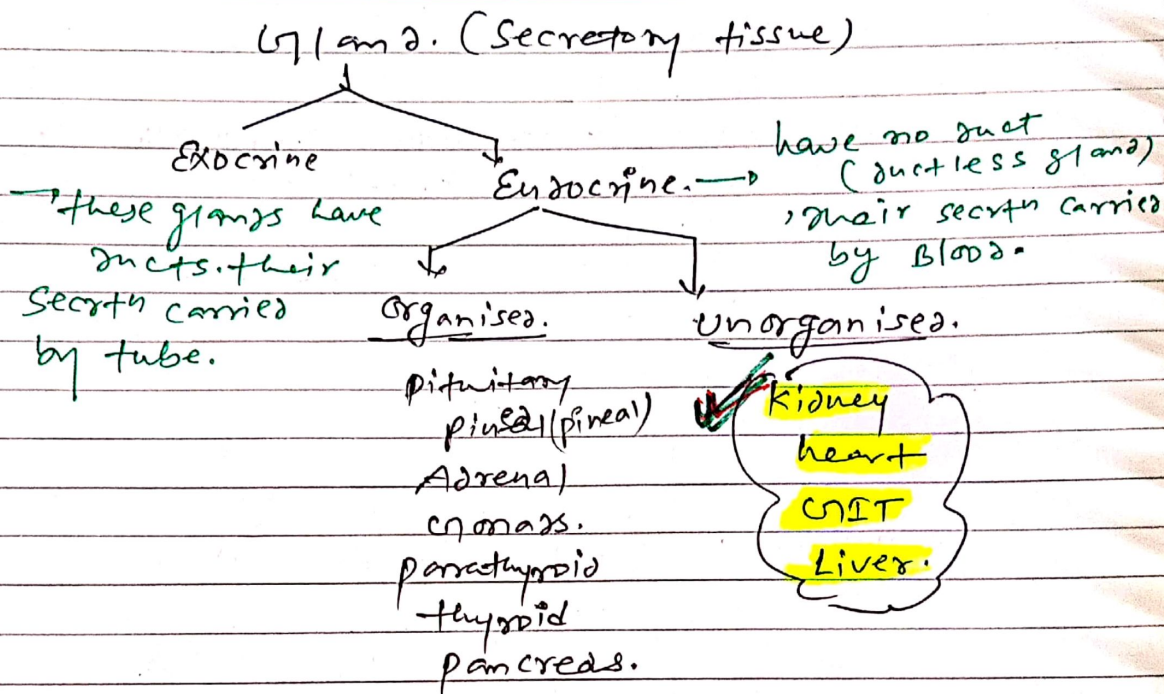


19st revision complete

Endocrine system



- * Hormones → secretion of endocrine gland.
→ transported by blood.
- low mol. wt, highly reactive.
 - 1st discovered hormone = secretin.
 - non-nutrients (not produce energy)
 - intercellular messenger.
 - produced in trace amount.
 - not stored in body. Exception: → Thyroid hormone.
 - not reused in body.
 - non-antigenic.
 - non-species specific.

* Modern definition → Hormones are non-nutrients which act as intercellular messenger and produced in trace amount.

Nature of Hormones.

(A) Steroid nature : → Sex hormones (Testosterone, Estradiol, progesterone).
→ Adrenal cortex hormone (Cortisol, Aldosterone)

(B) Amino-Acid derivative : → These are found from single AA.
→ Adrenal medulla hormone (Adrenalalin/hor Adrenalin)
→ [derived from Tyrosine AA]
→ Tryptophan AA → Serotonin + Melatonin.

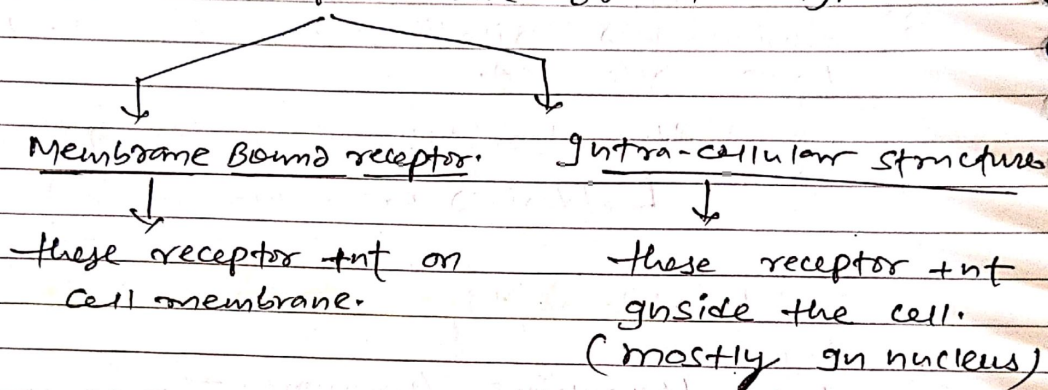
(C) Iodo-tyrosine hormone : →
eg: → thyroid hormones (derived from tyrosine AA).

(D) peptide nature, protein nature hormone.
→ formed from more than 1 AA, which are joined by peptide bond.
eg: → insulin
glucagon
thyrocalcitonin
thyroxin.
PTH
ADH, oxytocin.
→ Hypothalamus hor.
→ Anterior pituitary gland hormone.
[FSH, LH, ACTH, growth hormone, prolactin]

Mechanism of hormone action

* hormones bind with hormone receptors, which located in target tissue only. hormone receptors made up of only protein.

* Hormone receptors are of two types.



* Hormone bind with receptor and form "hormone receptor - complex". ~~Hormone~~ now this complex leads to certain Biochemical changes in the target tissue.

* Each receptor is specific to one-hormone only. so receptors are specific.

Hormone.

↓↓

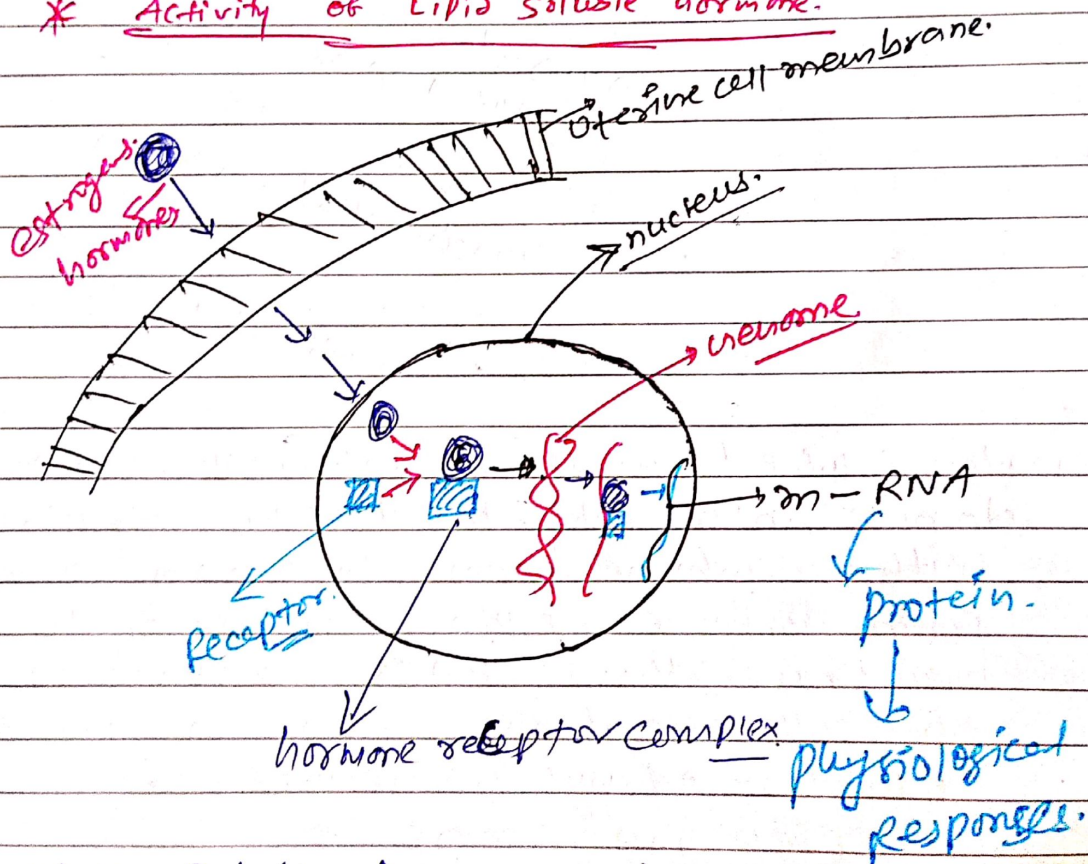
Lipid-soluble hormone.water soluble hormone

