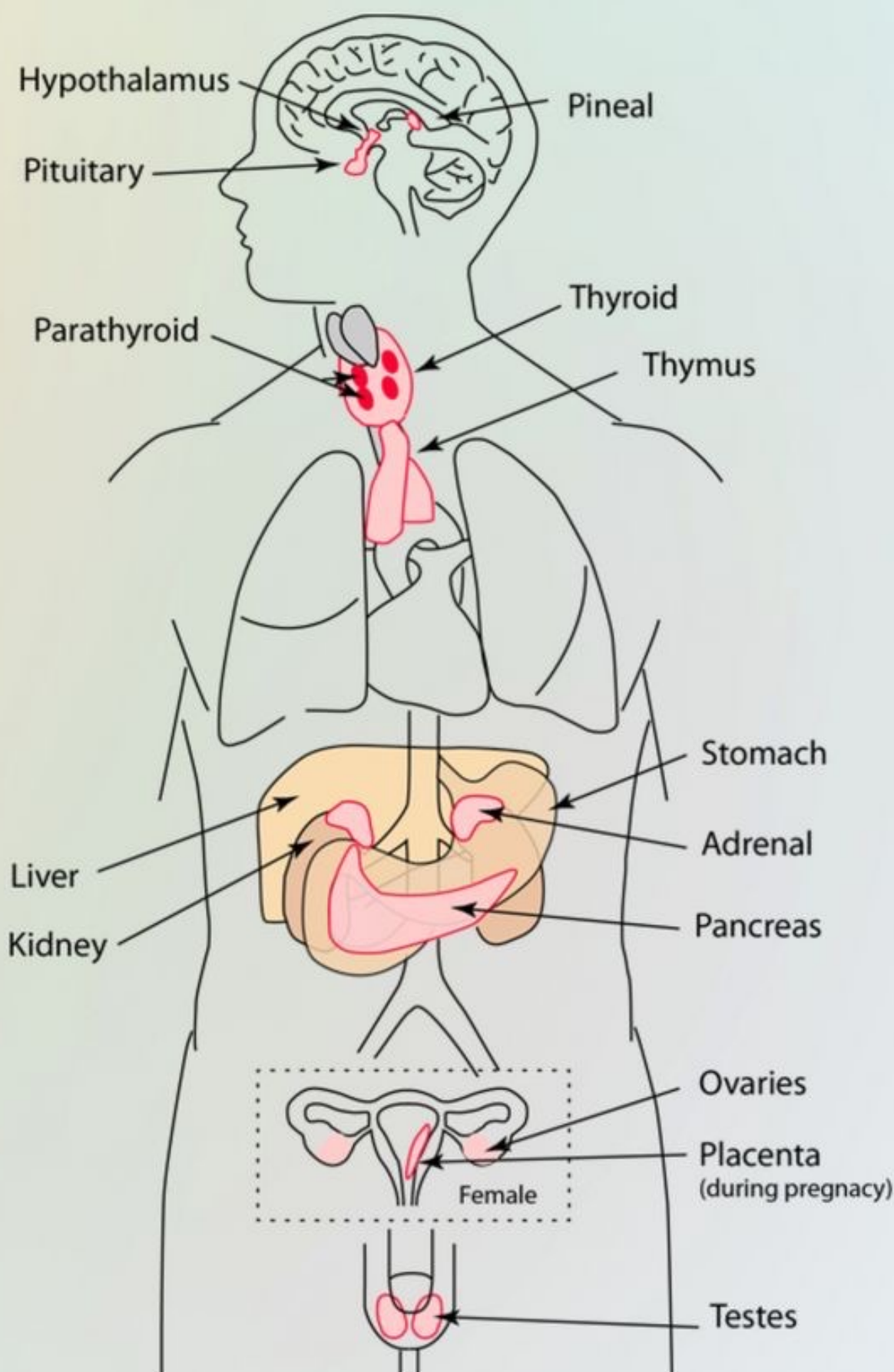


The Endocrine System



كل الكلام بي تحت

مع الدكتور والسلايدات

١٥٠% بس ماكن بجدول لتفعيل
الخطط (فكل اشئ مع السلايدات
دوم زيادة أو نقصان)

بالتوفيق

مقارنة: الجهاز العصبي (Nervous System) vs الجهاز الصمّاوي (Endocrine System)

