



Important Doctors slides
Extra Information **Doctors notes**



Editing file



Biochemistry

Biochemistry of
Cushing Syndrome

The expert in anything
was once a beginner

OBJECTIVES

By the end of this lecture, the students should be able to know:

- To identify different causes of Cushing's syndrome
- To understand the diagnostic algorithm for Cushing's syndrome
- To understand the interpretation of laboratory and radiological tests of Cushing's syndrome

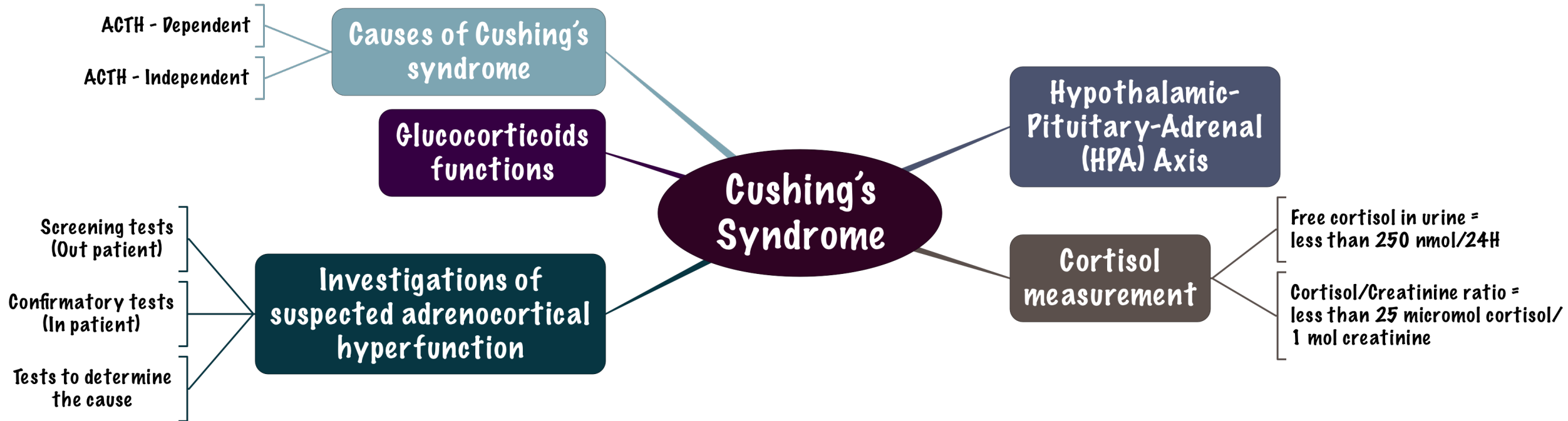
Dr. Rana:

Don't memorize Numbers or procedures

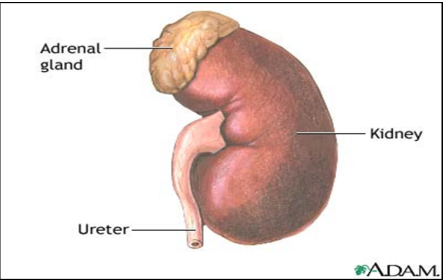
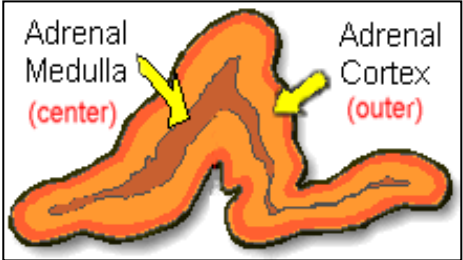
Normal ranges will be given in exam 😊