Eg: → Steroid hormone
+
Thyroid hormone.

Amine nature +
protein nature + peptide
nature hormone.

* Lipid soluble hormone work slower But
for longer duration.

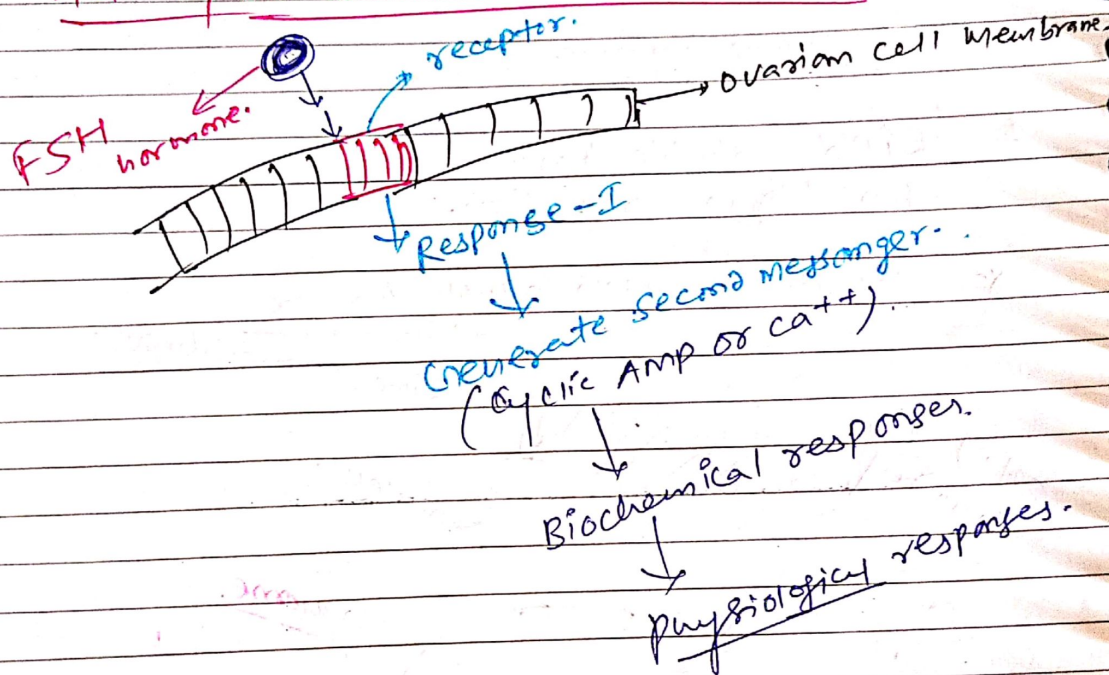
* Activity of Lipid soluble hormone.



* Lipid soluble hormone direct enter into
target cell. they bind with intracellular
receptor and form hormone receptor complex.

in the nucleus. This complex regulate gene expression or chromosomal function by interact with genome. So Lipid Soluble hormone act on gene level.

Activity of water soluble hormone.

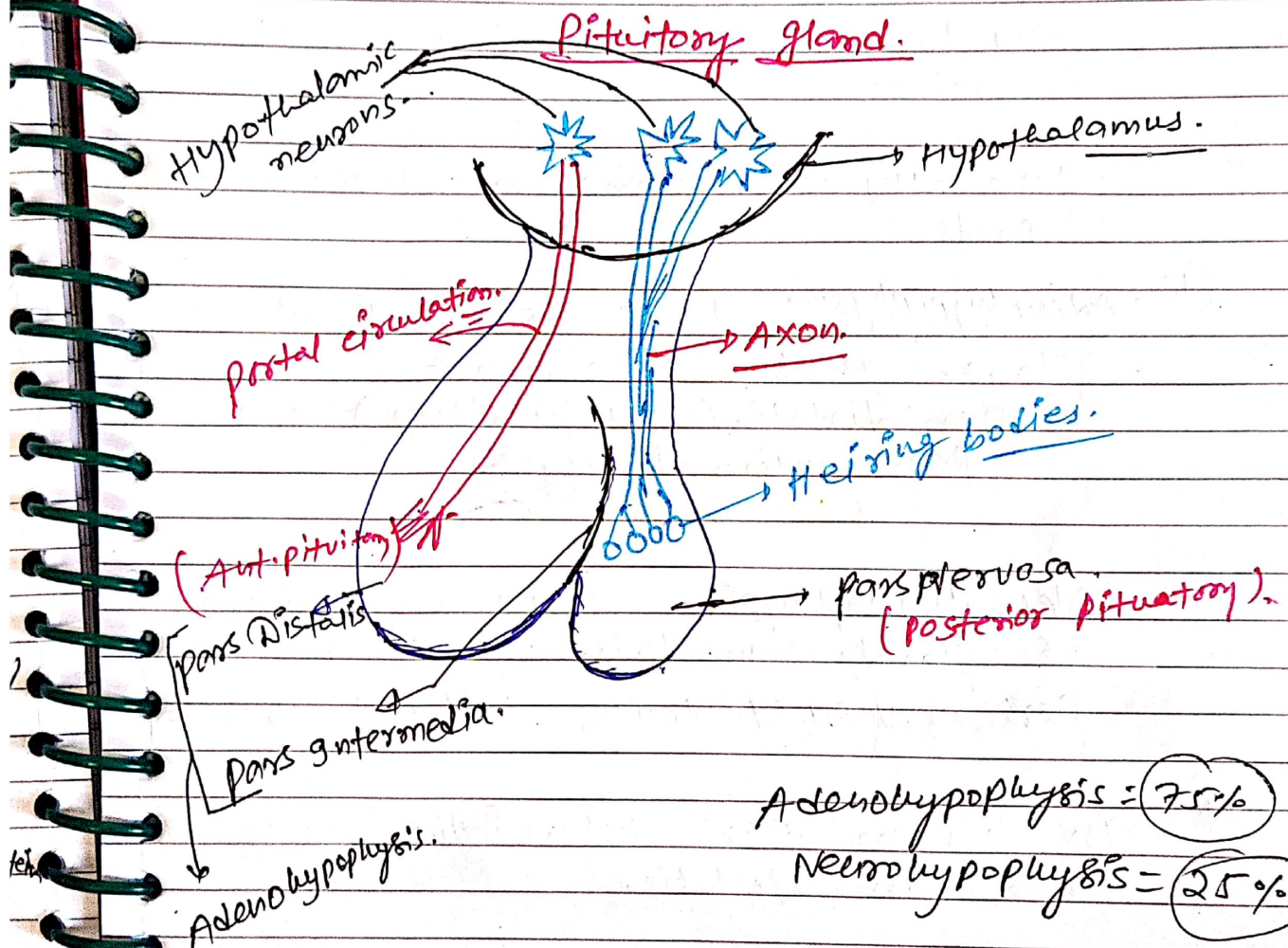


Water soluble hormone (adrenalin, FSH, LH, insulin) do not enter into target cell. they bind with membrane bound receptor and form hormone receptor complex on cell membrane. this complex activate G-protein of cell membrane. this G-protein activate Adenyl cyclase enzyme. This enzyme convert ATP into cyclic AMP, which act as a 2nd messenger. the cyclic AMP activate protein kinase enzyme in cytoplasm.