الجهاز الصمّاوي	الجهاز العصبي	الخاصية
	كلاهما يرتبط بمستقبلات (Receptors) على الخلايا المستهدفة (Target cells).	التشابه
استجابة أبطأ.	استجابة سريعة (بواسطة الناقلات العصبية (Neurotransmitters).	السرعة
تأثير أطول.	تأثير أقصر (Shorter).	مدة التأثير
واسع النطاق (Broad) على عدة مناطق.	مناطق محددة (Specific).	نطاق التأثير

الوظيفة العامة

مسؤول عن إفراز الهرمونات (Hormones) التي تنظم عمليات الجسم مثل التمثيل الغذائي (Metabolism) والنمو (Growth).

تعريف الهرمون (Hormone)

مادة تُفرز من مكان محدد في الجسم، لكن نشاطها يظهر في أجزاء أخرى من الجسم.

مسار الهرمون

1. يُفرز من الغدة.

2. ينتقل إلى السائل الخلالي (Interstitial fluid).

3. يدخل مجرى الدم (Blood stream).

4. يصل إلى الخلايا المستهدفة في أنحاء الجسم.

مستقبلات الهرمون (Hormone Receptors)

- كل هرمون يرتبط بمستقبلات محددة (Specific target receptors) على الخلايا المستهدفة.
- تنظيم عدد المستقبلات:
- التنظيم للأسفل (Down-regulation): يقل عدد المستقبلات عند ارتفاع تركيز الهرمون.
- التنظيم للأعلى (Up-regulation): تزداد حساسية الخلية عند انخفاض تركيز الهرمون.

تأثيرها مباشر

major endocrine glands

bind on receptors

3. مقارنة: Exocrine Glands vs. Endocrine Glands

Exocrine Glands	Endocrine Glands	المعيار
✓ تفرز منتجاتها في Ducts.	✗ لا تمتلك Ducts.	وجود Ducts
→ Body cavities أو Outer surface of the body.	→ Interstitial fluid → Blood.	مسار الإفراز
Sweat, Oil, Mucus, Digestive enzymes.	Hormones.	نوع المادة المفرزة
الغدد العرقية والهضمية.	Pituitary, Thyroid, Adrenal, Pineal, Parathyroid.	أمثلة

أعضاء أخرى تفرز Hormones: Hypothalamus, Pancreas, Ovaries, Testes, Kidneys, Stomach, Liver, Small intestine, Skin, Heart, Adipose tissue, Placenta

4. مقارنة: تنظيم Hormone Receptors

حساسية الخلية	التأثير على عدد Receptors	الحالة	النوع
تقل	يقل	عند ارتفاع كمية الـ Hormone	Down regulation
تزيد (More sensitive) ^{لـ hormones}	يزيد (أو تصبح أكثر فعالية)	عند انخفاض كمية الـ Hormone	Up regulation

5. مقارنة: أنواع الـ Hormones حسب مكان التأثير

سرعة التثبيط (Inactivation)	مسار العمل	النوع
أبطأ (في Kidney أو Liver)	Interstitial fluid → Blood → خلايا بعيدة	Circulating hormones ^{أغلبية الـ endocrine hormones}
أسرع	تؤثر محلياً دون دخول Blood	Local hormones
	تؤثر على الخلايا المجاورة	• Paracrine
	تؤثر على نفس الخلية المفرزة	• Autocrine

تبقى بالدم بجوانب → circulating hormones

فحقن بمحلول الـ inactivation دح تطول

أكثر منه الـ local hormones

فحقن الـ inactiv... عن طريق الـ liver

Kidney

6. مقارنة: التصنيف الكيميائي للـ Hormones

النوع	الذائبة	الفئات الرئيسية والأمثلة
Lipid-soluble hormones	تذوب في الدهون	• Steroid hormones: ^{من نفس تنظيم الـ cholesterol} Cholesterol, ^{أشياء مشابهة} Thyroid hormones: T3, T4 • Nitric oxide (NO): Hormone و Neurotransmitter
Water-soluble hormones	تذوب في الماء	• Amino hormones: Epinephrine, ^{أو dopamine} Norepinephrine, ^{histamine} • Peptide & Protein hormones: ADH, Oxytocin, Insulin, hGH • Eicosanoids: PGs, Prostaglandins, LTs, Leukotrienes

useful functionally

→ synthesized by attaching iodine to the amino acid (tyrosine)
→ very lipid soluble