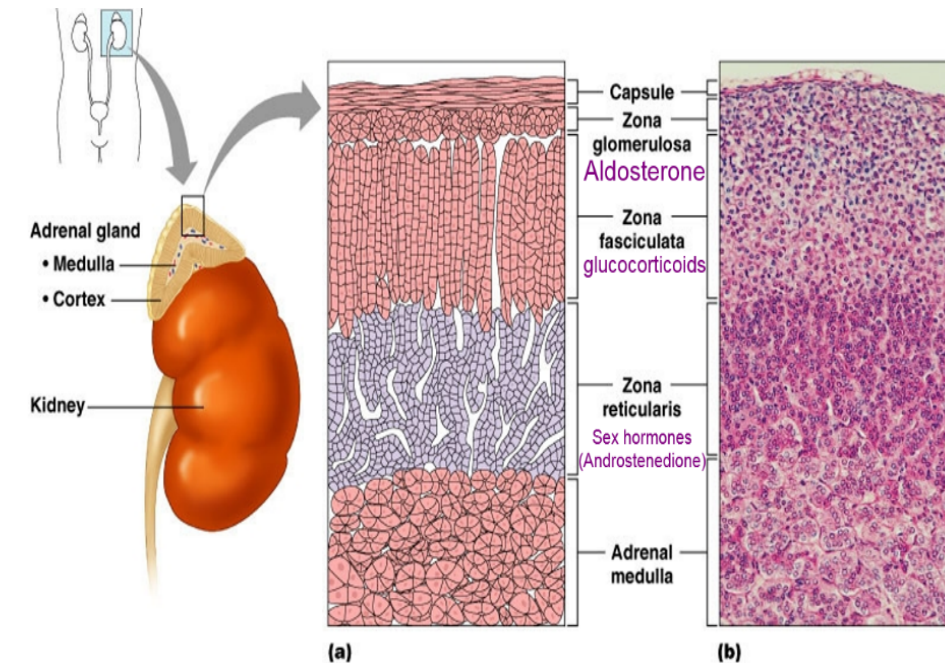
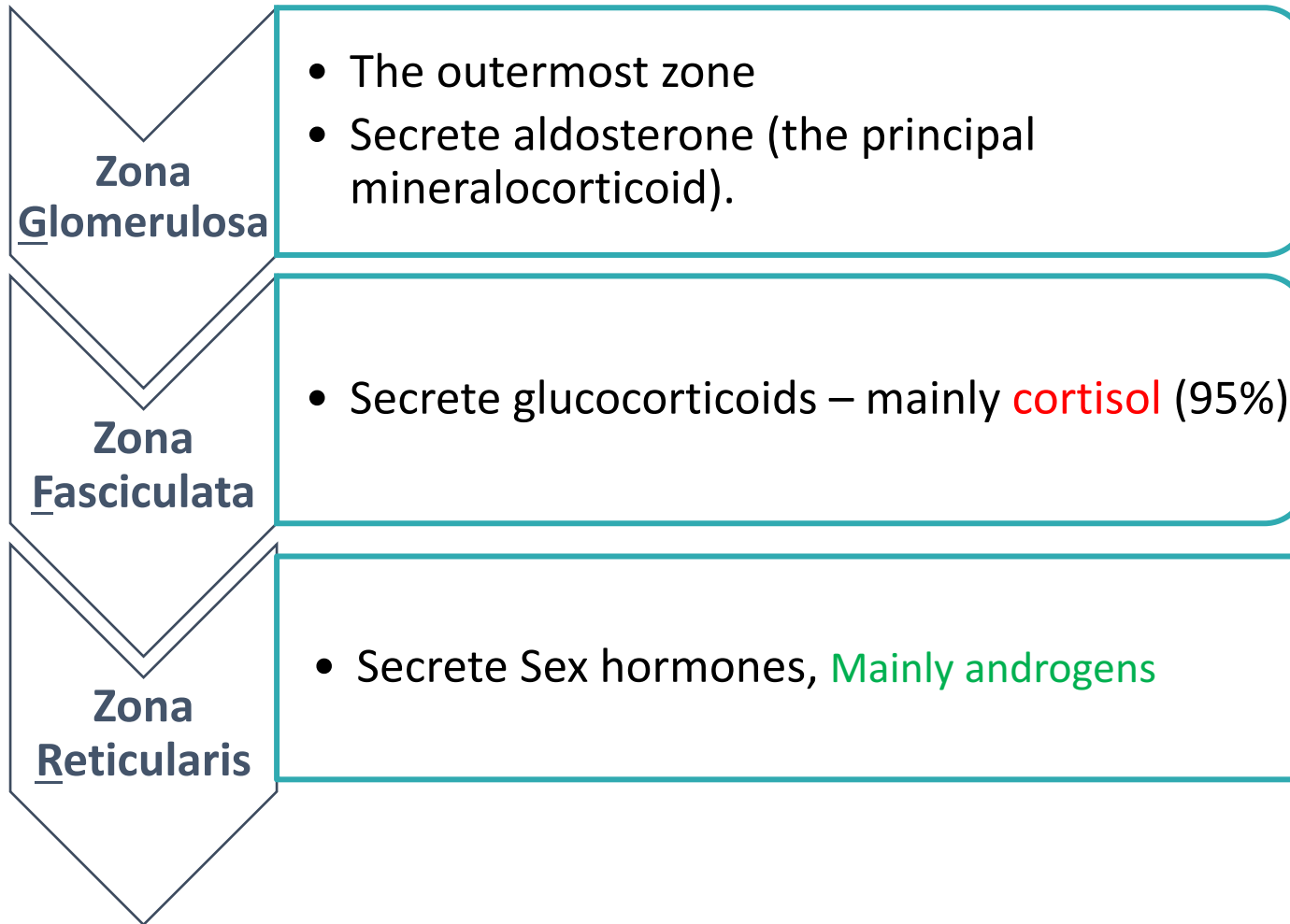
Overview



Adrenal gland “to understand better”

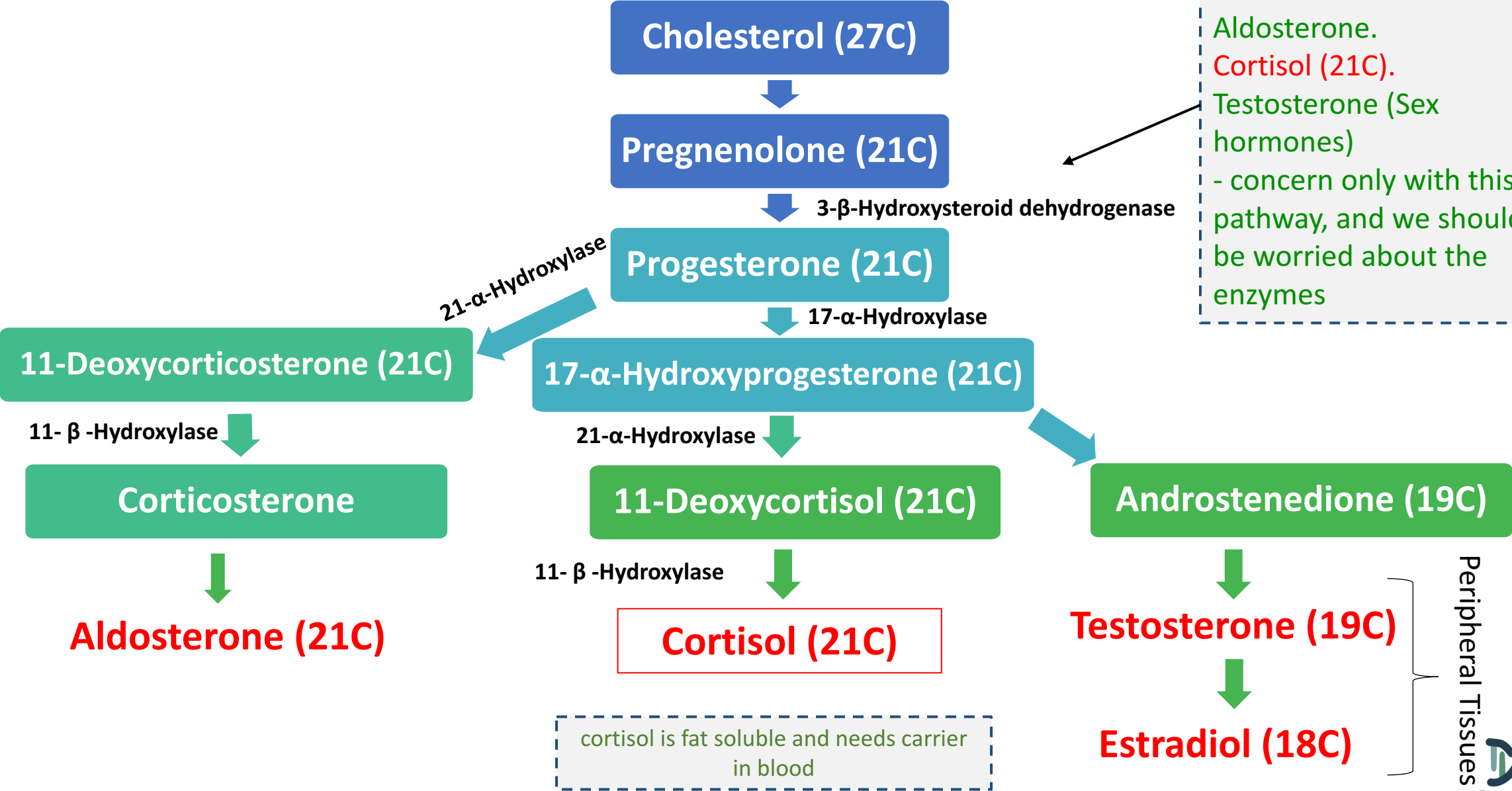
Anatomy	Histology
<p>The adrenal gland is situated on the anteriosuperior aspect of the kidney</p>	<p>The adrenal gland consists of two distinct tissues of different embryological origin, the outer cortex and inner medulla.</p>
 <p>An anatomical illustration showing the adrenal gland as a small, yellowish, triangular structure sitting atop the reddish, bean-shaped kidney. A thin tube, the ureter, is shown extending from the bottom of the kidney. Labels with leader lines point to the 'Adrenal gland', 'Kidney', and 'Ureter'. The ADAM logo is visible in the bottom right corner.</p>	 <p>A cross-sectional diagram of the adrenal gland. It shows an outer, thick, orange-colored layer labeled 'Adrenal Cortex (outer)' and an inner, darker, reddish-brown layer labeled 'Adrenal Medulla (center)'. Two yellow arrows point from the text labels to their respective parts in the diagram.</p>