NEET
KOTA
JULYAD

Due to this physiological response is occur.

- * Water Soluble hormone generate 2nd messenger like cyclic AMP, Ca^{++} , IP_3 . (inositol triphosphate), cyclic GMP (guanosine monophosphate), DAG (Di-Acetyl glycerol).



→ Smallest Endocrine gland.

⇒ Ectodermal.

→ this gland is connected to hypothalamus by a stalk called infundibulum.

→ It is located in bony socket called Sella turcica of sphenoid bone of cranium.

* Anatomically this gland is divided into 2 parts.

① Adenohypophysis = form 75% part of

gland. It has 2 regions -

pars distalis (Ant. pituitary) and
pars intermedia.

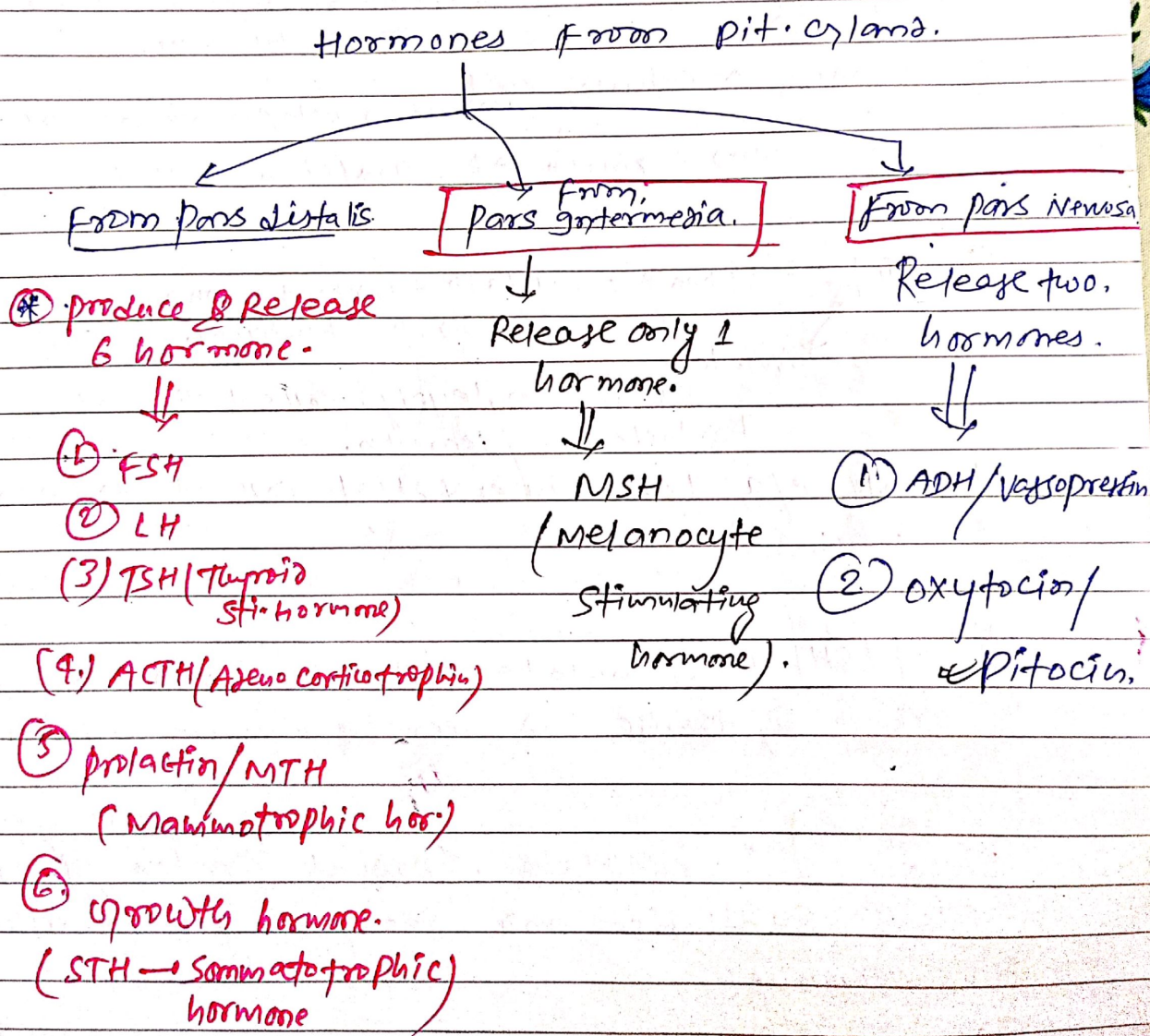
②

Neurohypophysis = form 25% part of gland. In this only 1 region pars nervosa (posterior pituitary) present.

* In human pars intermedia merge with pars distalis.

* Functions of Adenohypophysis regulated by hypothalamus to secrete several hormones. These hormones transport into Adenohypophysis by portal circulation / blood.

* Neurohypophysis store and secrete two hormones (ADH, oxytocin) - these hormones actually synthesise by hypothalamus and transport into posterior pituitary by axon. So post-pituitary is direct under neural regulation of hypothalamus.



ejectⁿ → Breast & areolae (constrictor),
secretion → Alveoli & nipple etc.

All hormones of pituitary gland not enter into target cell and Bind with membrane bound receptor.

* FSH and LH act on gonads and also called gonadotrophin hormone.

⊛ **FSH** → male = stimulate spermatogenesis + act on sertoli cells.
female = induce development of follicle and formation of graafian follicle.

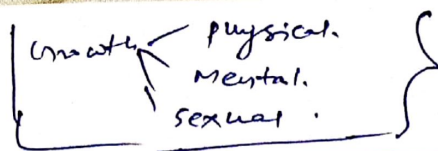
⊛ **LH** → female = ovulation + formation and maintenance of corpus luteum.
male = act on leydig cells + stimulate testosterone secretion.

Stimulate (e.g. ICH → interstitial cell stimulating hor)

⊛ **TSH** → Stimulate thyroid gland to synthesise and secrete thyroid hormone.

⊛ **ACTH** → Stimulate Adrenal Cortex gland to synthesise and secrete glucocorticoid hormone.

⊛ **Prolactin** → It is also called LTH (lactotrophic hormone)



It stimulates dev. of mammary gland and milk synthesis in them.

* Growth Hormone

It stimulates physical growth of body (not mental growth). It induces growth of bone and muscles.

* GH increases lipolysis in adipose tissue and induces (↑) ATP production.

↳ Promotes protein synthesis in liver.

↳ GH decreases glucose uptake in most of body cells so, **GH is diabetogenic hormone**.

↳ GH stimulates liver cells to form glucose from glycogen.