→ synthesis by nitric oxide synthase enzyme

→ synthesized from ornithine (histidine) via decarboxylation

carbon fatty acid

Other amino hormones

→ Serotonin و melatonin
synthesized via decarboxylation of amino acid (tryptophan)

Peptide & Protein → as amino acid polymers
small consist of chain of 3-10 amino acids
large → include 50-200 amino acids

* thyroid-stimulating hormone
↳ attached with carbohydrate group → Glycoprotein hormones

7. مقارنة: نقل الـ Hormones في الدم (Hormone Transport)

الخاصية	Water-soluble hormones	Lipid-soluble hormones
الحاجة لنقل <i>need to attach to other molecule</i>	X تنتقل حرة في Plasma Free-form	✓ تحتاج Transport proteins <i>→ synthesized by cells in liver</i>
فوائد الناقل	-	1. تجعلها water-soluble 2. تقلل فقدانها عبر Kidney 3. مخزون احتياطي في Blood <i>ready reserve hormone</i>

- ① [hormone] in blood ↑ *استجابة أسرع*
- ② Abundance of the target cell's hormone receptors ↑ *استجابة أسرع*
- ③ influences exerted by other hormones

8. مقارنة: آلية عمل الـ Hormones (Mechanism of Action)

المعيار	Lipid-soluble hormones	Water-soluble hormones
موقع الـ Receptors	داخل الخلية (Inside target cells)	على غشاء الخلية (Plasma membrane)
آلية العمل	1. يدخل الخلية. 2. يرتبط بمستقبل. 3. يغير Gene expression في Nucleus. 4. ينتج New mRNA. 5. يصنع New proteins.	1. يرتبط بمستقبل على الغشاء. 2. ينشط G protein. 3. ينشط Adenylate cyclase. 4. يحول ATP إلى cAMP. 5. ينشط Protein kinase. 6. تعمل Protein kinases على Phosphorylation. <i>then phosphodiesterase inactivates cAMP</i>

9. مقارنة: تفاعلات الـ Hormones (Hormone Interactions)

نوع التفاعل	الوصف	مثال مبسط
Permissive effect <i>if 2 hormones effect on target cell</i>	يحتاج Hormone لوجود Hormone آخر (غالباً بكمية قليلة) ليُظهر تأثيره الكامل.	يمهد الطريق لـ Hormone (أ). Hormone (ب).
Synergistic effect <i>مع بعض 2</i>	يعمل Hormone معاً لإعطاء تأثير أقوى من مجموع تأثير كل منهما منفرداً.	$1 + 1 = 3$ (تأثير تآزري).
Antagonistic effect <i>عكس بعض 2</i>	يعمل Hormone بشكل معاكس لتأثير Hormone آخر.	يرفع السكر (أ). يخفضه Hormone (ب).

Pituitary Gland (Hypophysis) was called the **Master Endocrine Gland**:

- **Because it secretes several hormones that control other endocrine glands**
- The true "Master" is the **Hypothalamus**
- Hypothalamus cells synthesize and secrete **9** different **hormones**
- Pituitary Gland cells secrete **7** different **hormones**
- **These hormones play important roles in regulation, metabolism, and homeostasis**

(Hypothalamus Hormone Secretion Pathway)
الخطوات:

1. إفراز هرمونات من خلايا Hypothalamus (إما releasing أو inhibiting) **axons** إلى **axon terminals** *من خلية*
2. انتقال الهرمونات عبر **axons** إلى **capillaries** *في*
3. انتشار الهرمونات (diffusion) إلى **capillaries** في **primary plexus** *في*
4. انتقال عبر **hypophyseal portal veins** إلى **secondary plexus** *في*
5. التوزيع (distribution) على target cells في **anterior pituitary** *في*

(Human Growth Hormone and IGFs)

مصادر إفراز IGFs

- from cells in*
- (Liver), (Skeletal muscles), (Cartilage), (Bones)

أنواع عمل IGFs	
النوع	الوصف
هرمونات منتشرة (Circulating hormones)	تنتقل عبر مجرى الدم (Bloodstream) من الكبد
هرمونات محلية (Local hormones)	تعمل محلياً (Locally): • Autocrine: على نفس نوع الخلايا • Paracrine: على الخلايا المجاورة

