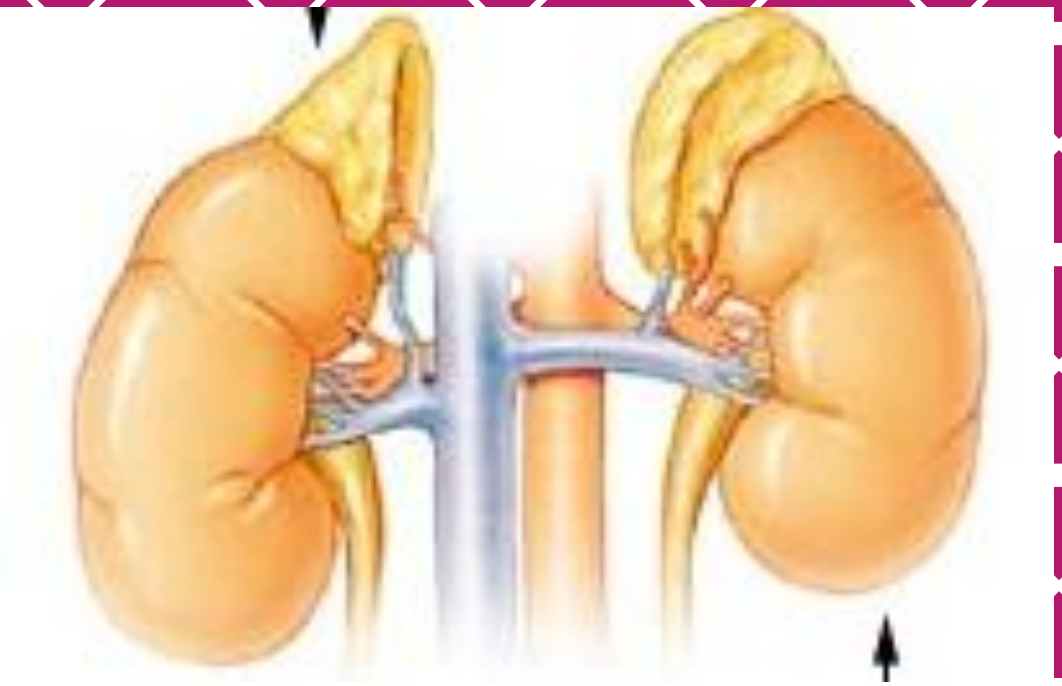
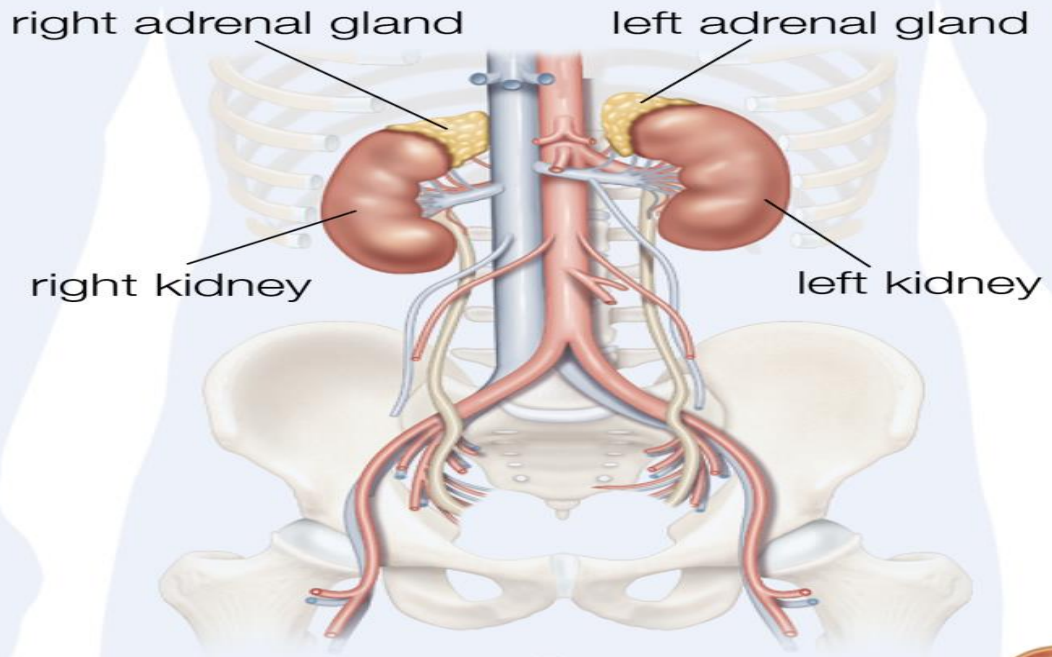