Adrenal cortex zones based on cell type and function “to understand better”



From outer to inner: GFR


Steroid Hormone Synthesis



- Just know that **Cholesterol (27C)** is the precursor of 6 hormones:
Aldosterone.
Cortisol (21C).
Testosterone (Sex hormones)
- concern only with this pathway, and we shouldn't be worried about the enzymes

cortisol is fat soluble and needs carrier in blood

Peripheral Tissues



BIOCHEMISTRY TEAM 436

Hypothalamic-Pituitary-Adrenal (HPA) Axis

- The hypothalamus secretes corticotropin-releasing hormone (CRH) which stimulates the anterior pituitary gland to synthesis and release ACTH.
- ACTH acts on the **zona fasciculata cells** → release of **glucocorticoids (Cortisol)**.
- Hypothalamus > release CRH > ACTH release > stimulates zona fasciculata > produce glucocorticoids

❖ Regulation of ACTH and Cortisol Secretion:

1. Negative feedback control:	<ul style="list-style-type: none">• ACTH release from the anterior pituitary is stimulated by hypothalamic secretion of corticotrophin releasing hormone (CRH).<ul style="list-style-type: none">• CRH → ↑ ACTH → ↑[Cortisol]• ↑[Cortisol] or synthetic steroid suppress CRH & ACTH secretion
2. Stress: (e.g. major surgery, emotional stress)	<ul style="list-style-type: none">• Stress → ↑ CRH & ACTH → ↑ Cortisol
3. The diurnal rhythm of plasma cortisol:	<ul style="list-style-type: none">• Highest Cortisol level in the morning (8 - 9 AM).• Lowest Cortisol level in the late afternoon and evening (8 - 9 PM).

If someone is taking exogenous cortisol drugs and want to stop the drug, it has to be stopped gradually, because the exogenous cortisol will result in –ve feedback on hypothalamus & pituitary which will lead to stopping their normal secretion so, we have to give them chance to secrete their hormones again.

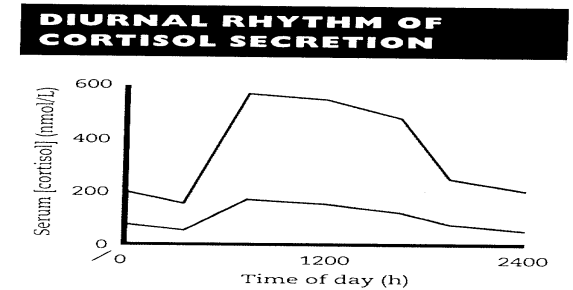
Hypothalamic-Pituitary-Adrenal (HPA) Axis

- The diurnal rhythm of cortisol secretion; the area between the curves represents values that lie within the reference range

❖ Plasma [CBG] :

- It's either protein bound and unbound
- In the circulation, glucocorticoids are mainly **protein-bound** (about 90%), chiefly to **cortisol-binding globulin** (CBG or transcortin).
- The biologically active fraction of cortisol in plasma is the free (unbound) component. (10% unbound and it is the active form)

Increases	Decreases
Pregnancy and estrogen treatment (e.g. oral contraceptives)	Hypoproteinemic states (nephrotic syndrome) proteins filtrated by the kidney



Free cortisol features:
Excreted in urine
Acts on tissue
Goes through hepatic
metabolism

❖ Serum [cortisol] and plasma [ACTH]:

- Serum measurement is preferred for cortisol and Plasma for ACTH.
- Samples must be collected (without venous stasis to avoid stress, which increase cortisol secretion) between 8 a.m. and 9 a.m. and between 10 p.m. and 12 p.m. because of the diurnal rhythm. (Cortisol secretion is constant in the these periods)
- Temporary ↑ in these hormones may be observed as a response to emotional stress,

• بسبب خوف من الإبر والمستشفى مثلاً

10% of cortisol is excreted in urine and this is what we measure. Most patient don't have compliance for UFC (because they have to collect urine for 24 hours otherwise it will not give us accurate result) so we do Cortisol/creatinine Which depend only in one urine sample.

