

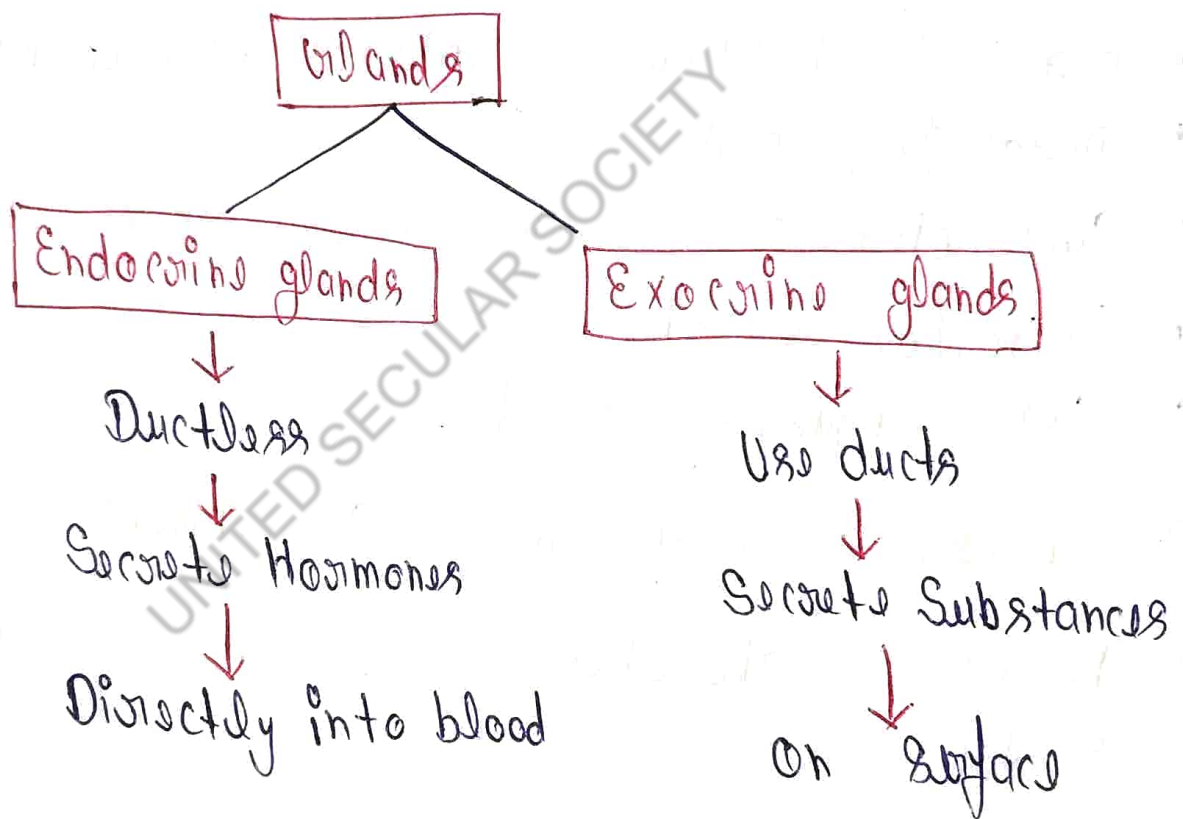
Endocrine System

Endo $\Rightarrow$ Internal Crins $\Rightarrow$ Secretory

$\Rightarrow$ The Endocrine system consists of glands that secrete hormones essential for maintenance of homeostasis ^{समस्थिति} throughout the body.

$\Rightarrow$ It consists of glands

Glands $\Rightarrow$ Secretory organ that produce and secrete chemical substances.



Endocrine gland $\Rightarrow$ A gland whose secretion is released directly into the bloodstream without a duct.

Hormone $\Rightarrow$ A hormone is a chemical substance that is secreted into the body fluids by one cell or a group of cells and that exerts a

Physiological control effect on other cells of the body.
Hormones are also called chemical messengers.
[or]

Hormones are chemical messengers that are secreted directly into the blood, which carries them to organs and tissues of the body to exert their functions.
जो कि अंगों को कार्य करवाते हैं।

Function →

[1] Help regulate :-

- chemical composition & internal environment
- metabolism and energy
- contraction of smooth muscle fibers
- glandular secretion
- Some Immune system process.