* MSH

↳ It acts on melanocyte cell [melanin pigment containing cell.]

It causes dispersal of melanin granules in the cells and causes darkening of colour. So **MSH is for pigmentation of skin.**

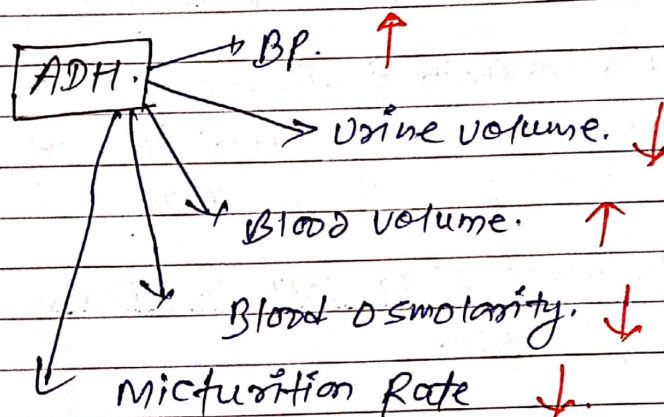
* Oxytocin/Pitocin.

It stimulates contraction in smooth muscles. In female it acts on uterine muscles. It is child birth hormone, labour pain hormone, **milk ejecting hormone.**
(Breast में दूध)

* **ADH**

↳ It is also called vasopressin.
ADH is synthesised by hypothalamus,
released by neurohypophysis and act
on distal part of renal tubules
in kidney - (DCT + collecting duct)

* ADH induce water reabsorption in DCT
and collecting duct -



When
* Excessive loss in body fluid volume when
hypothalamus stimulates ADH secretion.

* During summer ADH secretion ~~secreted~~ increases.

* Someone drink lot of water then
ADH secretion suppressed.

* Diuretic substance (Tea, coffee, Alcohol)
suppress ADH secretion and increased
urine vol^m this condition is called
Diuresis so **ADH prevents Diuresis.**

(Hyposecrn)

* Due to low level of ADH urine vol^m increases. this disease is called diabetes insipidus. (polyurea, polydipsia, delay, low BP)

Abnormal secretion of growth hormone

Dwarfism

Gigantism.

** Acromegaly.

* Due to low secretⁿ of GH gn child stage.

high secretⁿ of GH gn child stage.

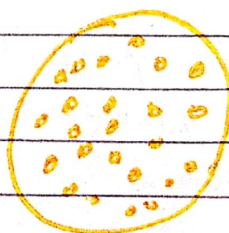
Hyper secretⁿ of GH gn Adult stage.

* Stunted growth. IQ normal. Puberty delay.

* Abnormal growth of Body gn proportionate manner.

* Abnormal growth gn size of bones of face, hands. (gorilla like appearance.)

* Due to damage of Anterior pituitary gland simmonds's disease occur gn adult stage. ↳ many organ affected. ↳ all it.



Melanin pigment (dark ep) than Dark skin.



Less of melanin than (white skin)

Hypothalamus.

It is part of forebrain.

It is ectodermal.

It contains group of neurosecretory cells which are called nuclei. These cells produce hormones which are called neurohormones.

* Hypothalamus secretes 9 hormones which regulate synthesis, secretion of ant-pituitary hormone. These hormones transport into pituitary gland by blood.

* All hypothalamus hormones are protein nature.

* Hypothalamus hormones are of 2 types.

Releasing hormone (RH)

They induce secretion of pituitary hormone.

Inhibiting hormone (IH)

They inhibit secretion of pituitary hormone.

(1) GnRH (Gonadotropin RH)

→ 1st prolactin IH.

(2) TRH (Thyrotropin rel. hormone)

→ MSH IH
→ Somatostatin

(3) MSH LH.

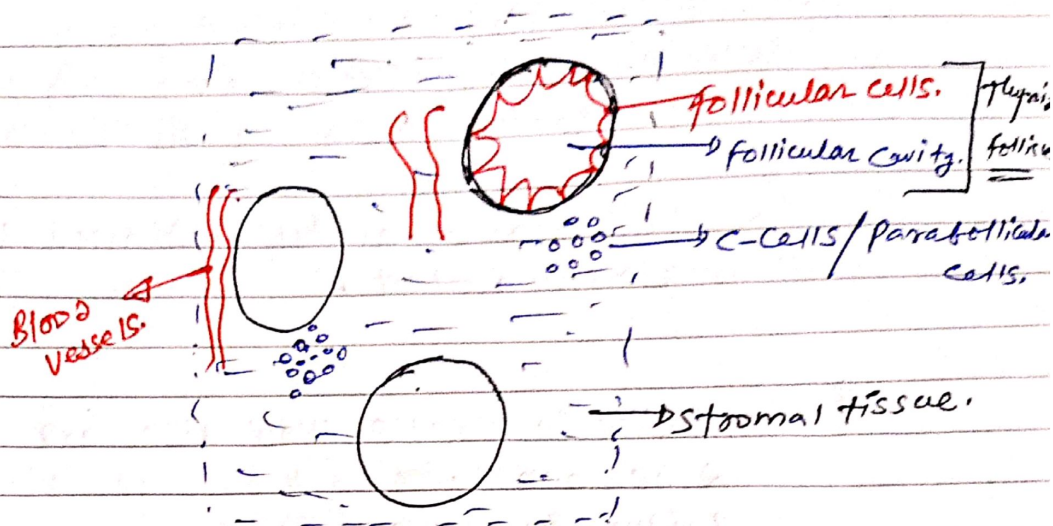
It suppresses release of growth hormone.

(4) Prolactin/RH.

(5) CRH (Corticotropin Rel. hor)

(6) GH RH (Growth hormone releasing hormone)

Thyroid gland.



- * (1) Largest Endocrine gland.
- (2) Endodermal.
- (3) only Endocrine gland which stores its secretion.
- (4) It consists of 2 Lobes. (Bilobed) Both Lobes are connected by a thin Flap of connective tissue called isthmus. It is non-glandular.
- (5) Each lobe composed of glandular tissue and stromal tissue.

* Stromal tissue contains loose connective tissue + Blood vessels + ~~parafollicular~~ C-cells/parafollicular cells.

* Parafollicular cells secrete thyrocalcitonin (TCT) hormone. It is peptide nature hormone (32 Amino Acid) It is non-iodinised. It regulates blood calcium level. It decreases Ca^{++} level of blood.

* Glandular tissue contain many thyroid follicle. each follicle as cuboidal follicular cells, enclosing a follicular cavity.

* In follicular cavity iodinated substance thyroglobulin + I⁻.

(*) Follicular cells synthesise and secrete 2 hormones.

(i) Triiodothyronin (T₃)

(ii) Tetraiodothyronin (T₄) or Thyroxine.

* T₃ and T₄ are collectively called thyroid hormone. they are formed from tyrosin AA

* T₄ is produced in more amount (80%) than T₃.

* T₃ is more active than T₄ so, in the target tissue T₄ convert into T₃ by removing iodine.

* Iodine is essential for formation of thyroid hormone.

