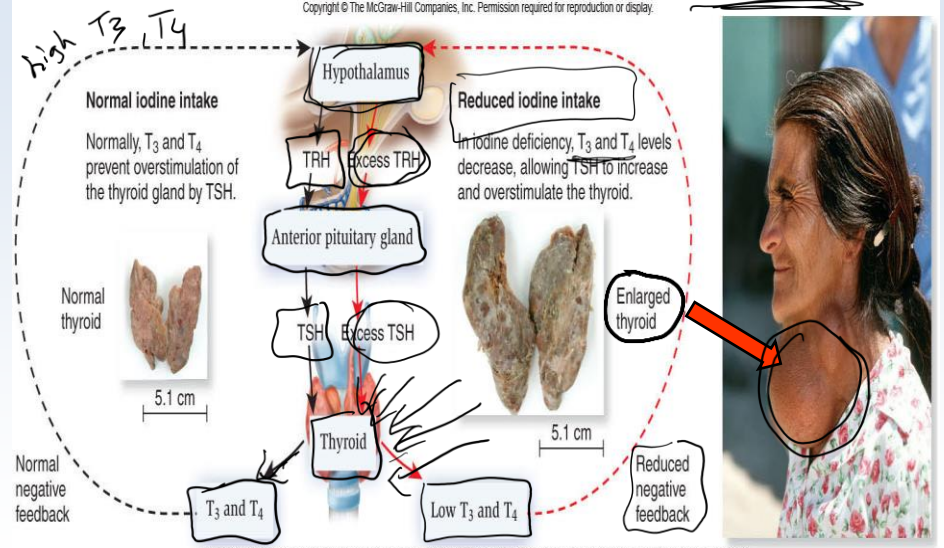
Hypothyroidism



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“Goiter” = thyroid can’t make thyroid hormones, it over-grows (swells)

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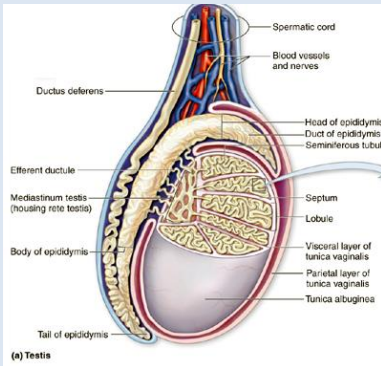
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Gonads Pg 276-277 Wiki text

Testes

Response to ^{Pituitary} LH = Testosterone

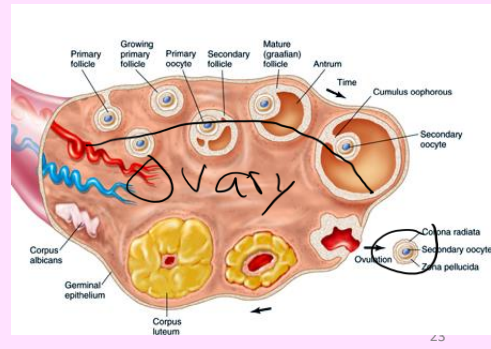
Response to FSH = Sperm maturation



Ovaries

Response to ^{Pituitary} LH = Estrogen & ovulation

Response to FSH = Egg maturation



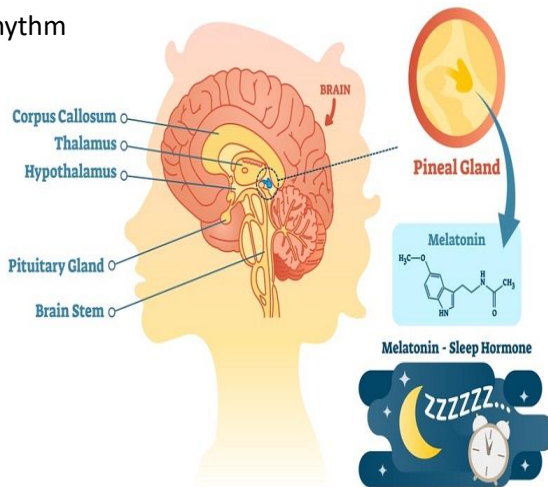
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Pineal gland