[2] Control growth and development

[3] Regulate operation of renal and reproductive system.

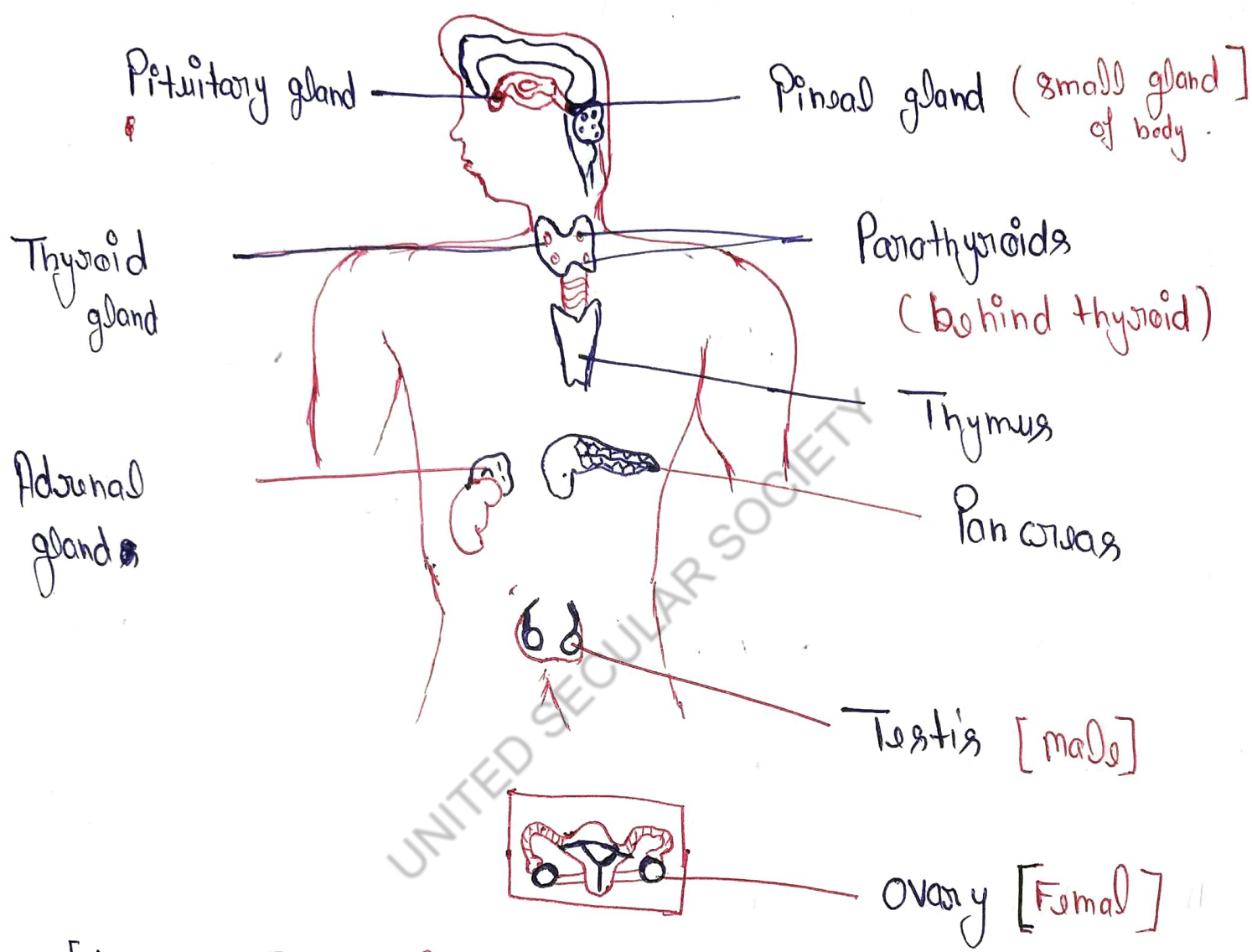
→ The major Endocrine glands are :-

- [1] Pituitary gland [~~Hypothalamus~~]
- [2] Thyroid gland
- [3] Parathyroid gland
- [4] Adrenal glands
- [5] Pancreas gland