Cortisol and ACTH measurements

❖ Urinary cortisol excretion :



- A small amount of cortisol is excreted unchanged in the urine (UFC).
- In normal individuals:
- Urinary free cortisol (UFC) is **< 250 nmol/24 h.**
- Cortisol / Creatinine ratio in an early morning specimen of urine is **< 25 μmol cortisol / mol creatinine.** الارقام اللي بالأحمر تحفظ

If someone came sweating or fasting he'll have concentrated urine:
↑cortisol ↑creatinine ↓volume
The result of cortisol/volume is false high

If someone drank a lot of water he'll have diluted urine:
↓cortisol ↓creatinine ↑volume
The result of cortisol/volume is false low

So, to have an accurate result we do Cortisol/creatinine

CAUSES OF ADRENOCORTICAL HYPERFUNCTION: CUSHING'S SYNDROME

ACTH - dependent :	<ol style="list-style-type: none"> 1. ↑ Pituitary ACTH 70% (Cushing's disease) 2. Ectopic ACTH by neoplasms 10%.
ACTH - independent :	<ol style="list-style-type: none"> 1. Adrenal tumor 20% (adenoma or carcinoma) 2. Glucocorticoid therapy. (eg.contraceptives)

The most common. This is the only case in which we call it "Disease" instead of "Syndrome".

Ectopic Neoplasm: Neoplastic cells release ACTH

❖ Causes of elevated serum cortisol concentrations:

1. Increased cortisol secretion:	Cushing's syndrome
	Exercise
	Stress, Anxiety, Depression
	Obesity
	Alcohol abuse
	Chronic renal failure
2. Increased cortisol binding globulin (CBG)	Congenital
	Estrogen therapy
	Pregnancy

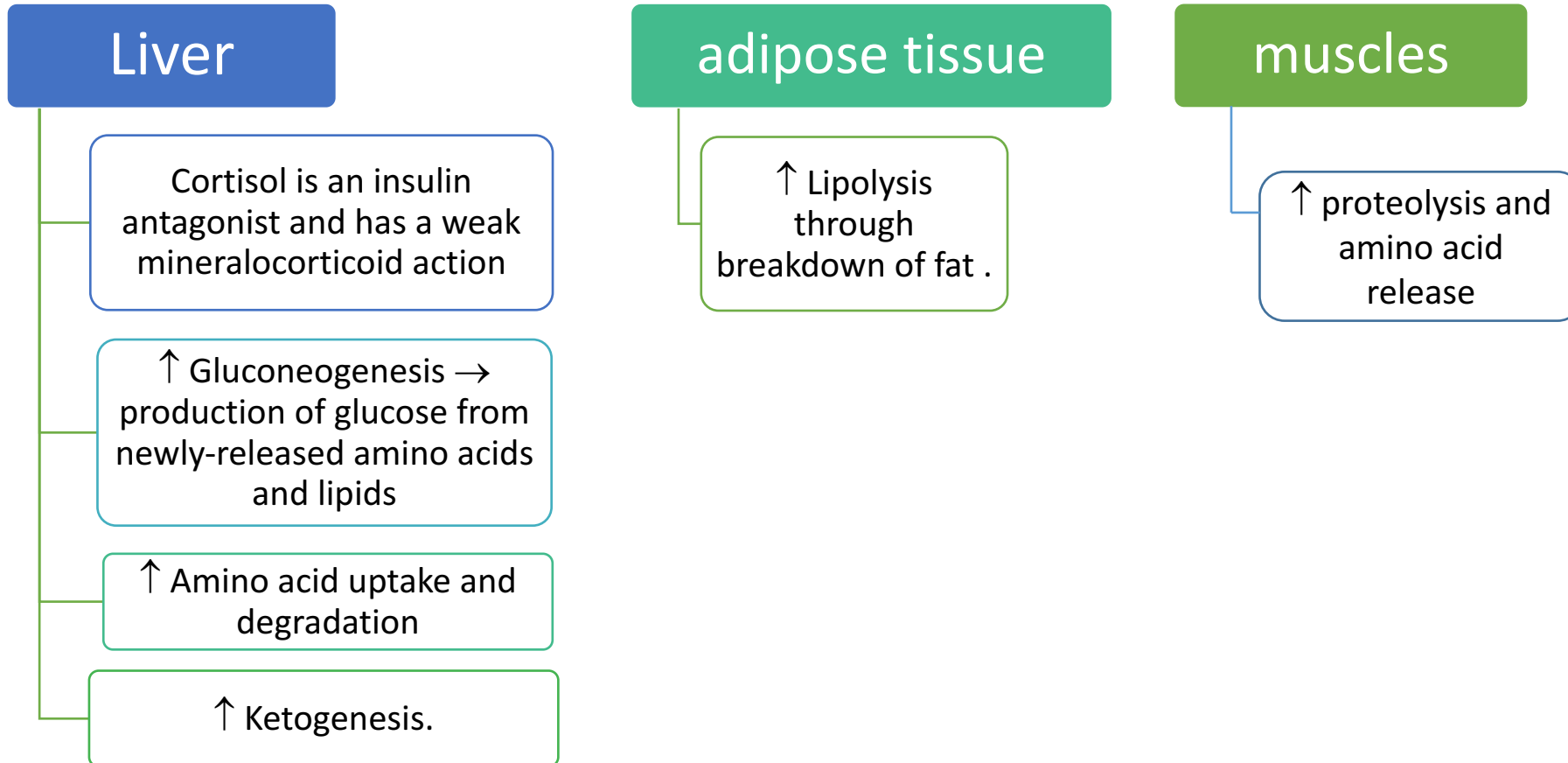
True Cushing's syndrome

pseudo-Cushing's syndrome

الكورتيزول الموجود في السيرم يزيد يا اما بزيادة الافراز من الأساس او بزيادة نسبة CBG وكل واحد منهم له أسبابه الموضحة في الجدول

Glucocorticoid functions

- Glucocorticoids have widespread metabolic effects on carbohydrate, fat and protein metabolism.
- Upon binding to its target, CORTISOL enhances metabolism in several ways:



- Conserving glucose: by inhibiting uptake into muscle and fat cells.