(*) If In diet iodine deficiency, then thyroid gland become enlarge (collar like gland) this disease is simple goitre. In this thyroxine secretion is low, so

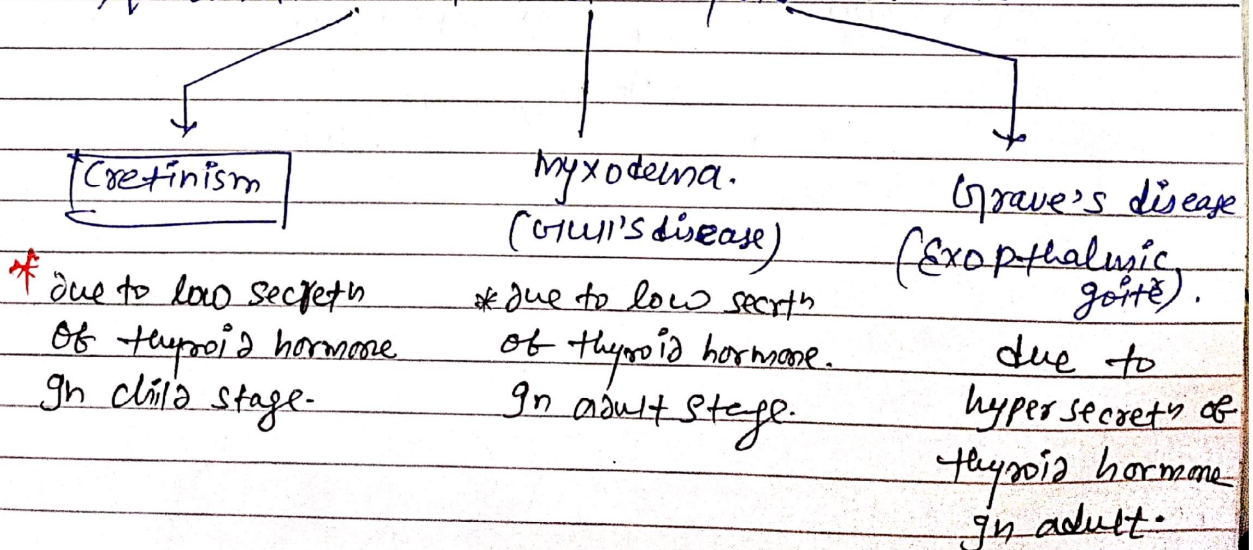
BMR, heart rate decreases. It occur in hilly (mountain) Area.

Thyroid
erythropoietin.

Function of thyroid hormones.

- (*) \uparrow BMR. (Basal metabolic rate) of body.
- (*) It accelerates physical, mental and sexual growth of body.
- (*) \uparrow food oxidation, so ATP/calorie/heat produced. due to heat production it is called calorogenic hormone. and it maintains body temp. (Secrets more in winter)
- (*) Regulation of MC.
- (*) Induce RBC production.
- (*) Control metabolism of carbohydrate, fat, protein.
- (*) maintenance of water and electrolyte balance.
- (*) \uparrow action of neurotransmitter (adrenalin)
- (*) Thyroid hormone induces metamorphosis of tadpole larva.
If thyroid hormone absent then tadpole larva remain in larva stage.

Abnormal secretion of thyroid hormone.



Symptoms:

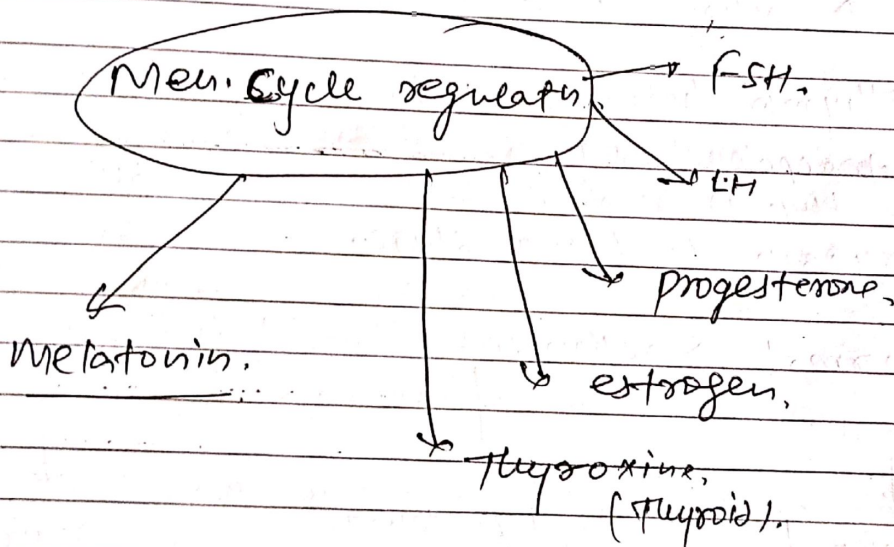
Stunted growth,
low IQ,
mental retarded.
+ Deaf.
mutism (मूकता)

low BMR,
low BP.
*obesity.
*irregular mc.
*Oedema (पूँन)
*Lack of alertness.

→ high BMR, High BP
→ weight loss
→ Restlessness
→ Sweating

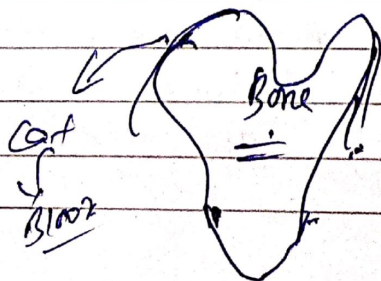
- ① It is caused by 2 reason: ① pregnant lady में thyroid का कमी। (Myxoedema)
② वयस्कों में ही कमी।

*



Parathyroid gland.

- (*) Total 4 Parathyroid gland +nt on the back side of thyroid gland, 1 pair +nt in each lobe of thyroid gland.
- (*) Endodermal
- (*) This gland contain chief cells, which is synthesise and secrete hormone.
- (*) Parathyroid gland secrete [Parathyroid hormone (PTH) / parathormone / collapse hormone] it is peptide nature hormone (84 Amino acid).
- (*) PTH regulate calcium and phosphate balance b/w blood and other tissue.
- (*) PTH increase calcium level of blood so it is hypercalcaemic hormone.
- (*) PTH has opposite effect to thyrocalcitonin so both are antagonistic hormone.
- (*) Secretion of PTH is regulated by level of calcium in blood.
- (*) PTH ↑ calcium level by 3 methods.
 - (i) PTH act on bones and stimulate process of Bone resorption / Demineralisation / Dissolution.



Due to this Ca^{2+} release into Blood From Bone.

(2) PTH increase Ca^{2+} absorption in a renal tubules of kidney (inhibit phosphate absorption).

(3) PTH increase absorption of Ca^{2+} in intestine from food.

* PTH stimulate kidney to secrete calcitriol hormone (active form of vit. D) this Calcitriol stimulate Ca^{2+} absorption in intestine.