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- 6) Sex glands [gonads] < Testes (m)
Ovaries (F)
- 7) Thymus
- 8) Pineal gland

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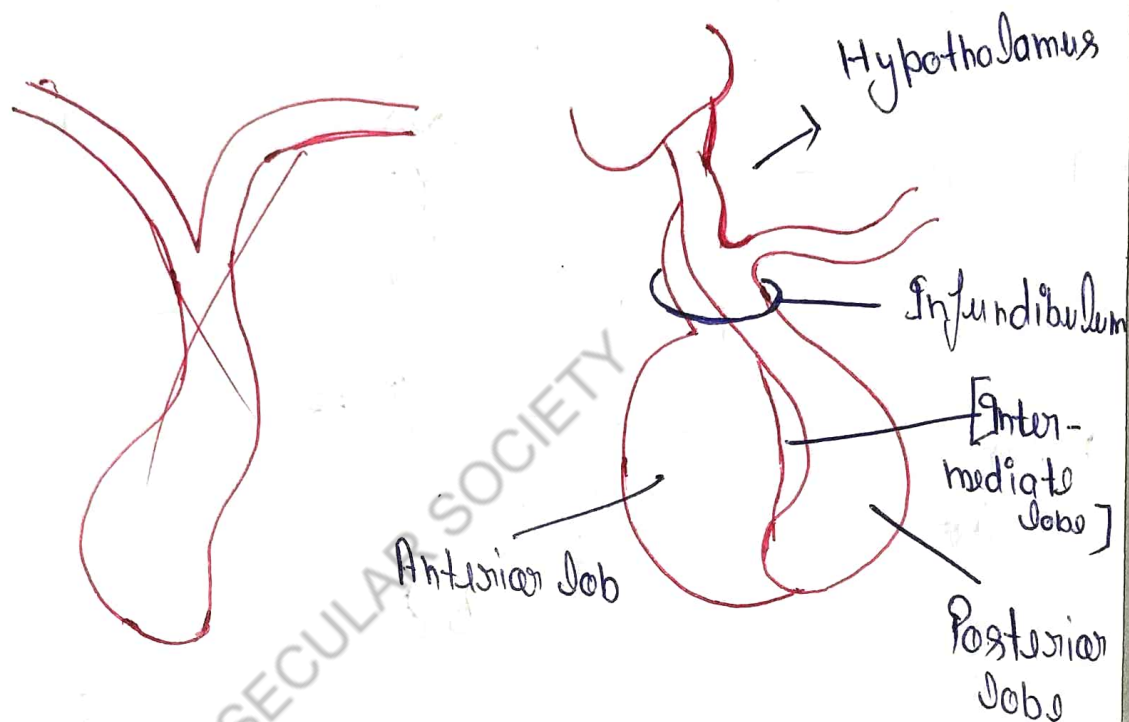


[Hypophysis] = Pituitary gland = [Hypothalamus gland]

- ⇒ Pituitary gland is situated at the base of brain in hollow called "sella turcica" of sphenoid bone.
- ⇒ The main endocrine gland. It is small structure in the head. It is called the "master gland" because it produces hormones that control other glands and many body function including growth.
- ⇒ The Pituitary consists of the three main lobes.

- (a) Anterior lobe [Adenohypophysis]
- (b) Posterior lobe [Neurohypophysis]
- (c) Intermediate lobe

Structure



[1] Anterior Pituitary :- The pituitary gland
The anterior lobe of pituitary contains
three types of cells namely "**chromophobe**", "**Eosinophil**" and
"**Basophil**".

Hormones of anterior pituitary ⇒

- Thyroxine $\xrightarrow{T_4}$
- Triiodothyronine $\xrightarrow{T_3}$
- Gonadotropins {
 - [1] Growth hormone [GH]
 - [2] Thyroid stimulating hormone [TSH] / Thyrotrophic hormone
 - [3] Adrenocorticotrophic hormone [ACTH]
 - [4] Follicle stimulating hormone [FSH]
 - [5] Luteinizing hormone [LH]
 - [6] Lutetotrophic hormone [LTH]
 - [7] Prolactin [PRL]

1] Growth hormone $\Rightarrow$ It is necessary for the normal growth and development of the body.

