

The adrenal gland are pyramidal shaped paired gland situated at the anterior lobe of each kidney. It is divided into two part @ inner medulla which secretes catecholamines by its chromaffin cells (b) and outer cortex.

The cortex consists of 3 parts

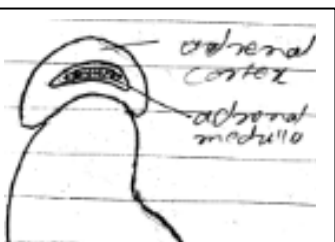
(b) Zona glomerulosa (c) Zona fasciculata which cells are also called spongio blast because it contains lipid molecules. (d) and the Zona reticularis.

The cortex secretes Corticoid hormones and Sex steroids.

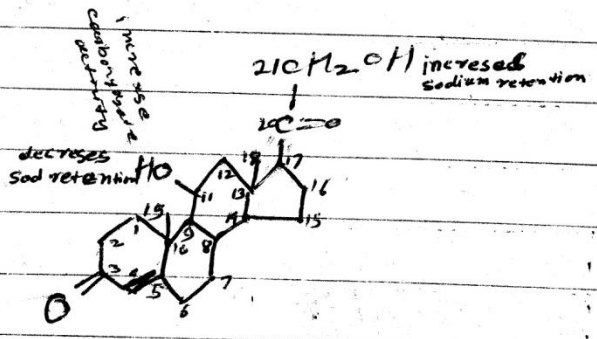
(see table below)!

Hormons group	Regulation Secretory cells.	Regulation	Plasma transport Proteins [PTP]
1) Glucocorticoids	Zona fasciculata cells [spongio-blast]	By ACTH from pars distalis of Pituitary	α [alpha] globulin called <u>Transcortin</u> or corticosteroid-binding globulin [CBG] produced in Liver
2) Mineralocorticoids [Aldosterone]	Zona glomerulosa cells	By <u>Renin</u> angiotensin [Angiotensin II]	Aldosterone has has no specific plasma transport protein [PTP] but it forms a very weak association with <u>albumin</u>
3) Sex-steroids	Zona reticularis	secreted under influence of ACTH not controlled by Gonadsotropin	

Function of Adrenal Gland

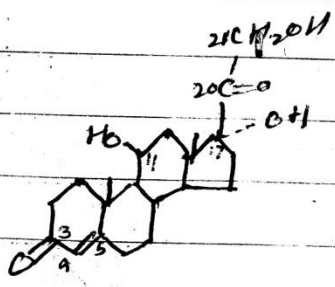


Corticoid hormones - several different corticoids are secreted. Some important are following; -



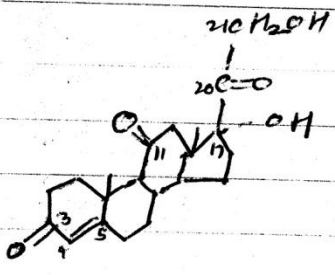
corticosterone

or 11, 21 dihydroxy progesterone
[abundant in Rodents]



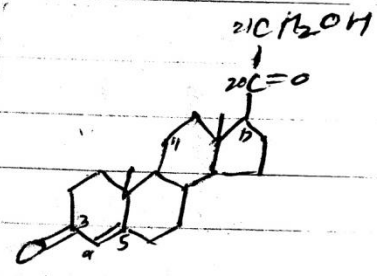
cortisol

or 17 hydroxy corticosterone
[abundant in Human]



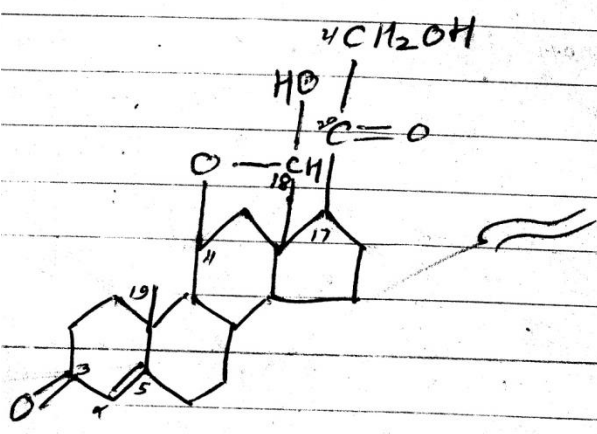
cortison

or 11 dehydroxy - 17 hydroxy corticosterone



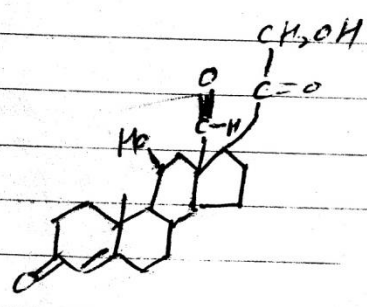
11 dehydroxy corticosterone

or 21 hydroxy progesterone



aldosterone

[hemiacetal form predominate]



oxygenated with carbo a protein metabolite

Relation of structure to physiological activities—

* For all the naturally occurring Δ^4 corticosteroids two structural features are essential for their biological actions.