تعمل secretion IGFs
insuline growth factors
إلى علاقة بال growth metabolism

Anterior Pituitary Cells and Their Hormones

Cell Type	Hormone Secreted	Main Function
Somatotrophs	Human Growth Hormone (hGH) / Somatotropin	Stimulates secretion of Insulin-like Growth Factors (IGFs) from several tissues
Thyrotrophs	Thyroid-Stimulating Hormone (TSH) / Thyrotropin	Controls activity of thyroid gland
Gonadotrophs	Gonadotropins: ① Follicle-Stimulating Hormone (FSH) ② Luteinizing Hormone (LH) <i>both are act on gonads</i>	In females: Helps with estrogen and progesterone secretion and oocyte maturation In males: Helps with testosterone production and secretion in testes
Lactotrophs	Prolactin	Stimulates milk production in mammary glands
Corticotrophs	Adrenocorticotrophic Hormone (ACTH) / Corticotropin	Stimulates adrenal cortex to secrete glucocorticoids like cortisol

Functions of IGFs

Somatotrophy in anterior-pitu. release burst of hGH every few hours especially during sleep

1. Growth:

- Cause cells to grow and multiply
- Increase uptake of amino acids
- Accelerate protein synthesis
- Accelerate growth of skeleton and skeletal muscles during childhood and teenage years

↓ vice

2. Metabolism:

↳ & maintain mass of muscles to promote healing injuries to tissue repair

- Help with lipolysis in adipose tissue
- Breakdown fatty acids to enhance ATP production
- Help with carbohydrate metabolism by decreasing glucose uptake

يقال انه حاجه الخلايا للجلوكوز لـ ATP production

Other Factors Stimulating hGH Secretion

↳ ↑ inc. in insulin level cause

- Decrease in fatty acids
- Increase in amino acids
- Deep sleep (Stage 3 and 4) of non-rapid eye movement sleep
- Stress
- Vigorous exercise
- Anything that increases sympathetic activation in the autonomic nervous system

Regulation of hGH Secretion

- Controlled by two hypothalamic hormones:

Hormone	Effect
Growth Hormone Releasing Hormone (GHRH)	Stimulates secretion of hGH from somatotrophs
Growth Hormone Inhibiting Hormone (GHIH)	Inhibits secretion of hGH from anterior-pituitary gland

- Regulated by blood glucose level:

Condition	Effect on hGH Secretion
Hypoglycemia ↓ B.G.L	Stimulation from somatotrophs
Hyperglycemia	Inhibition

Posterior Pituitary صبيانياتش بـ

- Does not produce hormones
- Stores and releases two hormones: يتم انتاجهم وتخزينهم posterior pituitary

Hormone	Main Functions
Oxytocin	-
Antidiuretic Hormone (ADH) / Vasopressin	1. Retention of body water 2. Decrease urine volume 3. Increase blood pressure by constricting arterioles

- Blood supply via inferior hypophyseal arteries

Blood is supplied to the posterior pituitary by the inferior hypophyseal arteries, which branch from the internal carotid arteries.

Oxytocin and ADH Secretion:

- Production site:** Synthesized in neurosecretory cell bodies within the hypothalamus.
- Packaging:** Immediately packaged into secretory vesicles.
- Transport:** Vesicles travel via fast axonal transport down the axons to the posterior pituitary terminals.
- Storage:** Hormones are stored in these axon terminals until needed.
- Release mechanism:** Nerve impulses trigger exocytosis, releasing the hormones into the bloodstream.

Thyroid Gland Anatomical Description

- Shape: Butterfly-shaped
- Location: Inferior to larynx (voice box)
- Unique feature: Only endocrine gland that stores hormones in large quantities - T3 and T4

Thyroid Hormone Synthesis Steps T3, T4

Step	Description
1. Iodide trapping	Thyroid follicular cells trap iodide ions from blood plasma
2. Synthesis of Thyroglobulin (TGB)	Large glycoprotein
3. Oxidation of iodide	-
4. Iodination of tyrosine	One molecule reaction: produces Monoiodotyrosine (T1) Two molecule reaction: produces Diiodotyrosine (T2)
5. Coupling	$T2 + T2 \rightarrow T4$ $T1 + T2 \rightarrow T3$

Thyroid Hormone Functions

- Increase Basal Metabolic Rate (BMR)
- Help with protein synthesis
- Help use glucose and fatty acids for ATP production

Negative Feedback Regulation of Glucagon & Insulin

1. Hypoglycemia:

- **Stimulates Alpha cells** to secrete Glucagon.
- Glucagon promotes gluconeogenesis (glucose formation from fatty acids & amino acids) in the liver.
- Blood glucose level increases.