2] Thyroid stimulating hormone $\Rightarrow$ It regulates the synthesis of thyroid hormones in the thyroid gland.

3] Adrenocorticotrophic hormone $\Rightarrow$ It stimulates the adrenal cortex to synthesize its hormones.

4] Follicle stimulating hormone $\Rightarrow$ It stimulates the ovary in females to synthesize oestrogen and testes in male to produce spermatozoa.

5] Luteinizing hormone $\Rightarrow$ It stimulates the ovary in females to produce progesterone and testes in male to produce testosterone.

6] Lactotrophic hormone $\Rightarrow$ It stimulates milk production in females.

7] Prolactin $\Rightarrow$ It also stimulates milk production in women after delivery.
 $\Rightarrow$ It stimulates the development of mammary gland duct.

Posterior pituitary $\Rightarrow$ The posterior lobe of pituitary secretes two hormones. They are Oxytocin and Vasopressin.

(1) Oxytocin

(2) Vasopressin.

(1) Oxytocin $\Rightarrow$ It has got two functions

- (a) Contraction of the uterus during labour (delivery) and to bring about ^{जन्म देने की प्रक्रिया} parturition (That is, birth of a baby).
- (b) ^{दूध निकालना} Ejection of milk from the breast.

(2) Vasopressin (Anti-diuretic hormone ADH) $\Rightarrow$ Its functions are

- (a) Decreasing urine output by increasing tubular reabsorption in the kidney.
- (b) Increasing blood pressure (BP) by constricting capillaries and arterioles.

Intermediate pituitary $\Rightarrow$ The intermediate lobe of pituitary secretes one hormone which is

(1) Melanocyte stimulating hormone [MSH]

(i) Melanocyte stimulating hormone [MSH] $\Rightarrow$ It is responsible for the colour of the skin.