- Makes melatonin at night
- helps regulate circadian rhythm

Pg 277 Wiki text

PINEAL GLAND



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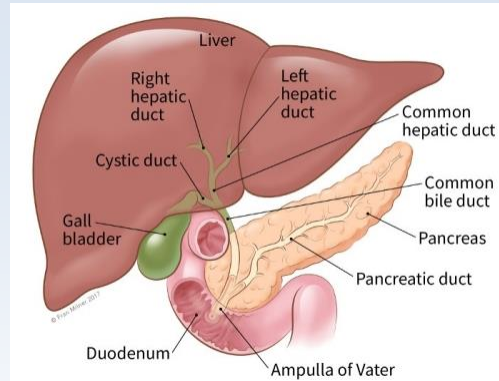
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Pancreas

- Makes **insulin** and **glucagon**
Pg 268, 272-274 Wiki text

Clinical App [ONLINE](#)

Diabetes mellitus



Liver

- Makes **erythropoietin** – stimulates RBC production
- Responds to ^{erythrocytes = RBC} pancreatic glucagon by engaging in Glycogenolysis
(~~break glycogen into glucose & release into blood~~)

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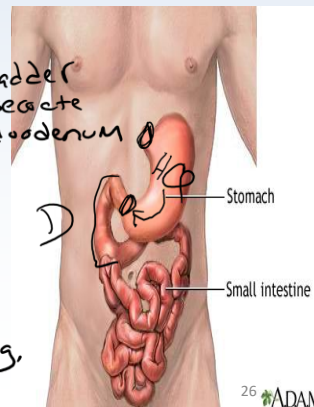
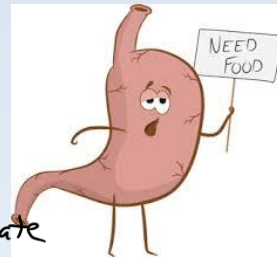
GI Tract

^{gastric}
1. **Gastrin** (stomach) = stimulates H^+ pumps to make HCl (acid)

^{duodenum}
2. **Secretin** (sm. intestine) = stimulates bicarbonate secretion (buffer to acid)
stimulate bile production by liver.

^{duodenum}
3. **Cholecystokinin** (sm. intestine) = stim. gallbladder contract to secrete bile into duodenum
(cholesterol) ^{stone}
cholelithiasis = gallstones

^{duoden}
4. **Gastric inhibitory peptide** (sm. intestine) = stimulates insulin secretion & slows gastric emptying.



26 ADAM

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Review

- Endocrine glands of body
 - Pituitary, adrenals, thyroid, parathyroids, gonads, pineal gland, pancreas, liver, GI tract
- Endocrine disorders
- Hormones produced by each gland

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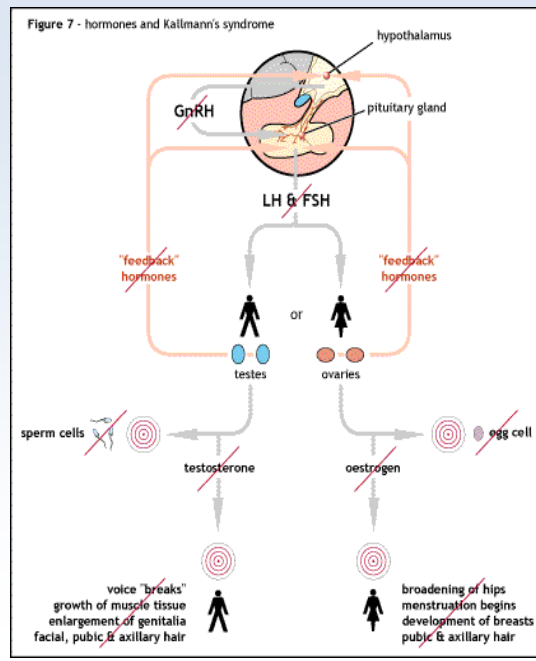
Sex Steroid Disorders:

A. Kallmann Syndrome

(Hypogonadism) = insufficient hypothalamic GnRH production. Results in less pituitary LH & FSH. Causes ↓ testes growth and ↓ testosterone and estrogen production.