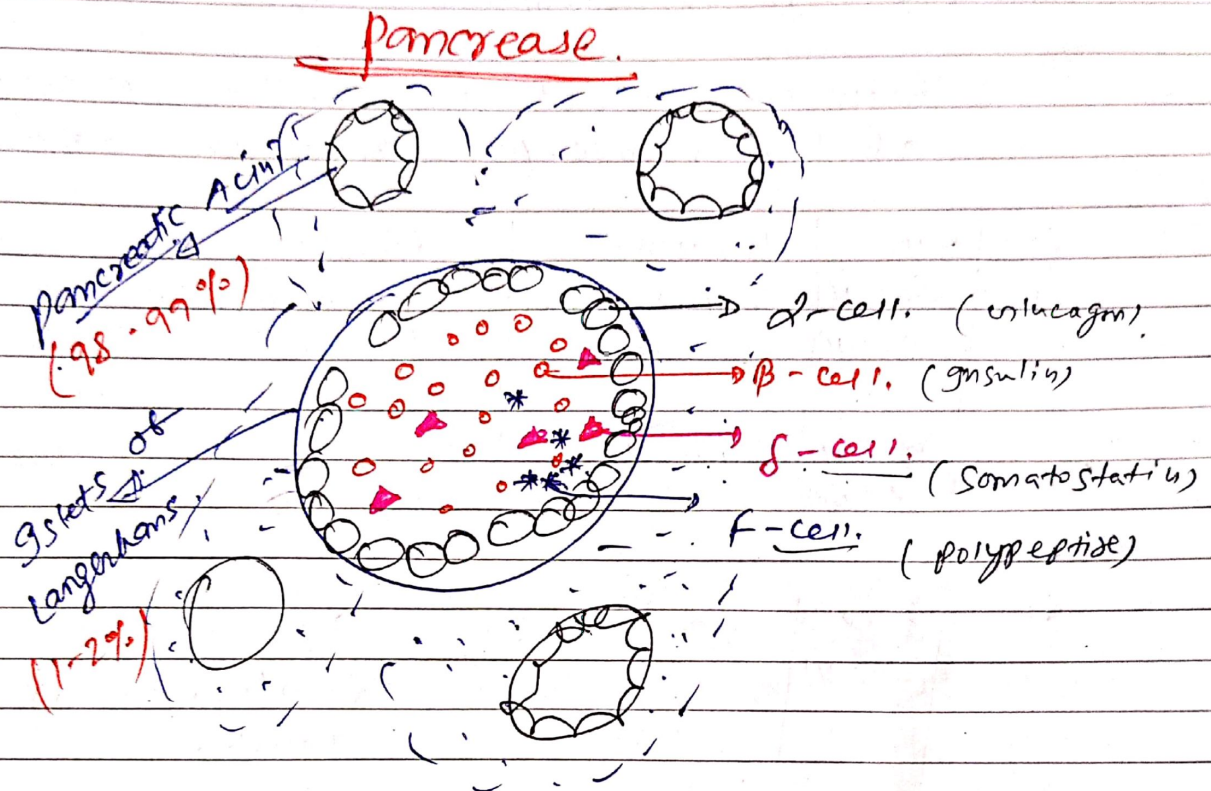
Abnormal secretion of parathyroid:

(1) Tetany :- It is due to Low secret of PTH. due to this Blood Calcium level decrease. Low level of calcium in Body Fluid. caused Rapid spasm (wild contraction) of skeleton muscles. So, muscle sustain in contract stage.

(2) osteoporosis :-

It is age related disorder, it's common cause is decreased level of estrogen. It is also due to hypersecretion of PTH and deficiency of vitamin-D. In this bones becomes weak, thin, porous and Bone mass decrease. Some bone substances is replaced by a cavity in which

Fibrous tissue deposite when gt is called
"Ostetis Fibrosa cystica".



- Endodermal
- Int b/w Both limbs of duodenum.
- gt acts as Both Exocrine and Endocrine gland. so called mixed gland.

→ gt has 2 parts.

- (i) Pancreatic acini → gt forms 98-99% part. gt synthesise pancreatic juice which is transported by pancreatic duct to duodenum. so gt is exocrine part.

* MSH and Melatonin *
antagonistic hormone.

(ii) islets of Langerhans: →. It form
1-2% part - It synthesise, secrete
hormone which transported by Blood
So It is Endocrine part.

(*) There are about 1-2 million islets
of Langerhans in human pancreas.

S.No	Cell.	hormone	functn.
1.	α -cell (A-cell)	glucagon <u>↑ Blood glucose level.</u>	Increase Blood glucose level.
2.	β -cell (B-cell)	insulin	Decrease Blood glucose level.
3.	δ -cell (D-cell)	Somatostatin	Suppress excess secretn of glucagon and insulin.
4.	F-cell (PP-cell)	Pancreatic Polypeptide	Inhibit secretn of pancreatic enzyme of pancreas.

(*) insulin and glucagon maintain Blood
glucose level. Both are antagonistic
hormone.

285419

AB Sir

* **glucagon** is a peptide hormone. It binds with membrane bound receptor. It consists of 29 Amino Acids. It increases Blood glucose level. So, it is called **Hyper-glycemic hormone**. It mainly acts on Liver cell. (Hepatocyte).

* **glucagon** (ग्लूकोन) inhibits cellular glucose uptake and utilisation. (इसके द्वारा शरीर में)

* Increase gluconeogenesis. (formation of glucose from amino acid and Lactic acid)

* Glucagon increases glycogenolysis (conversion of glycogen into glucose)

* **insulin** is a peptide hormone (51 AA). It is secreted by β -cell. It decreases blood glucose level. So, it is **hypoglycemic hormone**.

It acts mainly on hepatocyte (Liver cell) and adipocyte (adipose cell).

* Insulin increases cellular glucose uptake and utilization, so rapid movement of glucose from blood to hepatocyte and adipocyte cell occurs.

→ Insulin reduces gluconeogenesis in liver.

→ Insulin increases lipogenesis in adipose tissue.

* Insulin increases glycogenesis.
(Conversion of glucose into glycogen).

* Insulin increase protein synthesis from AA and tissue.

	<u>Glucagon</u>	<u>Insulin</u>
1. Blood glucose level	↑	↓
2. Cellular glucose uptake	↓	↑
3. Glucogenesis	↓	↓
4. Glycogenesis	↓	↑
5. Gluconeogenesis	↑	↓
6. Glycogenolysis	↑	↓
7. Lipogenesis	↓	↑