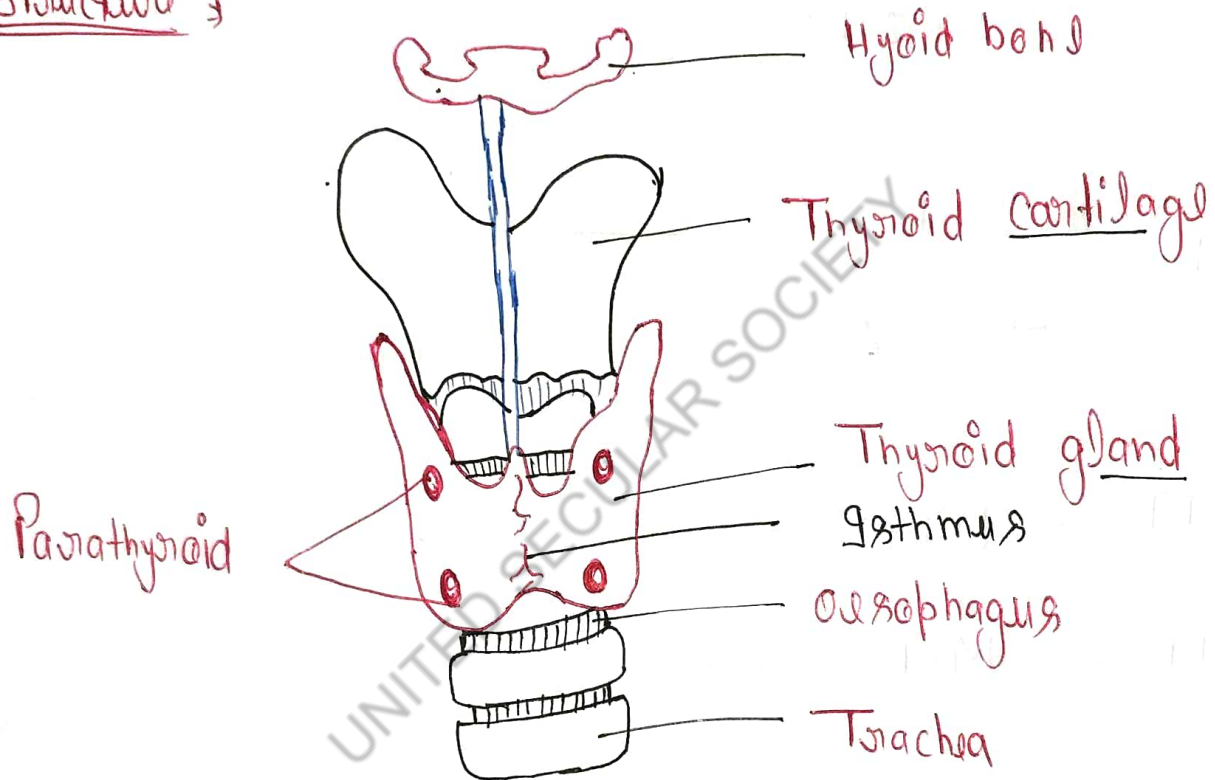
~~Thyroid~~

Regulation and release of hormones

Thyroid gland

- The thyroid gland is situated in the lower part of neck on the thyroid cartilage. the thyroid gland contains two lobes. one on each side of the trachea. these two lobes are connected by an "Isthmus" which lies in front of the trachea.
- This is the largest endocrine gland in our body.

Structure



The thyroid gland is divided by means of connective tissue into a number of lobules. Each lobule contains a number of spherical cells called "follicles". Each follicle is lined by a single layer of cuboidal epithelial cells. the follicles contain a jelly like substance called "colloid". The colloid stores the thyroid and releases when needed.

- follicular cells secrete T_3 & T_4 hormones
- Calcitonin is secreted by parafollicular cell.

$T_3 \Rightarrow$ Thyroxine
 $T_4 \Rightarrow$ Triiodothyronine

Secret

Formation and secretion of thyroid hormone :-

Iodide $\longrightarrow$ Iodine

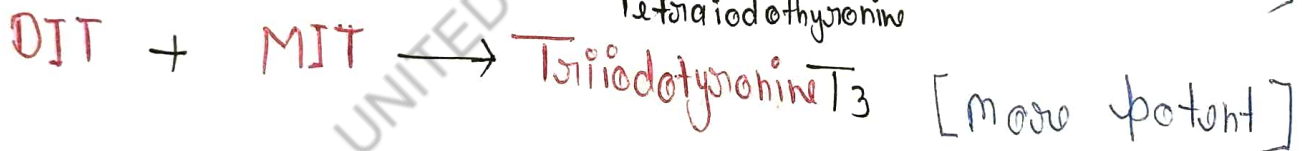
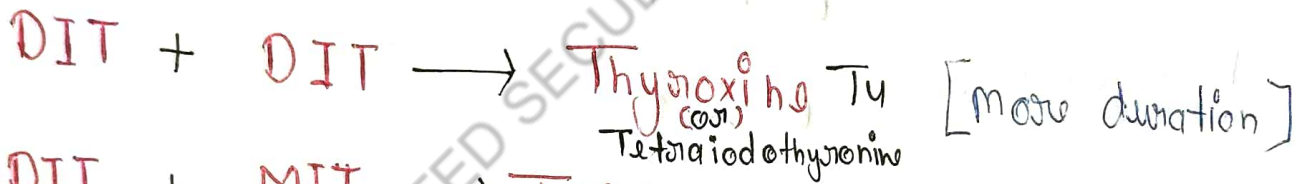
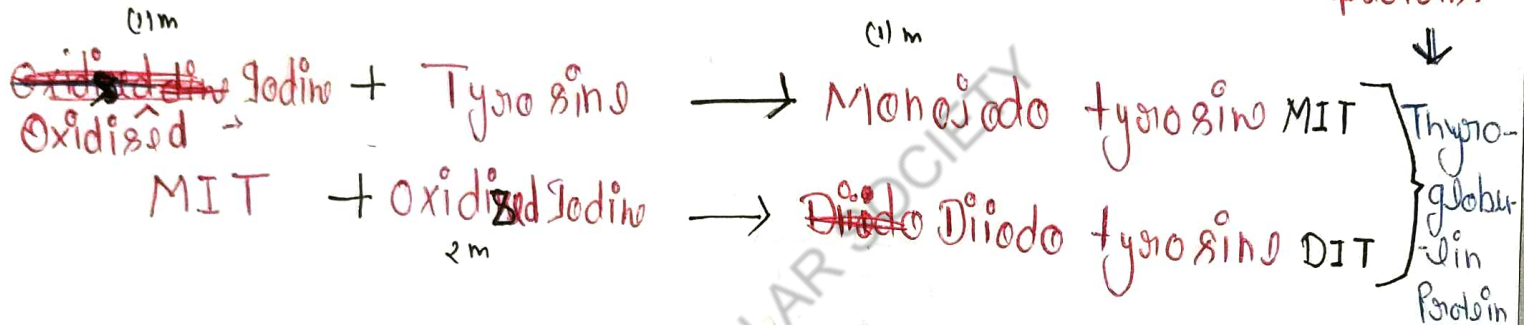
$\downarrow$