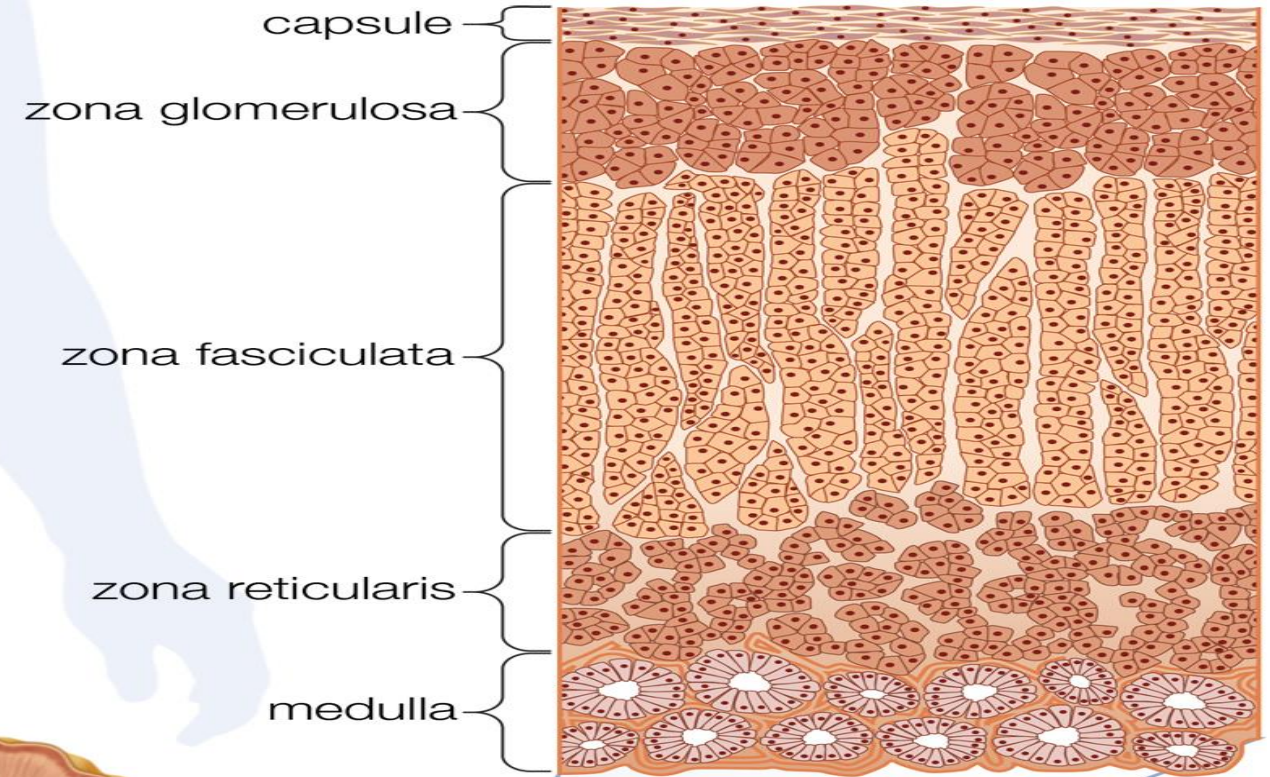
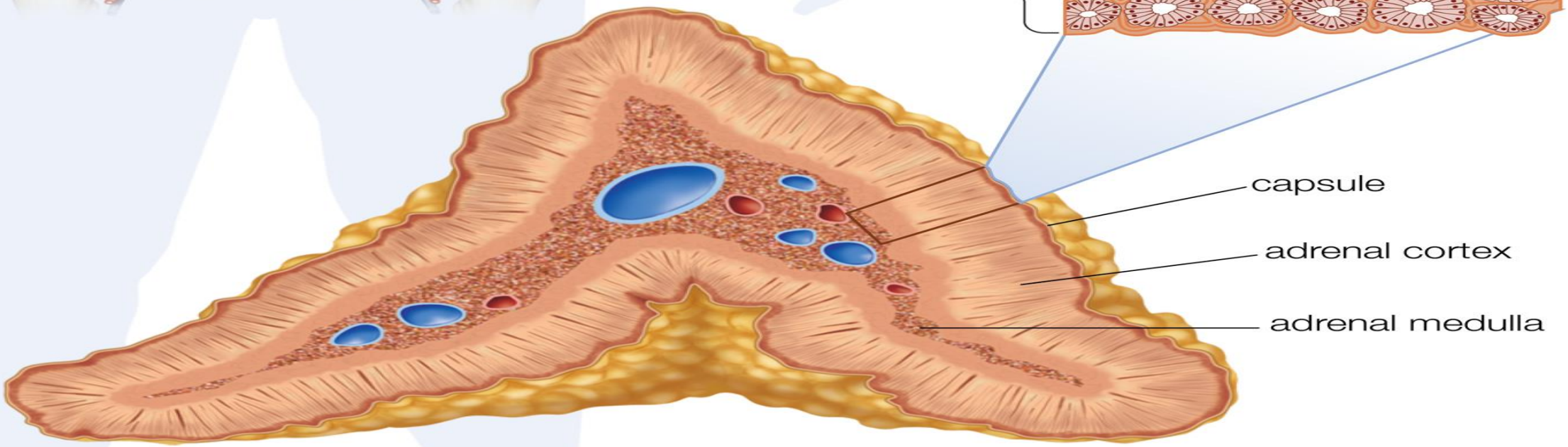