- **Stimulates Beta cells** to secrete Insulin.
- Insulin increases facilitated diffusion of glucose into cells, its conversion to glycogen, and protein synthesis.
- Blood glucose level decreases.
- ↑ inc uptake for amino acids
- speed up the synthesis of fatty acids

- Secretes hormones:
- **Epinephrine:** 80% of secretion.
- **Norepinephrine:** 20% of secretion.
- These hormones control the body's response to stress.

The pancreas is both:

- exocrine 99%
glands in pancreas arranged in
clusters $\rightarrow$ acini

- clusters → acini
↳ are 1–2 million tiny clusters of endocrine tissue called pancreatic islets.

Cell Type	Approx. %	Hormone Secreted	Primary Action
Alpha cells	17%	Glucagon	Raises blood glucose level. ↑
Beta cells	70%	Insulin	Lowers blood glucose level. ↓
Delta cells	7%	Somatostatin	Regulates secretion of other hormones.
F cells	Remainder of Pancreatic islets	Pancreatic Polypeptide	Regulates exocrine pancreatic activity.

Major Endocrine Disorders

1. Diabetes Insipidus:

- **Cause:** Dysfunction of the **Posterior Pituitary** gland responsible for Antidiuretic Hormone (ADH/ Vasopressin) secretion.
- Two Types:
 - **Neurogenic Diabetes Insipidus:** Hyposecretion of ADH.
 - **Nephrogenic Diabetes Insipidus:** Kidneys don't respond to ADH.
- **Possible Causes:** Brain tumor, head trauma, or brain surgery damaging the posterior pituitary or hypothalamus.
- **Main Symptom:** Secretion of large volumes of urine (Polyuria), leading to dehydration & thirst.
- **Treatment:**
 - Neurogenic: Hormone replacement therapy.
 - Nephrogenic: More complex, depends on the cause.

2. Thyroid Disorders:

- **Hypo**thyroidism: Hyposecretion of thyroid hormone.
- Congenital Hypothyroidism: Requires lifelong thyroid hormone treatment starting immediately after birth.
- **Hyper**thyroidism: Hypersecretion of thyroid hormone.
- Example: **Graves' disease:** An autoimmune disorder.
- Treatment: Antithyroid drugs, radioactive iodine, or surgical removal of part of the gland.

3. Parathyroid Disorders:

- **Hypoparathyroidism:** Deficiency of parathyroid hormone.
- Leads to low blood calcium, causing muscle spasms and contractions.
- Can occur from accidental damage during neck surgery.
- **Hyperparathyroidism:** Excess parathyroid hormone.

4. Diabetes Mellitus:

- Common Symptoms (The 3 Ps):
 - Polyuria: Excessive urine production.
 - Polydipsia: Excessive thirst.
 - Polyphagia: Excessive hunger.
 - Glycosuria: Glucose in urine.

5. Hyperinsulinism:

- **Cause:** Excess secretion of Insulin from pancreatic Beta cells.
- **Result:** Hypoglycemia.
- **Main Symptoms:** (Due to the body's secretion of Epinephrine, Glucagon, and Growth Hormone in response).
 - Anxiety, sweating, tremor, increased heart rate.
 - Hunger, weakness.

Baby is normal but the lipid soluble maternal TH cross placenta during pregnancy & allowed normal development - the baby should take Oral thyroid hormone treatment

produce antibodies mimic the action of TSH

Type	Type 1 Diabetes	Type 2 Diabetes
Description	Insulin-dependent diabetes mellitus (IDDM).	Non-insulin dependent diabetes mellitus (NIDDM).
Cause	Autoimmune destruction of pancreatic Beta cells, leading to little or no insulin production.	Insulin resistance, often with relative insulin deficiency.
Key Notes	- Can lead to ketoacidosis from buildup of ketones. - Treatment: Insulin injections, self-monitoring of blood glucose, diet control.	- Accounts for ~90% of cases. - Associated with obesity and age (often >35). - Treatment: Diet, exercise, weight loss, and sometimes drugs like Metformin or Glyburide.