

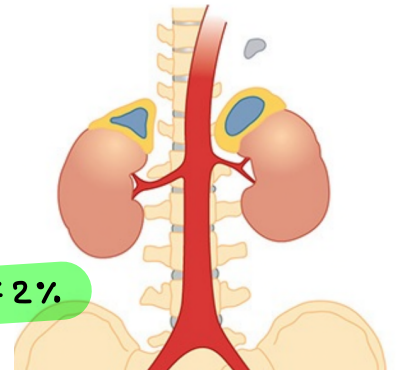
Adrenal Cortex

Introduction:

- It is called 'life-saving gland' or 'Essential endocrine glands'.
- Absence of Adrenocortical hormones cause death in 3-15 days.
- It secretes the steroid hormones, mineralocorticoids, glucocorticoids and androgen.

Functional Anatomy of Adrenal Glands:

- Two distinct parts:
 - (a) Adrenal Cortex : Outer portion, consisting 72%.
 - (b) Adrenal Medulla : Central 28%.
- Adrenal medulla develops from Neural Crest while cortex develops from Mesonephros.



Histology (Adrenal Cortex)

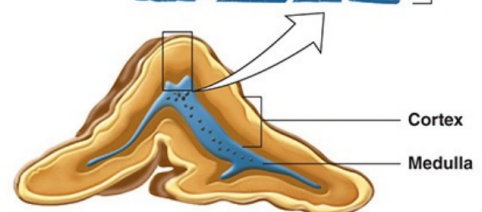
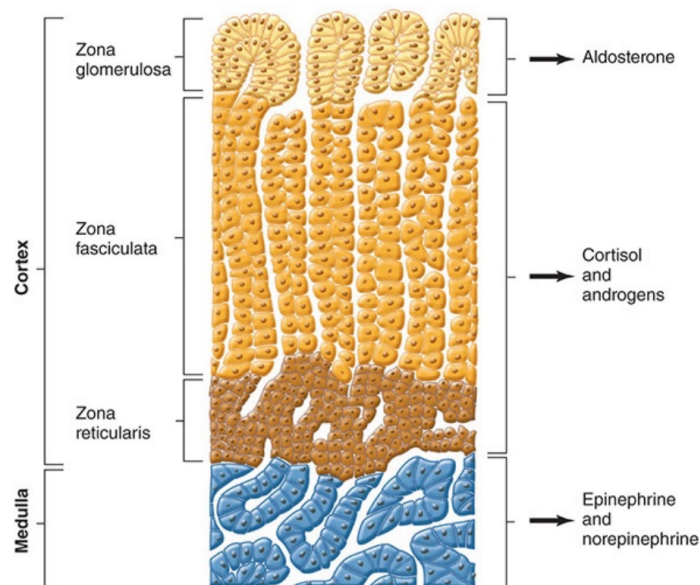
- Three layers :
 - (a) Zona Glomerulosa (Outer) GFR to reabs. (15%) = Aldosterone
 - (b) Zona fasciculata (Middle) (50%) = Glucocorticoids
 - (c) Zona reticularis (Inner) (7%) = Sex hormones

by Mass

Synthesis, Transport & Fate:

SYNTHESIS

- All adrenocorticoids hormones are steroid and synthesized mainly from cholesterol that is absorbed directly from circulating blood.
- Small quantity of cholesterol is also come from acetyl-coA.



TRANSPORT

- **Mineralocorticoids** - They are transported in blood by binding with plasma proteins esp. globulin.
 - As binding is loose, 50% hormones is free.
- **Glucocorticoids** - by special plasma protein known as Glucocorticoid-binding globulin or transcortin.
 - 94% is transported by this protein, whereas 6% free.
- **Sex hormones** - by plasma protein known as sex hormone-binding globulin.

FATE

- Corticosteroids are degraded in liver and conjugated to form glucuronides and sulfates.
- 25% of corticosteroids are excreted in bile and feces and remaining 75% in urine.