ADRENAL FUNCTION TEST

Adrenal gland







HORMONE SYNTHESIS

- Zona glomerulosa - Mineralocorticoid synthesis
- Zona fasciculata - glucocorticoid synthesis
- Zona reticularis - adrenal androgens, progesterone & oestrogen synthesis
- All steroidogenic pathways require cholesterol import into the mitochondrion

MC	Aldosterone	Reabsorption of H2O & expansion of ECF volume Sodium & water retention K+ & H+ excretion
GC	Cortisol	Carbohydrate,:Lipid, Protein metabolism Excessive catabolism of muscle,Bone Loss: Osteoporosis
ANDROGEN	DHEA , DHEAS Androstenedione	Stimulate masculinization

REGULATION OF ADRENAL CORTICOSTEROIDS

- Glucocorticoids & adrenal androgens

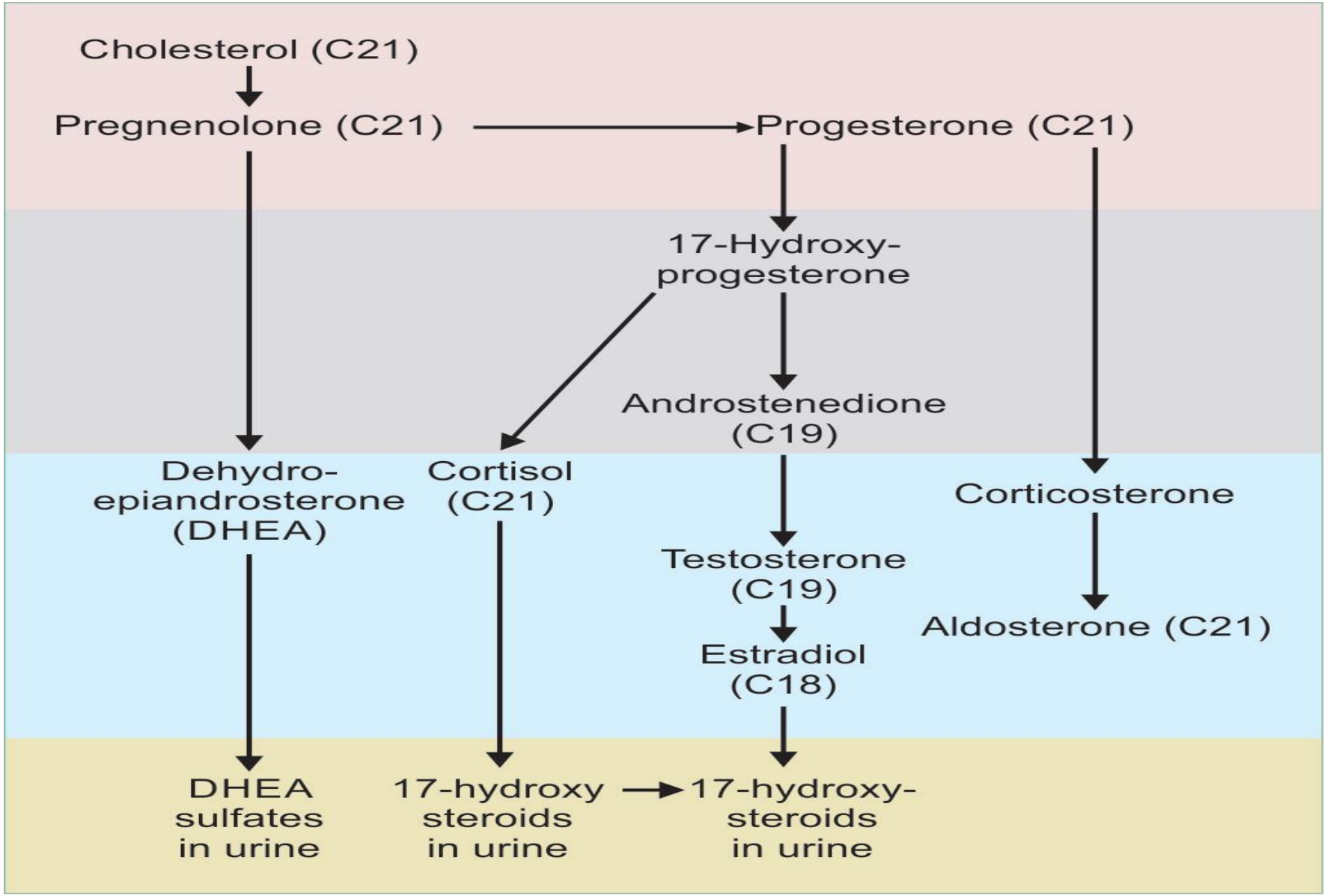
  -by -hypothalamic-pituitary-adrenal (HPA) axis

- Mineralocorticoids

  -by -the renin-angiotensin-aldosterone (RAA) system.

- Pulsatile fashion
- Follows a circadian rhythm
- Level rise in the early morning hours prior to awakening, peak levels in the morning & low levels in the evening

Summary of major pathways for production of glucocorticoids, mineralocorticoids and sex steroids.



Precursors -red box; intermediaries - gray box; hormones - blue box; excretory products - brown box.

WHY ADRENAL FUNCTION TEST?

- To assess **Glucocorticoids** (primarily cortisol)
- To assess **Mineralocorticoids** (primarily aldosterone)
- To assess the Etiology of adrenal gland pathology

- ***Hyperactivity of adrenals may be due to*** –
  - Primary defect in adrenal (Cushing's syndrome)
  - Ectopic ACTH production or ACTH by pituitary (Cushing's disease)

- ***Adrenal hypo-function may be due to*** –
  - Addison's disease.

- *Primary hyperaldosteronism (Conn's syndrome)* – Aldosterone secreting tumor.

ADRENAL GLAND DISORDERS

HYPERFUNCTION OF THE ADRENALS

- Cushing's Syndrome
- PrimaryHyperaldosteronism /Conn's Syndrome
- Congenital Adrenal Hyperplasia