~~Iodide~~

Oxidised Iodine

Thyroglobulin proteins.

$\downarrow$



$\Rightarrow$ The thyroid gland synthesises and secretes ~~the~~ hormones. They are thyroxine and triiodothyronine. The synthesis of these hormones occurs in the following four stages.

- (1) Iodide is oxidised to iodine
- (2) Iodine combines with the amino acid tyrosine and forms monoiodotyrosine (MIT) and diiodotyrosine (DIT)
- (4) Two molecules of DIT combine to form thyroxine T_4
- (5) One molecule each of DIT & MIT to form triiodothyronine.

Hormones → Thyroid stimulating hormone released by anterior pituitary gland regulates the secretion of thyroxine, triiodothyronine and Thyrocalcitonin [TCT] hormones from the thyroid gland.

(1) Thyroxine → Thyroxine is an iodine-containing amino hormone. It is made up 65% of iodine.

→ Thyroxine [T₄] is the main hormone secreted into the blood-stream by the thyroid gland. It is the inactive form and most of it is converted to an active form called triiodothyronine [T₃] by organs such as the liver and kidney.

Function →

- (1) Thyroxine regulates body's basal metabolic rate (BMR)
- (2) It controls urine output by regulating the working of renal tubules.
- (3) It stimulates protein synthesis.
- (4) It regulates the development of mental faculties.
- (5) It increases the action of adrenaline and nor-adrenaline hormones.
- (6) Storage of iodine.
- (7) Increase in the rate of cholesterol synthesis in liver.

(2) Thyrocalcitonin TCT → Thyrocalcitonin is a long peptide hormone which is released by the parafollicular cells of thyroid gland. It reduces

the reabsorption of calcium forms bone and inhibit reabsorption of calcium by the renal tubules.

Function of thyroid gland $\Rightarrow$

- (1) It controls the body's metabolic activity (the body's ability of converting food into energy).
- (2) It controls the breathing and heart rate.
- (3) It monitors the body weight.
- (4) It secretes a hormone which controls the internal body temperature and cholesterol levels.

Disorders of thyroid $\Rightarrow$

(1) Hypothyroidism
 $\downarrow$
(धीँड़ा रोग)

- Endemic goiter
- Myxoedema (swelling of skin)
- Cretinism (mental retardation)

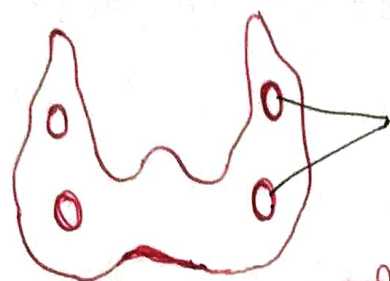
(2) Hyperthyroidism
 $\downarrow$

- Grave's disease
(अग्र (वेग) प्रोतुसion of eyeball)

Parathyroid glands

Parathyroid glands are small endocrine glands located in the neck and produce parathyroid hormone. The parathyroid glands are four in number and positioned behind the thyroid gland. These glands regulate the calcium level in the blood and bones.

