

Adrenal Gland

Adrenal Cortex

Adrenal Medulla



- G - Zona Glomerulosa (Mineralocorticoids) → Aldosterone
- F - Zona Fasciculata (Glucocorticoids) → Cortisol
- R - Zona Reticularis (Sex hormones)
 - Oestrogen
 - Androgen

More Deeper you go more "sweeter" it is

Adrenal Medulla (Catecholamine)

↳ Adrenaline → Epinephrine

→ Nonadrenalin → Norepinephrine

Cushing's Syndrome

(Hypercortisolism)

- It is an endocrine disorder with elevated cortisol levels in the blood due to the disease of adrenal cortex (zona fasciculata) like adenoma, carcinoma or hyperplasia.
- When it is due to the ↑ ACTH from pituitary then it is called Cushing's Disease.
- Free cortisol is part of circadian rhythm, which is peak in the morning and drop in evening.

Cortisol

- i) ↑ Gluconeogenesis ii) ↑ Proteolysis iii) lipolysis.
- iv) Maintains blood pressure by ↑ sensitivity of blood vessels to catecholamines.
- v) Dampens inflammatory & Immune response by ↓ Prostaglandin & Interleukins & T-lymphocytes.
- vi) Influences mood & Memory.

Causes

- i) Adrenal Cushing Syndrome (Adenoma, Carcinoma)
- ii) Pituitary Cushing disease (↑ ACTH → ↑ Cortisol)
- iii) Ectopic Cushing (Small Cell Lung Cancer);
- iv) Iatrogenic cause (Steroids to treat autoimmune & inflammatory disease (Asthma RA))

Pathophysiology

↑ Cortisol



- i) Severe muscle, Bone & Skin breakdown (Proteolysis)
- ii) ↑ Blood Glucose levels → ↑ Insulin levels.

↓
Targets adipocytes in centre of body →
↓
Activates lipoprotein lipase → Central Obesity.

iii) Hypertension

↓
By ↑ sensitivity of Blood vessels to catecholamines
↓
Cortisol cross react with mineralocorticoid
receptors which is same in structure to it-
Caldosterone

iv) Inhibit Gonadotrophin releasing hormone
↓
↓
↓ ovarian & Testicular function

v) Dampens inflammatory response

↓
More susceptible to infections

vi) Impair brain function

Symptoms

i) Proteolysis → Muscle wasting,
Thin extremities

Easy Bruising

Abdominal striae

Fractures, osteoporosis

ii) Lipid metabolism

→ Round "Full Moon" Face

→ "Buffalo hump"

→ Central obesity

iii) Hyperglycemia → Diabetes Mellitus; C#s di

iv) Amenorrhoea

v) ↑ Vulnerability to infection

vi) Psychiatric disturbances

vii) Risk for Cardiovascular disease

Diagnosis:

→ Measuring Free Cortisol.

→ 24 hr Urine sample.

→ Blood on Saliva test at night (to find the rise and fall)

Prognosis:

for Dexamethasone Suppression test.

Low Dose of Dexamethasone (Exogenous steroid).
(Suppress ACTH production)

↓
~~Should cause ↓ Cortisol levels~~ Positive in Tatrogenic.

→ If not ↓ Cortisol then

ACTH levels checks:

↳ Low ACTH → Adrenal Adenoma & Carcinoma.

→ High ACTH → Cushing disease & Ectopic

High dose of dexamethasone

↓ ACTH

↑ ACTH

Pituitary

Ectopic.

Imaging:

MRI of Pituitary → Disease

CT of Adrenal → Adenoma

CT of chest, Abdomen & Pelvis → Ectopic

Treatment:

i) Exogenous → Medications

↳ Drug is gradually decreased to avoid adrenal crisis as the glands are shrinken and body needs exogenous cortisol to function

ii) Pituitary → Surgery, NO Adrenal steroid

Addison's Disease

Primary Adrenocortical insufficiency:

- It is the disease in which the adrenal cortex is progressively damaged.
- Usually associated with other autoimmune diseases like Type 1 diabetes, Pernicious anemia, Myxedema.
- Associated with HLA DR3 & HLA D88

Causes:

1) Primary:

- Autoimmune destruction
- Tuberculosis from lungs
- Metastasis of cancer
- Adrenal hemorrhage (Waterhouse-Friderichsen syndrome)
- Bilateral adrenalectomy

2) Secondary:

- Hypopituitarism
- Sheehan's syndrome

Pathology:

- Destruction by autoimmune of all the three layers mainly the first two and sex hormones are rarely taken

→ Symptoms usually starts way later as it always has a reserve

Symptoms $\rightarrow$ Depend on the layers affected.

i) Zona Glomerulosa $\rightarrow$ Aldosterone falls.

$\rightarrow$ $\uparrow$ Hypokalemia $\rightarrow$ $\downarrow$ Hyponatremia $\rightarrow$ $\downarrow$ Hypovolemia
 $\rightarrow$ $\downarrow$ Hypotension, $\rightarrow$ High H^+ (Metabolic acidosis)

$\rightarrow$ Craving for salty foods, Nausea, Vomiting.
Fatigue, Dizziness while standing.

ii) Zona Fasciculata $\rightarrow$ Cortisol falls.