In male child – can interfere with development of penis, testes, sperm production, and other masculine traits.

> Rare - 1 out of 50,000 births



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B. Androgen Insensitivity Syndrome (AIS)

= genetic male (XY) with normal genes, testes development, normal vas deferens, normal testosterone production BUT tissues fail to respond to testosterone. (androgen-insensitivity)

> 1 / 13,000 male births

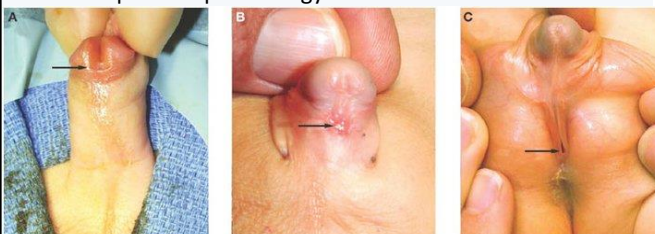
Born with varying degree of intersex

- > micropenis
- > incomplete fusion of labial folds into scrotal sac
- > hypospadias
- > poor or no sperm production (sterile)
- > extra testosterone converted into estrogen & get female hip development & gynecomastia.

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Complete AIS

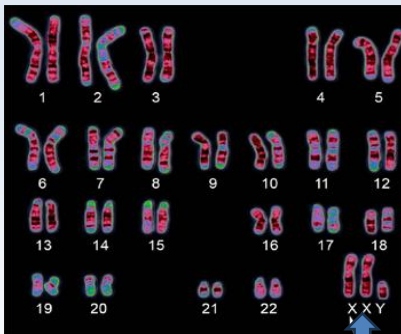


Partial AIS – partial fusion of scrotal skin, micropenis or enlarged clitoris

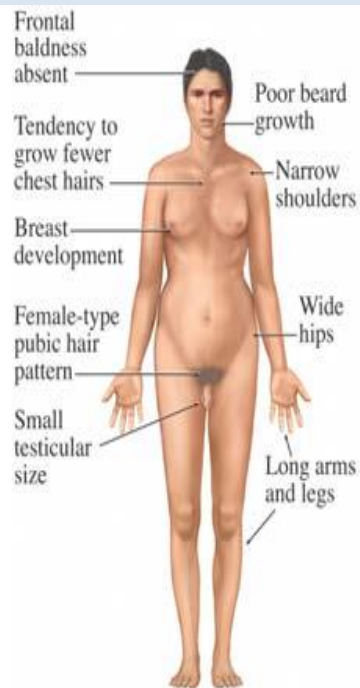
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Added slide 2/20/25

Klinefelter Syndrome



Failure of sex chromosomes to separate during meiosis



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C. Klinefelter Syndrome

XXY male (extra X chromosome)

- > Affects about 1 / 650 newborn boys.
- > It is among the most common sex chromosome disorders.
- > Have smaller testes, & low testosterone.
- > Some degree of feminized features after puberty if not diagnosed & treated with supplemental testosterone.

May or may not also have:

- > **Gynecomastia** = breast development
- > **Cryptorchidism** = one or both testes retained in abdomen
- > **Hypospadias** = urethral opening someplace other than head of penis
- > **Micropenis**
- > Hip development - due to estrogen changing fat deposition.
- > Infertility
- > Taller than average
- > Poor muscle development

Source: <https://medlineplus.gov/genetics/condition/klinefelter-syndrome/>

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Review

- Sex hormone disorders
 - Kallman's syndrome
 - AIS
 - Klinefelter's syndrome

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