HYPOFUNCTION OF THE ADRENALS

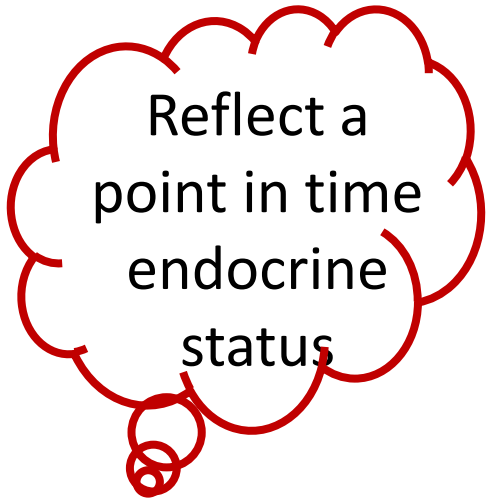
- Primary Adrenal Insufficiency
- Secondary Adrenal Insufficiency
- Hypoaldosteronism

ADRENAL FUNCTION TESTS

Estimation of hormones – Hypothalamic, Anterior Pituitary peptides & adrenal corticoids

Provocative / Dynamic testing

- ✓Stimulation tests of Adrenal function
- ✓Suppression tests of Adrenal function



Stimulation Tests

- *Provocative stimulation tests are useful in documenting hypo- secretion of adrenocortical hormones*

- Eg: Cortisol stimulation tests
- Metyrapone stimulation Test
- Mineralocorticoid Stimulation Tests
- Adrenal Androgen Stimulation Tests

Suppression Tests

- *Help to document hypersecretion of adrenal hormones*

- Eg: Dexamethasone Suppression Test
- Mineralocorticoid Suppression Tests
- Adrenal Androgen Suppression Tests

Assessment of Glucocorticoid Function

1. **Basal level of cortisol**
2. **Estimation of urinary free cortisol**
3. **Plasma ACTH**
4. **Urinary steroids**
5. **Dexamethasone suppression test**
6. **Stimulation test**
7. **Metyrapone test**
8. **CRH test.**

Basal level of cortisol

- Plasma cortisol – by RIA, ELISA
- Normal: 5-25µgm/dl [9.a.m]
  2- 5µgm/dl [10 pm]
- Early indication of disease : loss of diurnal rhythm.

Estimation of urinary free cortisol

- *Fraction of unbound cortisol excreted in urine unchanged.*
- *Sensitive index of adrenal activity.*
- *High – in hyperfunction*
- *Low –in hypoactivity*
- *High in night :10-100 µgm/dl*

Plasma ACTH

Suppressed ACTH –in hyperadrenalism

High – in hypoadrenalism,cushings disease

Urinary steroids

Indicated only in AG SYNDROME

To assess effectiveness of replacement therapy

To observe response to suppression & stimulation test.

- **DEXAMETHASONE (DEX) SUPPRESSION TESTS :**

- Dexamethasone is a potent suppressor of pituitary ACTH secretion and cortisol level,
causing about 50% fall in serum cortisol.

- **Stimulation test :**

To document the functional capacity of adrenal glands to synthesise cortisol

ACTH stimulation[cosyntropin test]

- **CRH test:**

- Direct and selective test of pitutary gland function
To differenciate ECTOPIC ACTH SECRETION

- **Metyrapone test**

ASSESSMENT OF MINERALOCORTICOID FUNCTION

- Estimation of Plasma aldosterone in blood [supine&erect posture]
- Estimation of sodium & potassium level in blood
- Estimation of urinary sodium & potassium
- Plasma renin estimation
- Bicarbonate estimation in blood
- Checking urine and plasma osmolality

ASSESSMENT OF ADRENAL ANDROGEN SECRETION

- To assess adrenal hyperfunction
- To assess adrenal hypofunction
- Primary hyperaldosteronism[conns syndrome]
- AG syndrome

Cushing's Syndrome

Result from chronic exposure to excess glucocorticoids of any etiology

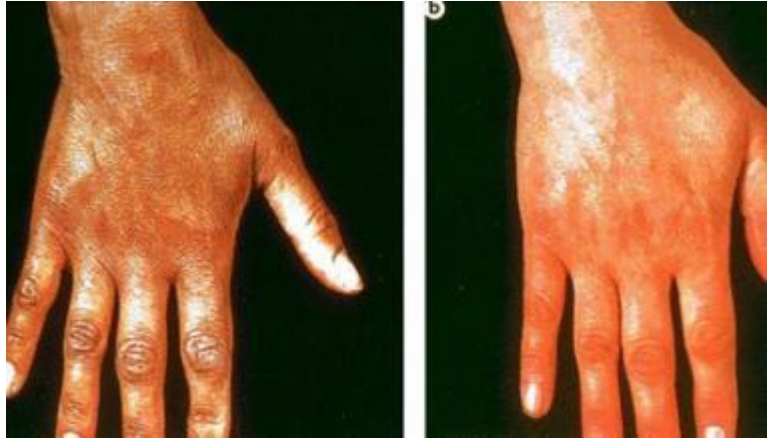
Laboratory findings:

Plasma and urine cortisol levels are elevated

Hypokalemia, hypochloremia and metabolic alkalosis

Failure to suppress cortisol secretion when dexamethasone is administered

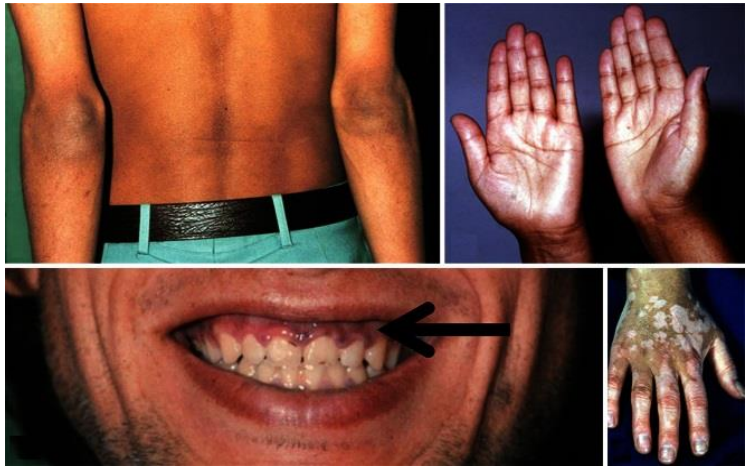
Addison's disease



- ACTH stimulation testing
- Primary adrenal insufficiency - Aldosterone level decreased

  - Plasma ACTH level elevated
- Secondary adrenal insufficiency - Normal /increased aldosterone secretion

  - Plasma ACTH values are low
- Hyponatremia & hyperkalemia



FINDINGS IN ADRENAL HYPERFUNCTION.

Cause	Plasma cortisol	Urinary free cortisol	Plasma ACTH
Adrenal adenoma	Increased; diurnal rhythm is lost	Increased	Decreased
Adrenal carcinoma	Increased; diurnal rhythm is lost	Increased	Decreased
Pituitary adenoma	Increased; no diurnal rhythm	Increased	Increased
Ectopic ACTH production	Increased; no diurnal rhythm	Increased	Increased

LABORATORY FINDINGS IN ADRENAL HYPOFUNCTION

Cause of adrenal insuffi-ciency	Plasma cortisol	Urinary free cortisol	Plasma ACTH	ACTH stimulation	CRH stimulation	Na^+ & K^+ in blood
Primary	Low	Low	Elevated	No effect	No effect	Na^+↓; K^+↑
Secondary	Low	Low	Low	Normal/ exaggerated	No effect	Na^+↓; K+↑
Tertiary	Low	Low	Low	Normal/ exaggerated	Exaggerated	Na^+↓; K+↑

Adreno-genital syndrome (AG syndrome)

- Continuous ACTH secretion leading to adrenal hyperplasia (CAH).
- Commonest cause is 21 hydroxylase deficiency.
- 17 hydroxy progesterone in plasma,
- urinary 17 keto steroids are elevated.
- Hirsutism is seen in female children.
- Variants include 11 hydroxylase (more serious), 17 hydroxylase and rarely 18 hydroxylase.

Laboratory Findings in Adrenogenital (AG) Syndrome and Related Diseases

	17-hydroxy progesterone	Testo-sterone	DHEAS	LH	FSH
AG syndrome	↑↑	↑	↑	N or	N or ¯
Simple hirsutism	N	slight ↑	slight ↑	N	N
Adrenal tumor	N	N or slight ↑	↑↑	N or ¯	N or ¯
Ovarian tumor	N	↑↑	N	N or ¯	N or ¯

DHEAS = dehydroepiandrosterone sulfate; N = normal.