Structure



Parathyroid glands

The parathyroid glands are composed of masses of epithelial cells. The cells are of two types.

- (1) 'Chief cells', - which secrete the "Parathyroid hormone (PTH) or Parathormone."
- (2) 'Oxyphil cell'.

Function $\Rightarrow$ PTH increases calcium (Ca^{+}) level of plasma and extracellular fluid. This effect is produced by the following mechanism.

- (a) Mobilisation of calcium of bone into the extracellular fluid.
- (b) Increased absorption of calcium in the renal tubule.
- (c) Increased absorption of calcium in the GIT gastro-intestinal tract.

Disorders

(1) Hyperparathyroidism



$\Rightarrow$ "Osteitis fibrosa"
[Loss of strength]

(2) Hypoparathyroidism

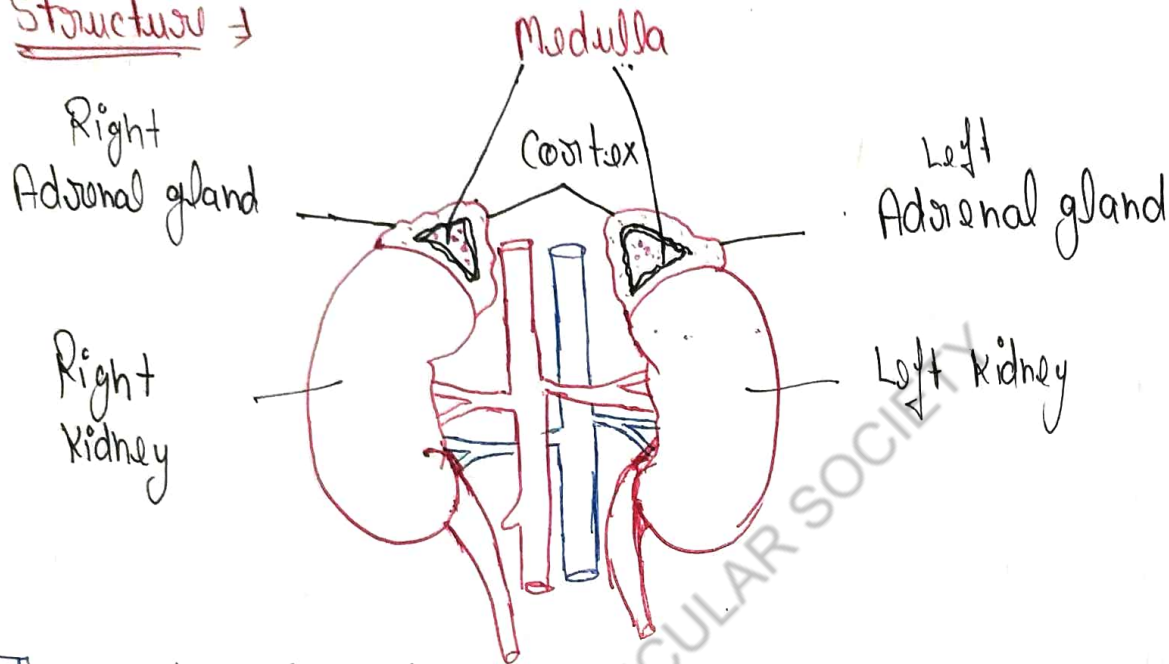


$\Rightarrow$ decreased amount of calcium in the blood.