(a) presence of an ~~an~~ ^{α, β} unsaturated ketonic group [a double bond between C₄ and C₅ and a ketonic group at C₃] and (b) presence of a ketone group at C₂₀.

However other functional groups on other positions also exhibit some specific and important functions eg.

(a) Hydroxy group (-OH) at C₂₁ ~~increases~~ increases sodium ~~water~~ retention and is necessary for carbohydrate metabolism.

(b) presence of either -OH or -CO at C₁₁ ~~increases~~ is necessary for carbohydrate activity and ~~decreases~~ decreases sodium ~~water~~ retention.

(c) -OH group at C₁₁ increases carbohydrate activity.

On the basis of above point 'b' cortical hormones can be chemically divided into three main types

(a) which are originated at C₁₁ eg cortisol & cortisone. they help in carbohydrate and protein metabolism.

(b) which is not originated at C₁₁ eg 11 dehydroxy corticosterone :-

these hormones are not active in carbohydrate and protein metabolism

② which is originated at C₁₁ and its methyl group at C₁₃ is replaced by an aldehyde group of aldosterone thus affects both mineral [Na, K, Cl etc] and organic metabolism.

Function -

these corticoids, which play intensive role in carbohydrate metabolism, are called Glucocorticoids and those which influence salt and water metabolism, are called mineralocorticoids.

Glucocorticoids -

of glycogen

① Carbohydrate metabolism - ^{they} causes hyperglycemia i.e. they tend to increase blood glucose level as well as help in deposition of liver glycogen. This is achieved by gluconeogenesis from protein and fats.

The corticosteroids do not increase the rate of utilization of glucose by the body tissue.

② Lipid metabolism - these excessive amount promotes lipolysis in some areas of body [extremities] and lipogenesis in other [Face and Trunk]

3) Anti protein metabolism! - Glucocorticoids like corticosterone ~~control~~ help in depleting the body proteins and convert them into glucose [gluconeogenesis] thus show anti anabolic action.

[From]

4) Cardio vascular functions - Glucocorticoids are necessary for maintenance of normal blood pressure and cardiac output.

5) Anti inflammatory property! - The steroids help in suppressing acute inflammation in inflammatory reactions without antibody formation.

6) Anti allergic

7) Anti fibroblastic! - The growth of fibroblastic tissue is suppressed.

8) Euphoria! - They promote sense of well being and a gain in appetite is experienced.

① Stress reactions:- they increase the effect/influence of catecholamines in fight or flight response

② Recently it is observed that metallothionein gene is also induced in some mammalian cells by glucocorticoids. [see SA July 1989]

③ Fluid metabolism:- Glucocorticoid have been observed to inhibit ADH release thus in the absence of glucocorticoid ADH level may increase and contribute to water retention [see Harper]

④ Mineralocorticoids:-

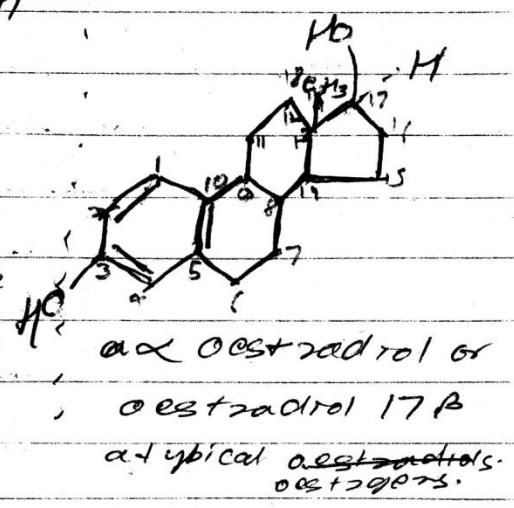
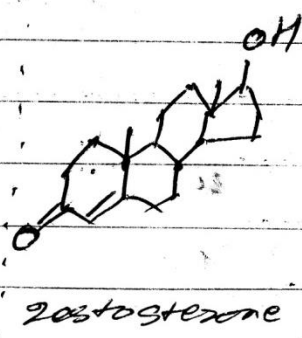
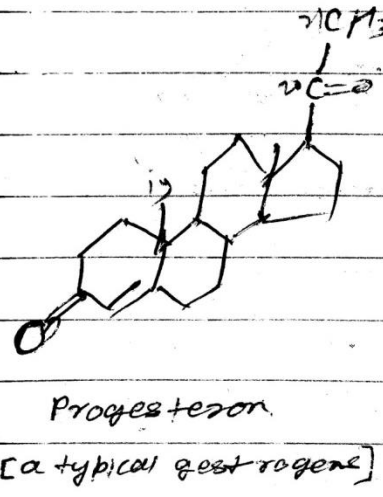
① In kidney:- Aldosterone stimulates Na^+ absorption by the cells in distal convoluted tubules. Hence this leads to increase in blood pressure. Cl^- also possibly blocked.