Symptoms

1. **Weight gain**: trunk and face with sparing of the limbs (central obesity).
2. Buffalo's hump*.
3. **Moon face**.
4. Excessive sweating.
5. Atrophy of the skin and mucous membranes.
6. **Purple striae*** on the trunk and legs.
7. Proximal muscle weakness (hips, shoulders).
8. **Hirsutism***
9. The excess cortisol may also affect other endocrine systems: ↓libido, amenorrhoea and infertility.
10. Patients frequently suffer various psychological disturbances ranging from euphoria to frank psychosis.

Signs

1. **Loss of diurnal rhythm of cortisol and ACTH.**
2. **Hypertension** (due to the aldosterone - like effects).
3. **Hyperglycemia** or diabetes due to insulin resistance.
4. Hypokalemic **alkalosis**. (aldosterone)
5. ↑protein metabolism.
6. Impaired immunity.

- * Buffalo hump, is extra fat around the neck and upper part of the back
- * purple lesions, which can appear anywhere on the body, but are most likely to appear in places where larger amounts of fat are stored
- *Hirsutism is a condition of unwanted, male-pattern hair growth in women

Investigations of suspected adrenocortical hyperfunction

A. Screening tests (out-patient):	to assess the clinical diagnosis of adrenocortical hyperfunction.
B. Confirmatory tests (in-patient):	to confirm or exclude the provisional diagnosis. (to Distinguish between Pseudo Cushing and real Cushing syndrome)
C. Tests to determine the cause: to ascertain:	(a) The site of the pathological lesion (adrenal cortex, pituitary or elsewhere?)
	(b) The nature of the pathological lesion. (Malignant or benign)
These tests are <u>all used together</u> : the first one to know whether the patient has cushing's disease or not then the second to know the type of the disease then the third	

If patient complains of Obesity, depression, fatigue slow & hirsutism
Our differential diagnosis going to be:
Cushing syndrome, Depression, Polycystic ovarian syndrome or
hypothyroidism . The screening test is used to tell weather the
cause is the Cushing syndrome or not

Cushing syndrome patient
usually come to clinics
Addison's disease patient
usually come to ER (life-
threatening)

A. Screening tests:

Effective screening tests need to be **sensitive** but **do not have to be highly specific**.

It includes:

1. **Low-dose dexamethasone* (DXM) suppression test (DST):** (Overnight suppression test). $DXM \rightarrow \downarrow CRH \rightarrow \downarrow ACTH \rightarrow \downarrow cortisol$
2. **24-hour urinary free cortisol**

Details are explained below

* Dexamethasone: Synthetic Cortisol

Low dose of DXM اذا اعطيناه بعني الزيدة

Normal person = Suppression of cortisol

Cushing syndrome = NO suppression

لو ماصار سبرشن ندخل البيشنت المستشفى ونسوي confirmatory test

1. Low-dose DST: (outpatient procedure)

Procedure "Not important"	<ul style="list-style-type: none"> - 1 mg DXM administered at 11-12 PM the night before attending the clinic. - serum cortisol is measured at 8-9 AM.
Result	Cortisol < 50 nmol/L (suppression) → exclude hypercortisolnemia (Cushing Syndrome)
Precautions	<p>Drugs that induce hepatic microsomal enzymes (Phenobarbitone & phenytoin) → ↑ DXM metabolism and ↓ DXM blood level to achieve CRH suppression (false diagnosis of Cushing).</p>

A. Screening tests: Cont'D

2. 24- hour urinary free cortisol:	
Disadvantage	incomplete collection of urine → a false-negative result.
Result	Cortisol < 250 nmol/day → exclude Cushing Syndrome.
An alternative is to determine the urinary cortisol	creatinine ratio on an early morning specimen

Interpretation of screening tests	
The screening tests serve to	distinguish simple non-endocrine obesity from obesity due to Cushing's syndrome.
Pseudo-Cushing's syndrome	<ul style="list-style-type: none">✓ Depressed or extremely anxious patients✓ Severe intercurrent illness✓ Alcoholism
Confirmatory tests (in-patient basis) are required to rule out pseudo-Cushing's syndrome	

B. Confirmatory tests: (Inpatient)

❖ Insulin-induced hypoglycemia :

- To distinguish true Cushing's syndrome from pseudo-Cushing's syndrome
- To test the integrity of the hypothalamic-pituitary-adrenal (HPA) axis.
- Contraindicated in: epilepsy or heart disease.
- Hypoglycemia \rightarrow \uparrow CRH \rightarrow \uparrow ACTH \rightarrow \uparrow cortisol
- True Cushing patients:
No response to hypoglycemia, (or not significant)
- Pseudo-Cushing patients show abnormal diurnal rhythm of S. cortisol, but, with Insulin-induced hypoglycemia \rightarrow \uparrow CRH, ACTH and cortisol blood levels

Pseudo-Cushing and true Cushing
عشان نفرق بين
نعطي البيشنت انسولين, لو هو
ما عنده كوشنق
hypoglycemia الكورتزول بيرتفع
عشان يعدل
But if he has cushing = No
further increase in cortisol
(NO response)

Insulin hypoglycemia test Cont'd

❖ Procedure:

For reading

- Insulin I.V. (0.15 U/kg) to lower blood glucose to 2.2 mmol/L or less .
- Samples for simultaneous measurement of serum glucose and cortisol levels are taken basally (before insulin injection) and at 30, 45, 60 and 90 min after I.V. insulin injection.
- Failure to achieve a glucose level of 2.2 mmol/L invalidates the test and should be repeated with increment in step of 0.05U/kg. (NO need to know about it)

Interpretation of the results

Normally

- Basal serum cortisol: at least 145 nmol/L
- At 60 - 90 minutes: the level > 425 nmol/L

Patients with Cushing's syndrome

- Whatever the cause, **do not respond** normally to insulin-induced hypoglycemia.
 - High basal serum cortisol than normal .
 - At 60 - 90 minutes: no increase in S. cortisol, despite the production of an adequate degree of hypoglycemia.

C. Tests used to determine the cause of Cushing's syndrome:

1. To differentiate ACTH-dependant from ACTH-independent:

- [Plasma ACTH \(Diurnal rhythm\)](#)

The difference in ACTH levels in Cushing disease and Ectopic tumor due to: Neoplastic cells are so many and there is NO control in ACTH releasing at all. While in Cushing Disease (problem in Pituitary) there have to be some -ve feedback (may be very small but it will affect the level that will prevent it from Jumping to sky-high level).