Mineralocorticoids :

- They are corticosteroids that act on the minerals (Na^+ , K^+).
- Mineralocorticoids are:
 - (a) Aldosterone
 - (b) 11-deoxycorticosterone.
- By Zona glomerulosa
- It is a C_{21} steroid with half life = 20 mins.
- Aldosterone is very essential for life as it maintains osmolality and volume of ECF.
- It has 3 important functions :

Hormone	Daily output (μg)	Plasma level ($\mu\text{g/dL}$)
Aldosterone	0.15	0.006
11-Deoxycorticosterone	0.2	0.006

- gl increases - (a) Reabsorption of Na^+ from Renal tubules
- (b) Excretion of K^+ through Renal tubules
- (c) Secretion of H^+ into Renal tubules.

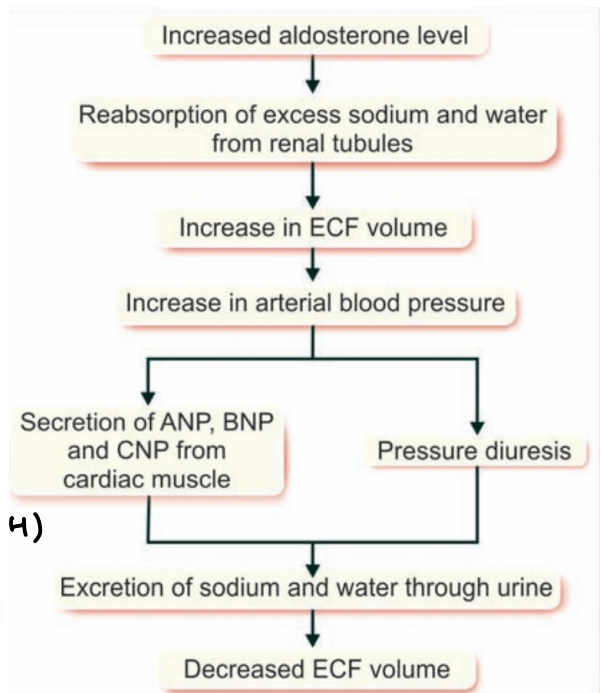
Actions of aldosterone :

- (1) On Sodium ions - Inc reabsorption via DCT
- (2) On Extracellular Fluid Volume - $\uparrow$
- (3) On blood pressure - $\uparrow$ (As volume of ECF $\uparrow$)
- (4) On K^+ level - Excretion of K^+ $\uparrow$
- (5) On H^+ ion - Excretion $\uparrow$
- (6) On Sweat glands & salivary gland - Na^+ $\uparrow$ (Retention)
- (7) On Intestine - $\uparrow$ Na^+ absorption from Intestine.

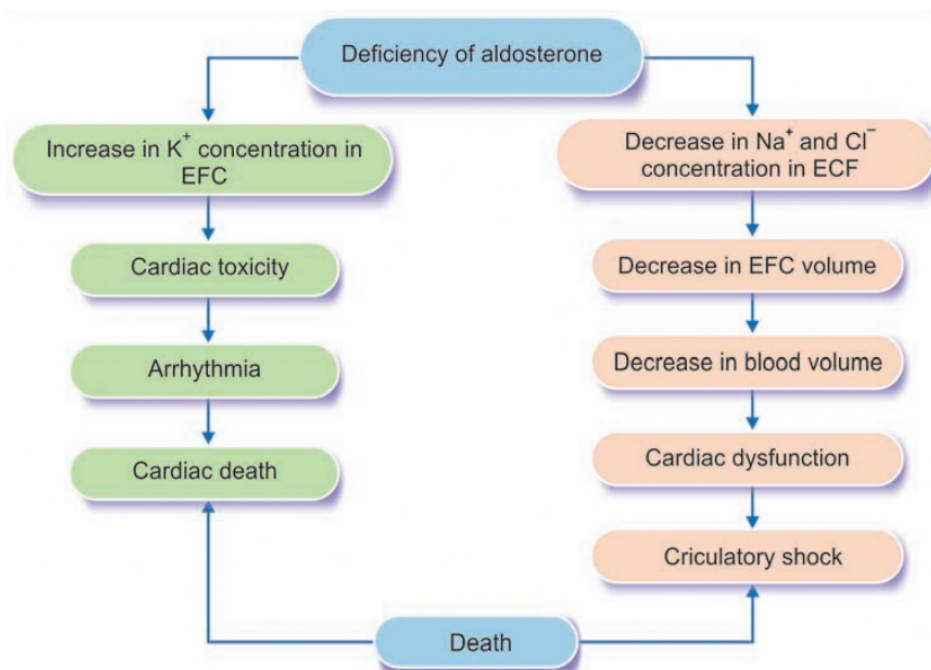
Regulation :