It also promote the secretion of K^+ , H^+ and NH_4^+ by the kidney.

② Deficiency of the salt hormones causes salt loss from the body causing weakness, hypotension

ketone Polynuclear etc.

(B) Sex Steroids: — mainly consist of oestrogens, Progesterones and androgens [testosterone]



Function: — they regulate the development of accessory sex glands and secondary sexual characters.

Nature of cortex hormones

these are steroids and comes under hormone group. ~~They~~ These hormones are made to bind to intracellular receptors. they have following characteristics: —

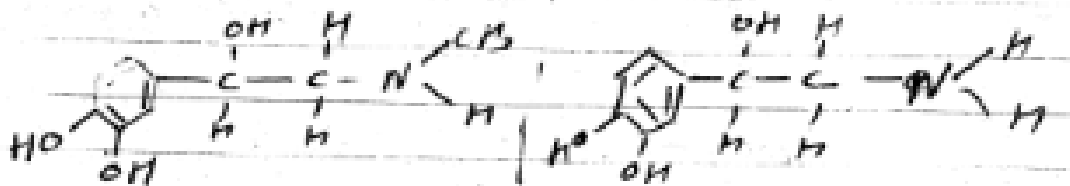
- Ⓐ Solubility — Lipophilic
- Ⓑ Transport protein — Yes
- Ⓒ Plasma half life — Long [hours to days]
- Ⓓ Receptor — Intracellular
- Ⓔ mediator — Receptor-hormone complex

Disorders due to Adrenal Cortex

HORMONE	HYPOSECRETION	HYPER SECRETION
Glucocorticoids	Addison's disease	results in excessive secretion of ACTH which gives rise to Cushing's syndrome [mediated through ACTH]
Mineralocorticoids		Conn's syndrome [Aldosteronism]
Sex steroids		Adrenogenital syndrome

ADRENAL medulla

The chromaffin cells of medulla synthesize the catecholamine hormones viz. Dopamine, epinephrine, nor epinephrine



epinephrine

major product from catecholaminergic

nor epinephrine

FUN:-

① Both these hormones raise the blood pressure, epinephrine by raising the cardiac output by increasing the force [inotropic effect] and rate [chronotropic effect] of contraction and nor epinephrine by increasing the peripheral resistance due to vasoconstriction.

② Epinephrine helps in raising the systolic pressure [diastolic pressure remains same] whereas nor epinephrine raises both the systolic as well as

diastolic pressures without changing the cardiac output.

① In adipose tissue epinephrine increases cAMP which activates Lipase ~~which~~ which in turn ~~activate~~ ~~lipase~~ promote lipolysis and release of fatty acids into ~~cytoplasm~~ circulation [these fatty acid serves as an energy source in muscle and can activate gluconeogenesis in liver]

② In muscle and to lesser extent in liver epinephrine stimulates glycogenolysis [By activating a protein kinase]

③ Epinephrine increases body temperature basal metabolic rate, oxygen consumption and the respiratory quotient

④ Epinephrine accelerates conversion of liver glycogen into glucose with a consequent rise in the blood sugar level. Muscle glycogen is broken down to lactic acid.

⑤ Epinephrine inhibits the smooth muscle of stomach, intestines urinary bladder and uterus, whereas it excites the smooth muscles of Uterus, pyloric, sphincter of bladder and anus.

⑥ 2+ [epinephrine] causes emotional conditions.

⑦ Epinephrine and nor epinephrine stimulate the central nervous system and produce a state

of excitation alertness and awareness

Disorder |—

Phaeochromocytoma :- occurs when medullary
tumour develops which produce catecholamines
chromaffin-cells