1. Plasma [ACTH]:

Undetectable = 0	↑↑ ACTH = little bit high	↑↑↑↑ ACTH = very high
Functional adrenal tumor → confirmed by an abdominal CT scan to detect an adrenal mass. <div style="border: 1px dashed green; padding: 2px; display: inline-block;">Because of -ve feedback</div>	Cushing's disease (pituitary-dependent).	Ectopic (non-endocrine) origin of ACTH.

C. Tests used to determine the cause ... Cont'd :

2. To distinguish between ACTH-dependent causes (Pituitary Vs Lung):

- a) High-dose DST.
- b) CRH stimulation test

2 (a) High-dose DST

Suppression

is defined as a fall to less than 50 % of basal value

○ It is used to distinguish Cushing's disease from ectopic ACTH secretion.

- 2 mg dexamethasone six-hourly (every 6 hours) for 48 hours to suppress cortisol secretion.
- Basal (pre-dexamethasone) serum cortisol or 24-hour urine free cortisol is compared with the results at the end of the 48-hour period.
- About 90 % of patients with Cushing's disease show suppression of cortisol output.
- In contrast, only 10% of patients with ectopic ACTH production (or with adrenal tumors) show suppression.

Pituitary Adenoma (Cushing's disease)

Low dose DXM → No Response (No suppression)

High dose DXM → Starts to respond (starts to suppress)

High dose of DST
يعني باختصار اذا اعطينا
البيشنت :

Cushing disease: SUPPRESSION of cortisol (90%)

Ectopic: NO suppression of cortisol (90%)

C. Tests used to determine the cause ... Cont'd :

2 (b) CRH stimulation test:

Procedure: "Not important"

- Measures the ACTH and cortisol levels basally and 60 minutes after injection of 100 µg CRH
- In Cushing's disease: High-dose dexamethasone suppression test + the CRH test =100% sensitivity and specificity.

يعني هنا نكون تأكدنا ان المريض عنده كوشنق دزيز

Because the pituitary is the only one that directly affected CRH

Ectopic ACTH & adrenal tumors	Cushing's disease
No response	↑ ACTH & cortisol above basal at 60 min.
False-positive responses are unusual	10% of patients fail to respond

C. Tests used to determine the cause ... Cont'd :

3. Radiological tests:

MRI of pituitary and ultrasound or CT of adrenals

3. Radiological Investigations:

CT scanning of the adrenal glands/ Lungs

MRI of the pituitary gland

❖ Other blood tests :

- commonly performed for patients suspected to have Cushing's syndrome are:

Full blood count

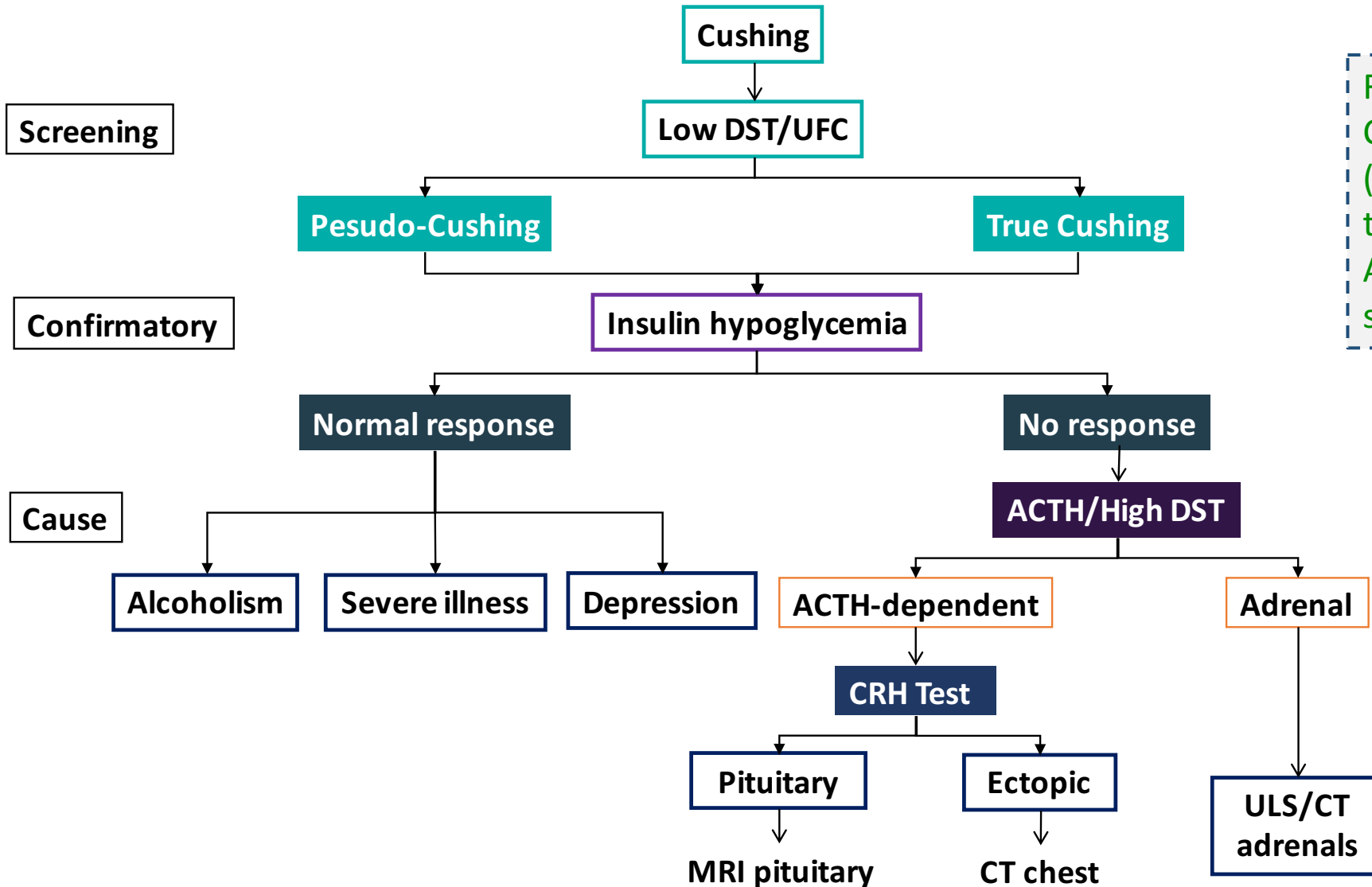
Blood glucose

Blood electrolytes and pH

Renal function tests

Liver function tests

Cushing's Syndrome



For diagnosis we use
Cushing syndrome
(hyperfunctioning): suppression
tests.
Adrenocortical hypofunctioning:
stimulation tests.