$\rightarrow$ low Blood Glucose in stress $\rightarrow$ Fatigue
Weak, fixed, disoriented.

$\rightarrow$ Pituitary Gland overactive (Nelson's Syndrome)
due to adrenalectomy

$\downarrow$ Produces $\leftarrow$
Proopiomelanocortin (Precursor)

ACTH

Melanocyte stimulating hormone (MSH)

$\downarrow$
Hyperpigmentation in the exposed areas (hands, joints)

iii) Zona reticularis $\rightarrow$ Androgen Falls

Men $\rightarrow$ Not affected because major source testes

Women $\rightarrow$ Loss of pubic & axillary hair, $\downarrow$ Sex drive

Addisonian crisis (Acute Primary Adrenal insufficiency) (Adrenal Apoplexy)

$\rightarrow$ During any major stress (Trauma, surgery, infection)

$\rightarrow$ It is usually after missed or ignored.

$\rightarrow$ Sudden withdrawal of glucocorticoids

CHF: Pain in back, abdomen, legs, $\downarrow$ BP

vomiting, diarrhea, shock, death

$\rightarrow$ May be also caused by Waterhouse-Friedrichsen syndrome due to meningococcal septicemia, $\uparrow$ BP $\rightarrow$

Vessel rupture $\rightarrow$ Toxemia

Diagnosis:

→ ACTH stimulation test
measure cortisol and aldosterone
produced

Treatment:

→ Cortisol & Aldosterone & Androgen
for life

- If stopped it produces Addisonian crisis.

Primary Hyperaldosteronism

Conn's Syndrome

- Endocrine disorder in which the zona glomerulosa
of the adrenal cortex produces excess of Aldosterone
than the normal

Causes:-

i) Primary:-

a) Idiopathic Hyperaldosteronism (due to
adrenal hyperplasia)

b) Conn's Syndrome (Adenoma, secreting aldosterone)

c) Familial Hyperaldosteronism

ii) Secondary:-

outside the adrenal due to low BP → ↑ Renin & ↑ Aldosterone

a) Congestive heart failure, Cirrhosis

b) Renal artery stenosis

c) Prolonged use of diuretics

Clinical features:

i) Hypokalemia

→ Constipation

→ Weakness, heart rhythm changes

i) Hyponatremia

ii) Hypertension $\rightarrow$ Flushing, headache

iv) Alkalosis $\rightarrow$ low H^+ (Metabolic).

- Conn Syndrome patient do not have edema.

This phenomenon is called mineralocorticoid escape.

Diagnosis:

* Measure the levels of Renin & Aldosterone.

i) Primary $\rightarrow$ $\uparrow$ Aldosterone & $\downarrow$ Renin

ii) Secondary $\rightarrow$ $\uparrow$ Aldosterone; $\uparrow$ Renin.

Treatment:

- Surgery, Managing heart failure & cirrhosis.

ADRENAL MEDULLA

Pheochromocytoma (Paranganglioma Tumor in Sympathetic ganglia)
 $\downarrow$
Dark colour cell tumor.

- Rare endocrine adrenal gland tumor where the cells darken in colour when they form tumor.

- Adrenal medulla has chromaffin cells which secrete catecholamine (Epinephrine & Norepinephrine).

Fight or flight $\rightarrow$ $\uparrow$ Blood sugar.
 $\downarrow$ $\downarrow$ Dilated pupil
 $\uparrow$ Cardiac output $\uparrow$ Blood pressure $\uparrow$ Blood flow to skeletal muscle.

Causes: $\rightarrow$ chromaffin cells divide uncontrollably.

- Usually one adrenal gland.

- Other sites (Carotid arteries, Bladder, Abdominal aorta).

- Most arise sporadically. Associated with:

i) Multiple Endocrine neoplasia 2 [Hyperthyroidism]
ii) Von Hippel-Lindau } MEN 2 Medullary Adenoma
iii) Neurofibromatosis } Mutation in Tumor suppressor gene

Pathophysiology:

Stress ... Physical exercise ... Food with Tyramine
(Chocolate, cheese, wine)

Adrenal Medulla

Catecholamine in Blood

Smooth muscle constriction (Blood vessel)

Hypertensive attacks (180/120 mmHg)

Break small Blood vessels

Heart

CHF

Brain

Stroke

Eye

Retinal Hemorrhage

Kidney

Failure

Clinical features:

Metastasis to lymph nodes, Liver, Bone, lungs

→ High Blood pressure

→ Anxiety, Headache, Sweating, Palpitations

Diagnosis:

→ ↑ Catecholamines (Blood or Urine)

→ Metanephrine (Urine)

→ Ultrasound / CT scan → Identify location

Rule of Tens:

10% extra adrenal

10% bilateral

10% malignant

10% Familial

10% Children

Treatment:

→ Reduce the BP, Remove tumor