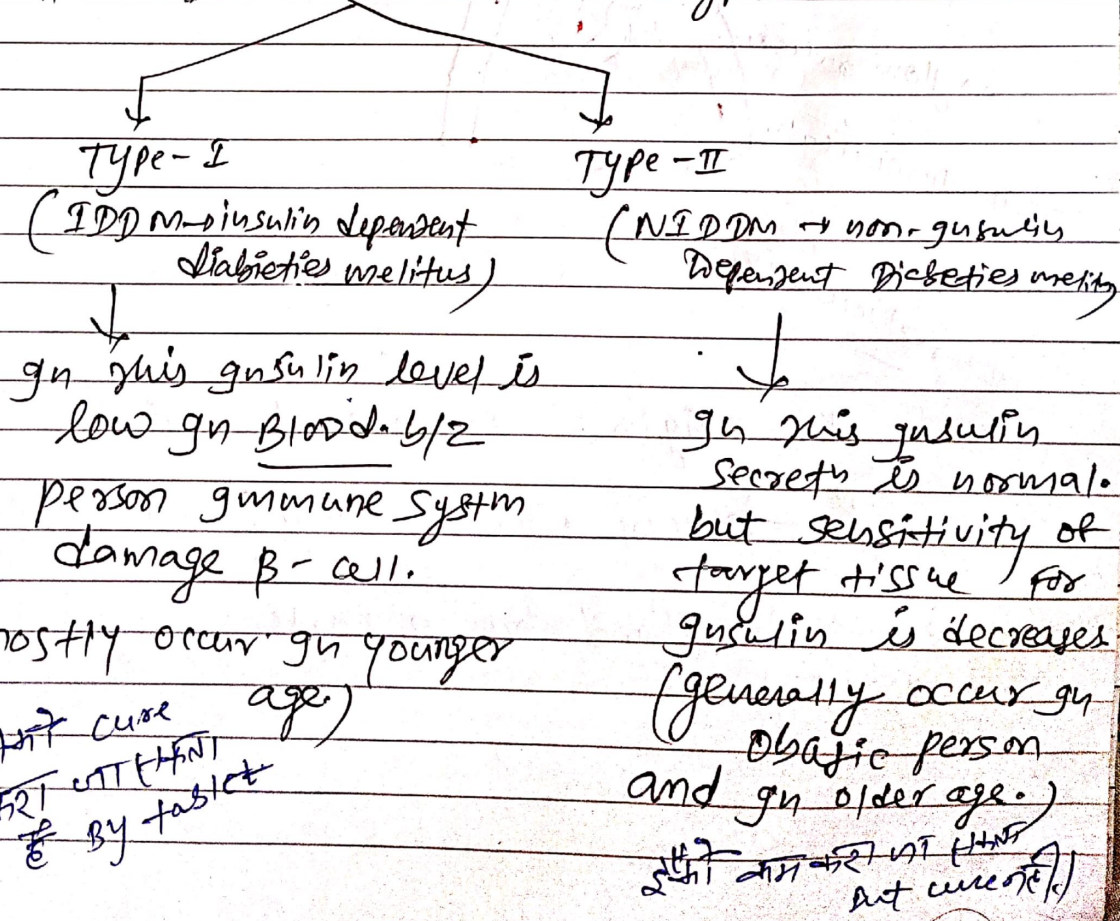
Disorders:-

Due to low secretion of insulin Blood glucose level increases. This condition is called hyperglycemia. prolonged hyperglycemia causes diabetes mellitus disease.

Diabetes mellitus.

- glycosuria = +ve of glucose in urine.
- ketonuria = " " ketone body " "
- polyuria = urine volm ↑
- polydipsia = more thirst.
- polyphagia = more hunger.

* Diabetes mellitus 2 type.

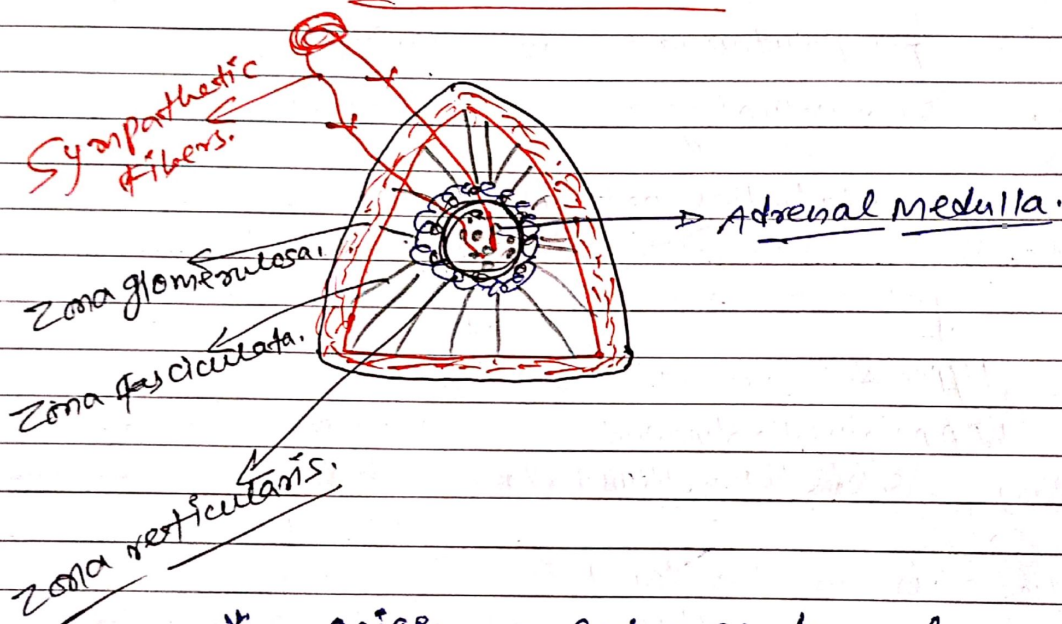


Insulin ppt
(more dangerous)
↳ 1

* Due to high level of insulin
Blood glucose level highly decreases this
is called hypoglycemia. ~~and~~

- ↳ weakness
- ↳ sweating
- ↳ vision problem.
- ↳ unconsciousness
- ↳ Coma.

ADRENAL GLAND.

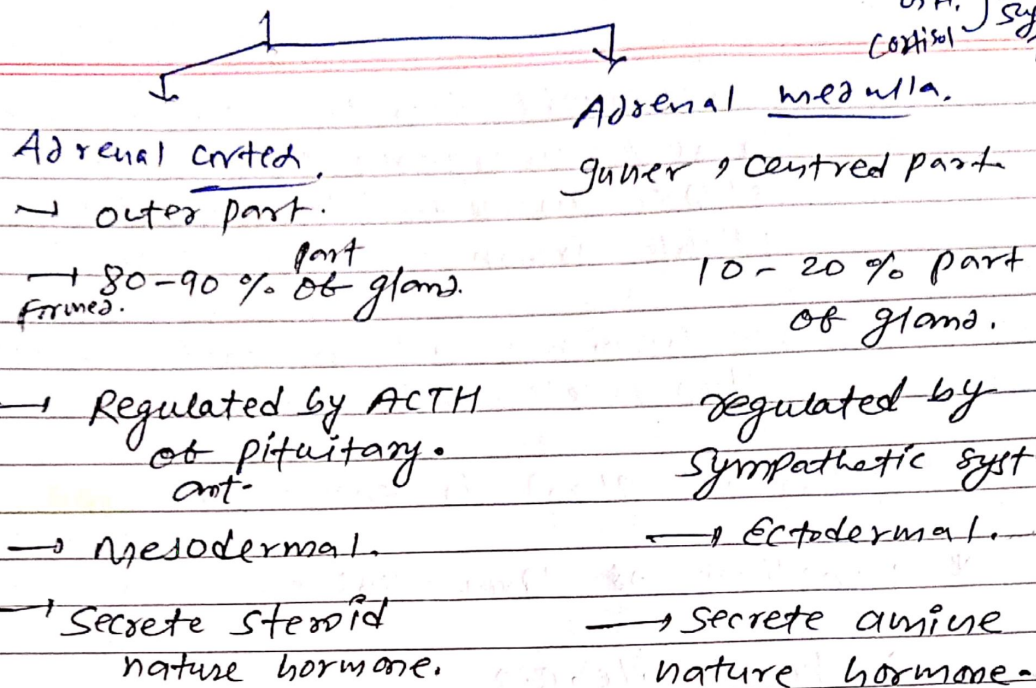


* Origin → ectomesodermal.

* present above kidney, cap like (supra
renal gland)

* this gland has 2 parts.

Adrenalin
(nicotinic)
Thyroid
L.H.
Cortisol
Blood
Sugar
T.



* Adrenal medulla.

- It is inner, ectodermal, central part.
- It contains Chromaffin cells (supra renal mass). These cells are connected with prefibres of sympathetic nervous system.
- Pituitary gland not control adrenal medulla directly.

* Adrenal medulla secrete 2 hormone.

- ① Adrenalin / Epinephrin.
- ② Nor-adrenalin / non-epinephrin.

* Both of these hormones are collectively called Catecholamines. They are derived from Tyrosin AA. They are amine nature hormone and bind with membrane bound structure.

They are rapidly secreted in response of stress / emergency conditions so they are called Emergency hormone / Fight or Flight hormone.

* These hormones act on heart, muscles, Blood vessels, Fat cell.

* Adrenal gland is known as **3F-island**.
fear, fight, flight.

* Functions of Adrenalin :-

↑ heart rate, B.P.
↑ Strength of heart contraction (stroke volume)
↑ Breathing rate.
↑ Pupil dilation.
↑ hair raised on skin. (pilo-erection)
decreased (t) salivation, paresthesia.

↑ Breakdown of glycogen. (Blood glucose level)

Stimulate Breakdown of lipid and protein.