Adrenal Hyperfunction (Summary of Biochemical Tests):

This table is Important

Test	Cushing's disease	Adrenal tumor	Ectopic ACTH secreting tumor
S. cortisol	↑	↑	↑
Low dose DST	Not suppressed	Not suppressed	Not suppressed
Urinary cortisol	↑	↑	↑
Diurnal rhythm	Lost	Lost	Lost
Insulin-induced hypoglycemia	No response	No response	No response
Plasma [ACTH]	Normal or ↑	Not detectable	↑↑↑
High dose DST	suppressed	Not suppressed	Not suppressed
CRH test	↑	No response	No response

Case study

- 58 years old man was admitted with weight loss and respiratory distress. He had increased pigmentation and BP was 140/80.

Lab tests :

Urea	8.6	(2.5-7 mmol/L)
Sodium	144	(135-145 mmol/L)
Potassium	2.0	(3.5-4.5 mmol/L)
Cortisol	1650	(150-550 nmol/L)
Post overnight DXM1530		(<50nmol/L)

Diagnosis : Ectopic ACTH

- Further investigation revealed the following:

DXM suppression test	Basal	after 48 h 0.5 mg qid	after 48h 2.0 mg qid
Serum cortisol	1350	1420	1100 No suppression
	8 am	22.00 pm	Loss of diurnal rhythm
Plasma ACTH (ng/L)	220	180	Ref. range: 7-51

CRH showed flat response for cortisol and ACTH.

Flat response: no response

Take Home Message

- Disorders of the adrenals are uncommon.
- Sensitive screening tests for adrenocortical functions are important.
- Additional confirmatory tests are required to establish the diagnosis and rule out pseudo-Cushing.
- Other biochemical tests and radiological investigation are required to determine the cause of Cushing's syndrome.

Summary

Regulation of ACTH and Cortisol Secretion	1- - Negative feedback CRH → ↑ ACTH ↑ [Cortisol]	<u>CAUSES OF ADRENOCORTICAL HYPERFUNCTION: CUSHING'S SYNDROME</u>	
	2- stress ↑CRH & ACTH → ↑ Cortisol	<u>ACTH – dependent</u> 1. ↑Pituitary ACTH 70% (Cushing's disease). 2. Ectopic ACTH by neoplasms 10%. 3. ACTH therapy.	<u>ACTH – independent</u> 1-Adrenal tumor 20% (adenoma or carcinoma) 2. Glucocorticoid therapy.
	3- The diurnal rhythm of plasma cortisol ↑ Cortisol level in the morning, ↓ Cortisol level in the late afternoon and evening		
Glucocorticoid Functions	In the muscles : Cortisol ↑ proteolysis and amino acid release		
	In the adipose : tissue: Cortisol ↑ Lipolysis through breakdown of fat		
	In the liver : Cortisol is an insulin antagonist and has a weak mineralocorticoid action 1- ↑ Gluconeogenesis 2- ↑Amino acid uptake and degradation 3- ↑ Ketogenesis.		
Cushing's Syndrome	Symptoms 1- Weight gain: (central obesity) 2- Moon face 3- Excessive sweating 4- Purple striae on the trunk and legs 5- Proximal muscle weakness (hips, shoulders)		
	Signs 1- Loss of diurnal rhythm of cortisol and ACTH. 2- Hypertension 3- Hyperglycemia. 4- Hypokalemic alkalosis 5- protein metabolism. 6- Impaired immunity		

Summary

Investigations Of Suspected Adrenocortical Hyperfunction

A- Screening tests (out-patient): to assess the clinical diagnosis of adrenocortical hyperfunction

1-**Low-dose dexamethasone (DXM) suppression test** → **Result:** Cortisol < 50 nmol/L . exclude Cushing's disease

- 2- **24- hour urinary free cortisol** **Result:** Cortisol < 250 nmol/day exclude Cushing's disease.

B. Confirmatory tests (in-patient): to confirm or exclude the provisional diagnosis by Insulin-induced hypoglycemia

1- Pseudo-Cushing patients → Insulin induced hypoglycemia → ↑CRH, ACTH and cortisol blood levels