- gl is regulated by four important factors :

- (a) Increase in K^+ in ECF
- (b) Decrease in Na^+ in ECF
- (c) Decrease in ECF vol.
- (d) Adrenocorticotrophic hormone (ACTH)



[Aldosterone escape]



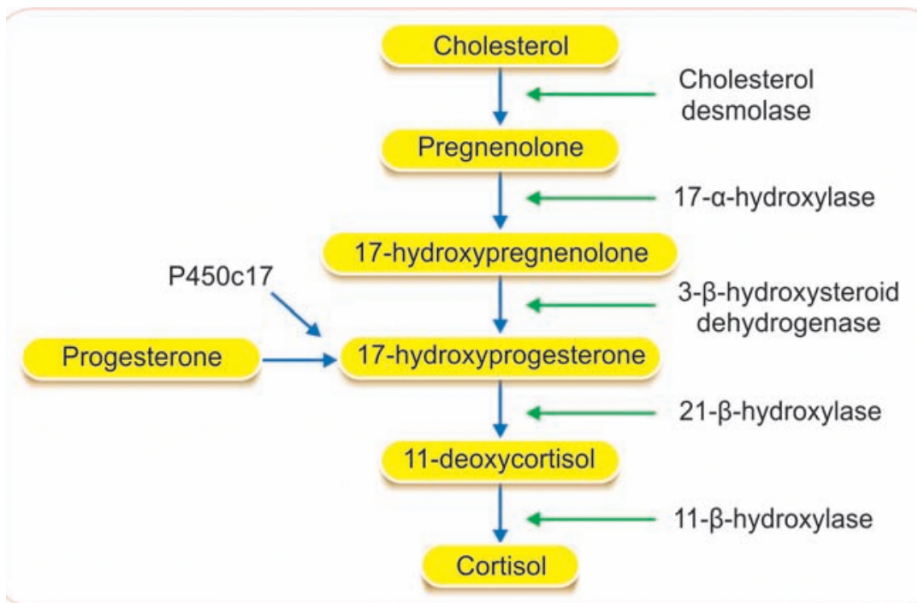
Glucocorticoids :

- Act mainly on glucose metabolism.
- Glucocorticoids are :
 - (a) Cortisol
 - (b) Corticosterone
 - (c) Cortisone
- Secreted mainly by Zona fasciculata of adrenal cortex.
- Small quantity of glucocorticoids is also secreted by Zona reticularis.
- It is C_{21} steroid with Half life = 70 to 90 mins.
- Cortisol is more potent and it has 95% of glucocorticoid activity.

Synthesis :

Corticosterone = 4%

Cortisone = 1%



Mode of Action :

- (1) On carbohydrates - Increases blood glucose level.
- (2) On protein metabolism - Increases catabolism of Protein that leads to
 - (i) Cellular Protein ↓
 - (ii) Plasma level of AAs ↑
 - (iii) Protein Content in Liver ↑
- (3) On fat metabolism - Causes mobilization and redistribution of fats. Hypersecretion → Obesity by increasing deposition.

- (4) On Water metabolism - It accelerates excretion of Water.
- (5) On Mineral metabolism - It enhances the retention of Na^+ and to lesser extent, increases excretion of K^+ .
- (6) On Bone - It stimulates the bone resorption and inhibits bone formation and mineralization.
- (7) On muscle - Increases catabolism of proteins in muscle.
- (8) On Blood cells - Overall decrease the numbers.
- (9) On Vascular Response - Essential for the constrictor action of adrenaline & Noradrenaline.
- (10) On CNS - Essential for Normal functioning.

Deficient hormone $\rightarrow$ Personality changes, lack of control and Irritability

- (11) Permissive action (Sensitivity to Olfactory & Taste stimuli $\uparrow$
 (Needed for other hormones to work))

(a) Catabolic effect of glucagon

(b) Lipolytic effect of catecholamines.

(c) Vascular (Bronchodilator effect) of Catecholamines.
 effect (in skeletal muscle)

- (12) Anti-Inflammatory effects - Glucocorticoids prevent the inflammatory effects by -

(a) Release of chemical $\downarrow$

(b) Causing Vasoconstriction.