↑ Sweating.

Adrenal Cortex.

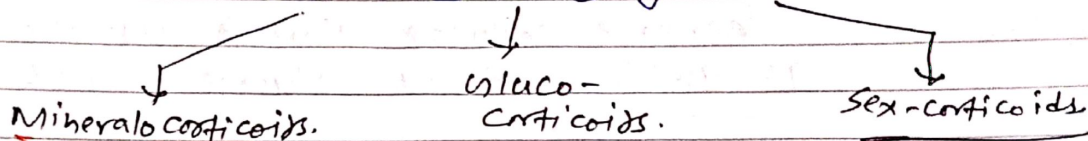
→ It is outer, mesodermal part.

→ It has 3 layers.

- outer = zona glomerulosa.
- middle = " fasciculata.
- inner = " reticularis.

* hormone secreted by adreno-cortex are called corticoids, these are steroid nature hormone. they bind with intercellular receptors.

* Corticoids divides into 3 groups.



* secreted by zona-glomerulosa layer.

By zona fasciculata layer.

Zona reticularis layer.

* Regulate balance of water and electrolyte.

Involved in Carbohydrate metabolism.

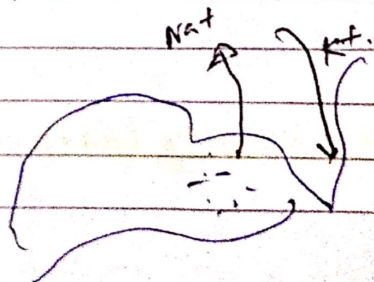
involved in secondary sexual character

* main hormone is aldosterone.

main hormone is Cortisole.

Aldosterone → It is secreted by adreno cortex. It act on DCT and collecting duct of nephron. It induce Na^+ , water reabsorption (in blood) and induce K^+ & phosphate excretion (urine)

So $\uparrow \text{Na}^+$ in blood, $\uparrow \text{B.P}$, \uparrow Blood volm.



(*) Thyroid
Adrenalin.
Cortisol.
Testosterone.
Erythropoietin. } RBC
Produ.

Cortisol

It is main gluco-corticoid.
It regulate carbohydrate metabolism.
It stimulate gluconeogenesis. It decrease cellular glucose uptake so It increase Blood glucose level.

↳ It stimulate lipolysis and proteolysis so increase level of AA and Fatty acid in Blood.

- (*) It Induce RBC production.
- (*) Cortisol is immuno suppressive. It suppress synthesis of Antibody so, it is used in the organ transplantation surgery.
- (*) It is anti-inflammatory.
- (*) Cortisol is anti-allergic hormone. It reduces histamine secretion, mast cell activity. It is used in treatment of allergy (asthma).
- (*) Cortisol regulate Cardiovascular System as well as kidney function.
- (*) It ^(stabil) inhibit ↑ in WBC in Blood. _(decrease)
- (*) Cortisol is life-saving hormone.

Sex-corticoid.

↳ these are produced in trace amount by zona-reticularis layer. they play role in development of axial hair, pubic hair, facial hair.
(man sex-corticoid is DHEA → DihydroEpi Aldosterone)
and Estradiol → (woman) etc.

⊕ In female excessive secretn of sex-corticoid DHEA causes Adrenal virilism disease. So, male character appear in this female

* Abnormal secretn of corticoids.

~~NCERT~~

Addison's disease.

Cushing syndrome.

Conn's disease.

due to hyposecretin of glucocorticoid and mineralocorticoids.

Due to hypersecretin of Cortisol.

due to hypersecretin of aldo-sterone.

↳ Low sugar level
Low Na⁺ in blood.
→ vomiting, diarrhoea

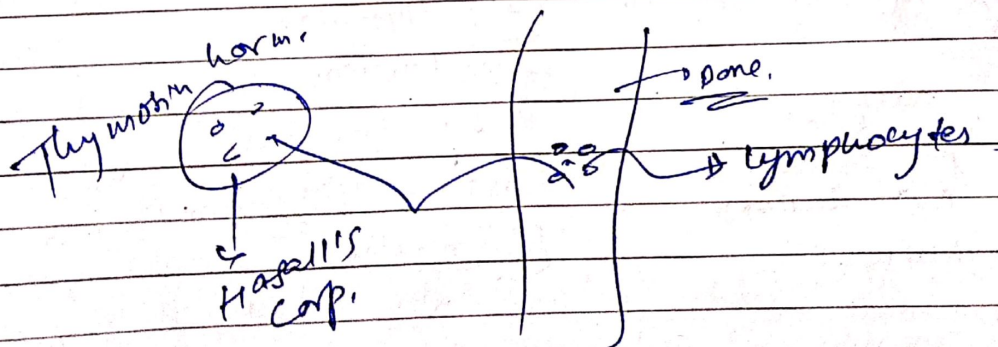
* Hyperglycemia,
→ hypertension.
→ Pubby appearance
→ Buffalo's hump
→ fish mouth

↳ High Na⁺ in blood,
high B-P, very low K⁺ in blood.
Blood-nervous system weakness.

(infectⁿ in intestine)
Hyper-pigmentation of skin.

Thymus gland.

- * Endodermal.
- * present at ventral site, behind sternum, b/w two lungs \rightarrow (mediastinum space).
- * Thymus gland secrete peptide hormone thymosin. This gland play major role in development of immune system.
- * Thymosin play role in differentiation and maturation of T-Lymphocyte. So, it help in cell-mediated immunity.
- * Thymosin also increase secretion of antibody from B-Lymphocyte.
- * Thymus gland contain spherical shape phagocytic cell called Hasall's corpuscles.
- * Thymus gland degenerate in old person.



Pineal gland.

→ Ectodermal

→ Located on the dorsal side of forebrain.

→ It secretes melatonin hormone.

It is Amine nature.

* It is derived from tryptophane Amino Acid.

* Melatonin is called sleep hormone. It induces sleep and decreases alertness. Its concn increases in dim light and decreases in bright light.

* Darkness ↑, melatonin ↑, alertness ↓.

* Melatonin maintains normal rhythm of sleep-wake cycle.

* Pineal gland plays a role in 24 hr (daily-rhythm) regulation of body.

* Melatonin stimulates/influences metabolism + Defence capability.

* Melatonin maintains body temp + regulates menstrual cycle.

* Melatonin influences pigmentation of skin in amphibians, reptiles. It ~~induces~~ light colour in skin so antagonist causes to MSH.

→ In mammals pineal gland secretion suppress gonadal activity and sexual character after birth. At puberty GT's secretion stop and gonadal activity start.

→ Mostly receptors of melatonin located in hypothalamus

Hormones from Kidney, GIT, Heart.

(1) Kidney.

↳ contain J. cell
which secrete 2 hormones.

↳ Renin → for osmoregulation.

↳ Erythropoietin → for RBC production.

(2)

Heart → the wall of atria release hormone ANF. It is vasodilator.

↳ It has opposite effect to renin.

(3)

Gastrointestinal tract : →
wall of GIT secrete 4 major peptide hormone.

(a) Gastrin hormone = stimulate secretion of gastric juice (HCl, pepsinogen)

(B) CCK (cholecystokinin) → It acts on both gall bladder and pancreas and stimulates secretion of bile juice and pancreatic juice.
CCK stimulates contraction of gall bladder.

(C) Secretin (It is secreted by duodenum into blood.) It is a discovered hormone. It acts on pancreas and stimulates secretion of alkaline fluid of pancreatic juice (Bicarbonate).

(D) GIP (gastric inhibitory peptide)
→ It inhibits gastric motility and secretion.