2- True Cushing patients: No response to hypoglycemia

C. Tests used to determine the cause of Cushing's syndrome

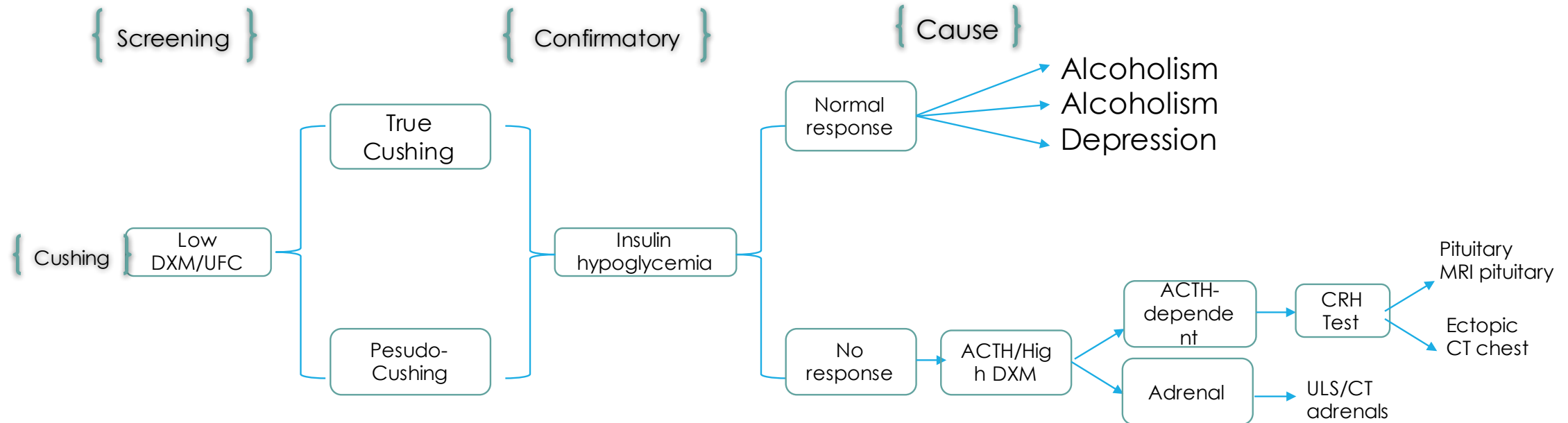
1- High-dose DST

2- CRH stimulation test

Undetectable Functional adrenal tumor

↑ACTH Cushing's disease (pituitary dependent)

↑↑↑↑ACTH Ectopic (nonendocrine) origin of ACTH



QUIZ

Q1 : Which of the following tests is used as a confirmatory test for Cushing's syndrome of ectopic origin?

- A. Low Dose Dexamethasone
- B. High Dose Dexamethasone
- C. Induced Hyperglycemia
- D. Urinary Cortisol

Q2 : 29 year old female patient, came to the clinic with a history of increased facial hair over the past year.

Her husband mentioned that she is having mood swings and her face seems to have become round. They also mentioned that they are not very financially capable. Which of the following tests would you order to confirm your diagnosis of Cushing's Syndrome ?

- A. Insulin Induced Hypoglycemia
- B. CRH Suppression
- C. CBC + MRI + CT + Blood Glucose + LFT + Ultrasound
- D. Low Dose Dexamethasone

Q3 : Which one of the following is correct in a patient with an ectopic ACTH secreting tumor?

- A. Low dose dexamethasone suppresses cortisol secretion.
- B. The tumor's ACTH secretion is more sensitive to Negative feedback.
- C. High dose dexamethasone shows no suppression of cortisol.
- D. MRI shows enlarged pituitary gland.

Q4 : In case of insulin induced hypoglycemia in a patient with Pseudo Cushing, which of the following is false?

- A. Increased Serum CRH.
- B. Increased Serum ACTH
- C. Increased Serum Cortisol
- D. Increased Serum Aldosterone.

Q5 : Which of the following describes true Cushing's disease?

- A. Increased Serum cortisol with Normal Plasma ACTH
- B. No response to Hypoglycemia & sky high Plasma ACTH
- C. No response to CRH test & Increased Urinary cortisol
- D. Increased serum cortisol & suppression upon CRH test administration.

Q6 : 7 year old girl, came with her parents in the clinic for a routine visit. Their chief complain was that she is not able to sleep well for the past 3 months.

Which of the following tests would you order to know what is wrong with her?

- A. Insulin induced hypoglycemia
- B. CRH stimulation
- C. Urinary cortisol
- D. High dose dexamethasone

QUIZ

Q7 : 38 year old woman, admitted with hyperglycemia and increased serum cortisol.

There was no response upon inducing hypoglycemia with insulin and the plasma ACTH was normal

Upon administration with high dose of DST the serum cortisol was suppressed.

Which of the following is a correct diagnosis?

- A. Adrenal tumor
- B. Cushing's Disease
- C. Primary adrenal insufficiency
- D. Pseudo-Cushing

Q8 : 29 year old male patient, came to the clinic with a history of increased facial hair over the past year, and purple striae on his abdomen.

Lab results revealed cortisol level to be 780nmol/L (Normal is 150-550). Plasma ACTH was 1200 (normal is 7-51)

There was no hypoglycemia upon insulin induction, High dose DST showed no response & CRH test also showed no response.

Which of the following might be the correct diagnosis?

- A. Secondary adrenal insufficiency
- B. Pseudo-Cushing
- C. Ectopic ACTH secreting tumor
- D. Cushing's disease

Q9 : 41 year old male patient, came to the clinic with a history of increased facial hair over the past year, and purple striae on his abdomen.

Lab results revealed cortisol level to be 650nmol/L (Normal is 150-550). Plasma ACTH was 3 (normal is 7-51). There was no hypoglycemia upon insulin induction, High dose DST showed no response & CRH test also showed no response.

Which of the following might be the correct diagnosis? ?

- A. Adrenal tumor
- B. Cushing's Disease
- C. Primary adrenal insufficiency
- D. Pseudo-Cushing

Q11 : 70 Year old female, came to the clinic with complains of abnormal sleeping times.

Upon administration of insulin, her CRH, ACTH & cortisol levels all increased.

Which of the following is a correct diagnosis?

- A. Adrenal tumor
- B. Cushing's Disease
- C. Primary adrenal insufficiency
- D. Pseudo-Cushing

QUIZ

Q12 : 55 year old female came to your clinic.

She says that she came because she has been feeling depressed lately. She also mentioned that she loves to drink alcohol a lot these days.

A) Mention 3 causes of Pseudo-Cushing.

Alcoholism, Severe illness, Depression

B) Mention the test used to differentiate between Pseudo and true Cushing's Syndrome and what type is it ?

Insulin induced hypoglycemia, it is a confirmatory test.

C) Are there any contraindications to this test?

Yes, it can't be used for patients with epilepsy or heart diseases

D) What is plasma ACTH used for?

It's used as a test to differentiate between causes of Cushing's syndrome for example: Cushing's disease, Ectopic ACTH secreting tumors & Functional adrenal tumors.

*Suggestions and
recommendations*

1) B 2) A 3) C 4) D 5) A 6) C 7) B 9) C 10) A 11) D

TEAM LEADERS

Mohammad Almutlaq
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THANK YOU

FOR CHECKING
OUR WORK

PLEASE CONTACT
US IF YOU HAVE
ANY ISSUE

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