(c) Decrease permeability

(d) Inhibit migration of leukocytes.

(e) Suppressing T cells.

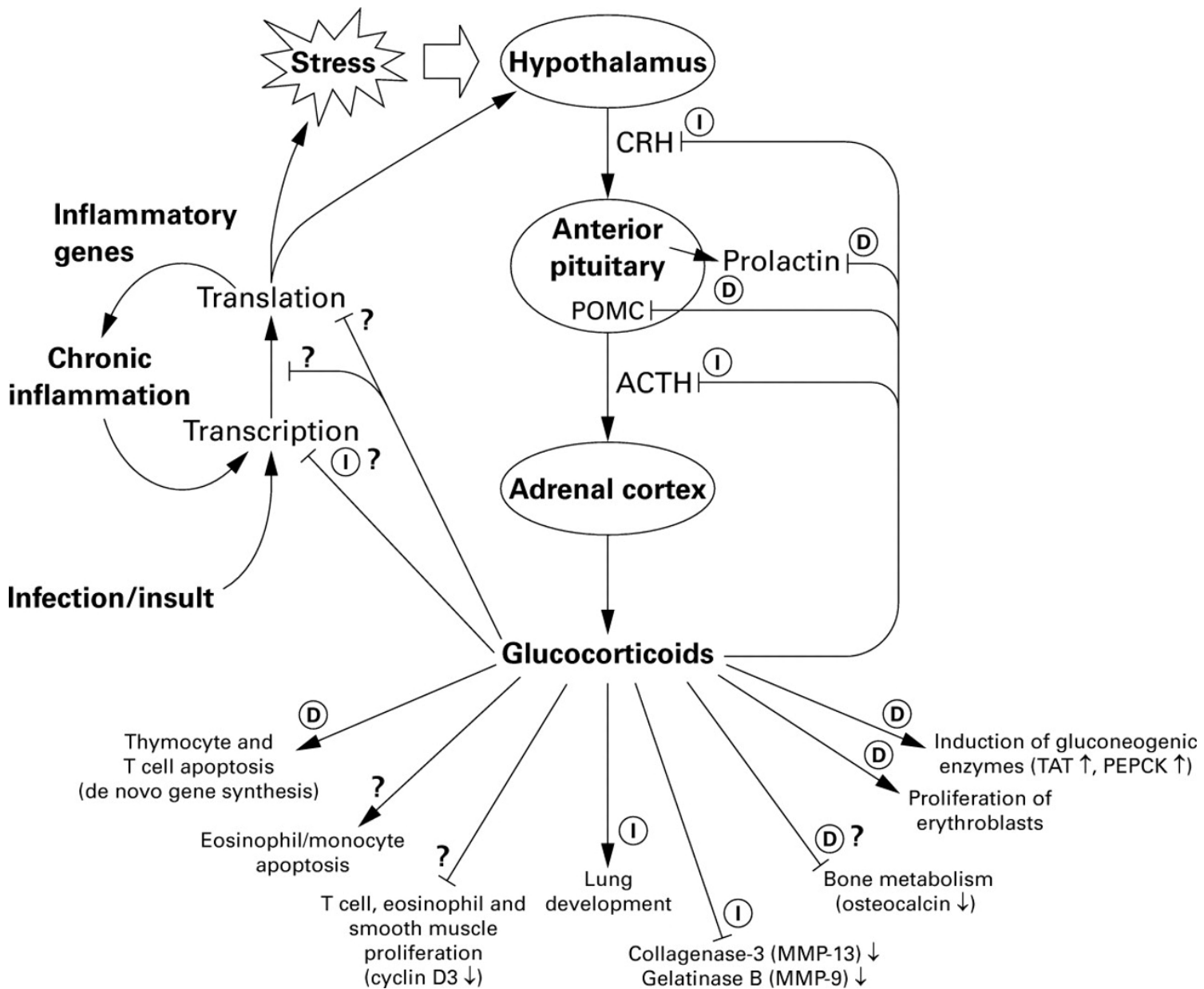
- (13) Anti-Allergic and Immunosuppressive Effects -

- It suppresses T cells and lymphoid tissues.

- Glucocorticoids also prevent the release of interleukin-2 by T-cells.

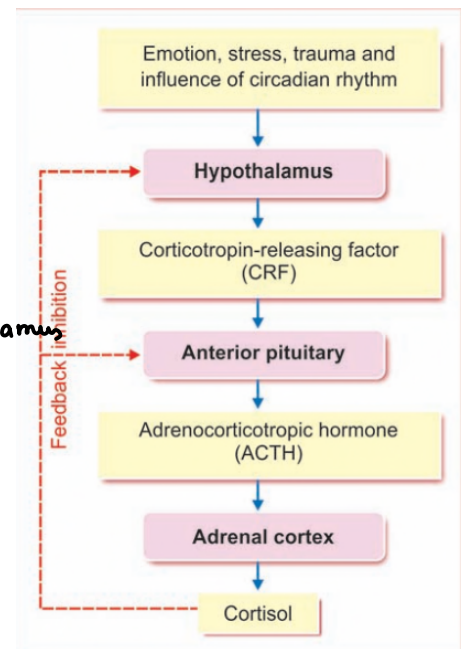
- Also used in Organ Transplantation due to its immunosuppressive effects.

Regulation:



Feedback Control:

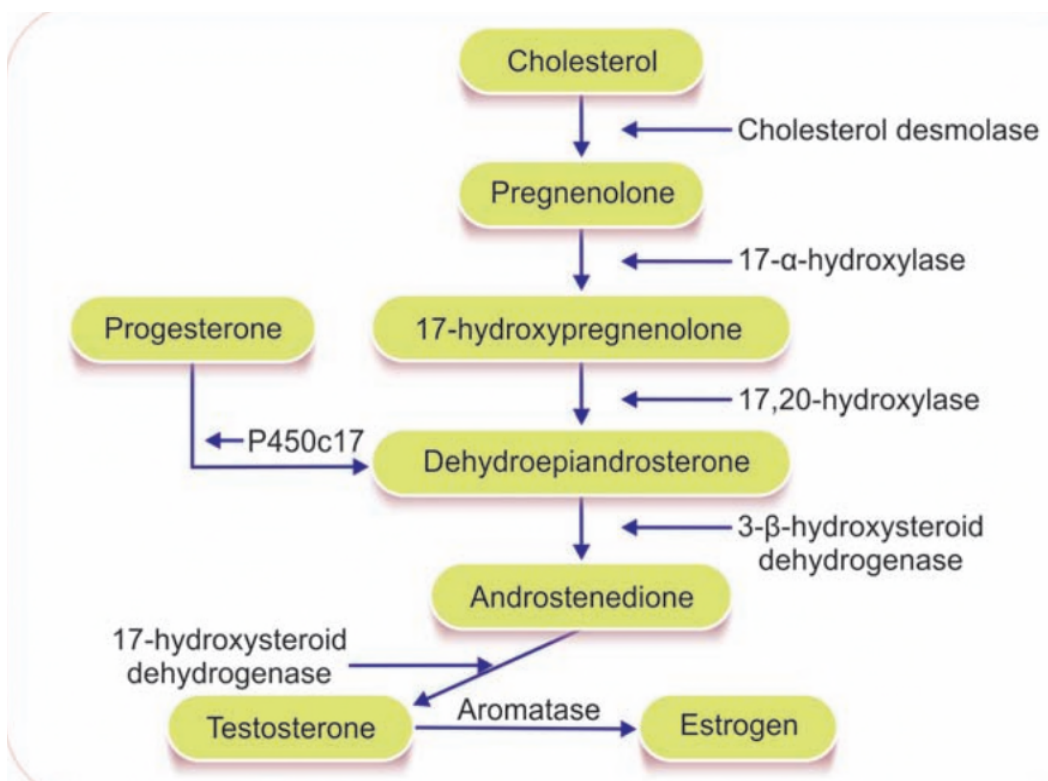
- Cortisol regulates its own secretion through negative feedback control by inhibiting the release of CRF from hypothalamus and ACTH from pituitary.



Adrenal Sex Hormones :

- Mainly secreted by Zona reticularis. Zona fasciculata also secretes in small quantities.
- Adrenal Cortex secretes mainly male sex hormone (androgen) but small quantity of estrogen and progesterone also.
- Androgens secreted by Adrenal cortex:
 - (a) Dehydroepiandrosterone [most active].
 - (b) Androstenedione
 - (c) Testosterone.

Synthesis :

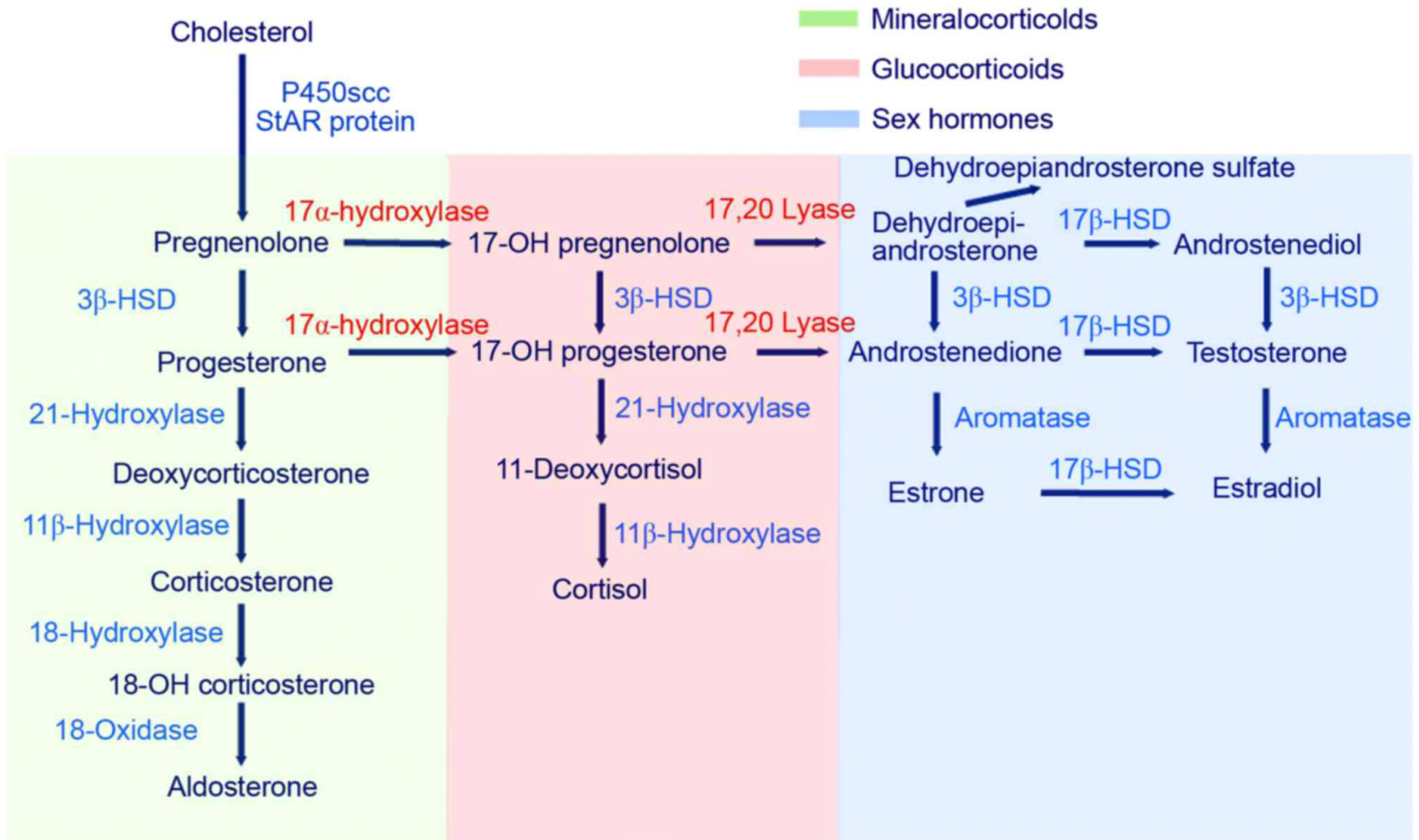


Synthetic Steroids :

- (1) Cortisone and Hydrocortisone $\Rightarrow$ For Glucocorticoid Δ Mineralocorticoid
- (2) Prednisolone = Glucocorticoid (mainly)
- (3) Fludrocortisone = Mineralocorticoid (mainly)
- (4) Dexamethasone = Glucocorticoid only.

Overall Synthesis Chart:

Adrenal steroidogenesis pathway



* Applied Physiology in Next one!

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