Adrenal gland # / Suprarenal glands

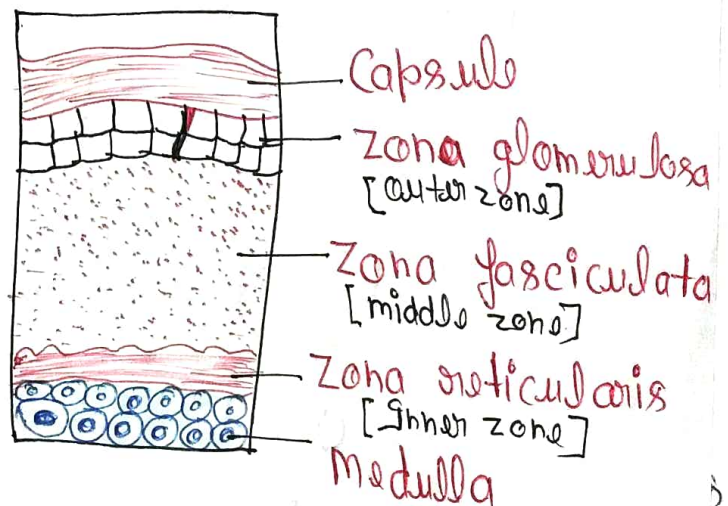
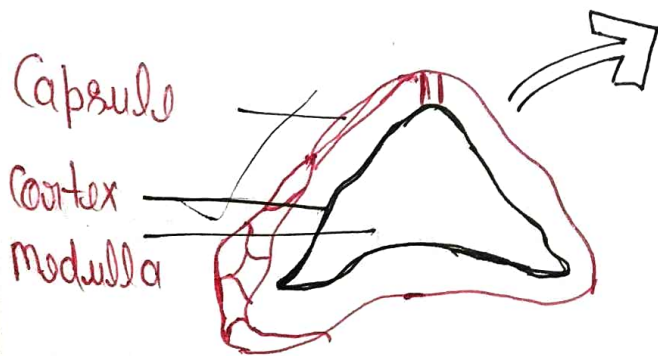
The adrenal glands are two in number. Adrenal gland is situated on top of each kidney. Each gland has two parts - reddish brown medulla and external bright yellow cortex.

Structure →



The adrenal gland can be divided into two parts which are different in structure and function. They are:

- (1) An Inner "Medulla"
- (2) An Outer "Cortex"



* The cortex has three distinct layers of cell.

- (1) zona glomerulosa ~~secretes~~ (an outer layer)
- (2) zona fasciculata ~~secretes~~ (a middle layer)
- (3) zona reticularis (an inner layer)

Adrenal Cortex $\Rightarrow$ The adrenal cortex secretes three groups of hormones. These hormones are secreted by the three different layers of cortex as follows:

- (1) Zona glomerulosa secretes "mineralocorticoid"
- (2) Zona fasciculata secretes "glucocorticoid"
- (3) Zona reticularis secretes "sex steroids"

Mineralocorticoid $\Rightarrow$ The mineralocorticoids are "Aldosterone" and "Deoxycorticosterone". They help to maintain electrolyte and water balance of the body as follows:
 $\Rightarrow$ By increasing the reabsorption of sodium in the renal tubules.

Glucocorticoid $\Rightarrow$ The glucocorticoids are "Cortisol", "Cortisone" and "Corticosterone".
 $\downarrow$

function $\Rightarrow$

- (a) To $\uparrow$ increase the synthesis of glycogen
- (b) To $\uparrow$ increase the breakdown of protein into amino acid.
- (c) $\downarrow$ Decreasing the production of eosinophils and lymphocytes
- (d) Anti-inflammatory and anti-allergic effect.

Sex steroid $\Rightarrow$

Androgens [In male]

Oestrogens [In females]

$\Rightarrow$ These two hormones are similar to those produced by testes and ovaries. These hormones influence growth and sexual development.

Adrenal medulla $\Rightarrow$ The adrenal medulla secretes adrenaline and nor-adrenaline. These two substances are liberated from sympathetic nerves.

Adrenaline $\Rightarrow$ Epinephrine $\Rightarrow$ Adrenaline exerts biological effects similar to sympathetic nervous system (SNS). This system acts in a similar way on similar organ.

Function $\Rightarrow$ Adrenaline increases blood pressure $\uparrow$ (BP) by increasing $\uparrow$ heart beat and cardiac output.

$\Rightarrow$ It $\uparrow$ increases blood sugar level by stimulating liver glycogenolysis.

$\Rightarrow$ It $\uparrow$ increases respiration rate by dilating trachea.

$\Rightarrow$ It $\uparrow$ increases fatty acid level in blood by increasing lipolysis in adipose tissues.

$\Rightarrow$ It dilates the pupil of eye.

$\Rightarrow$ Relaxation of the intestine.

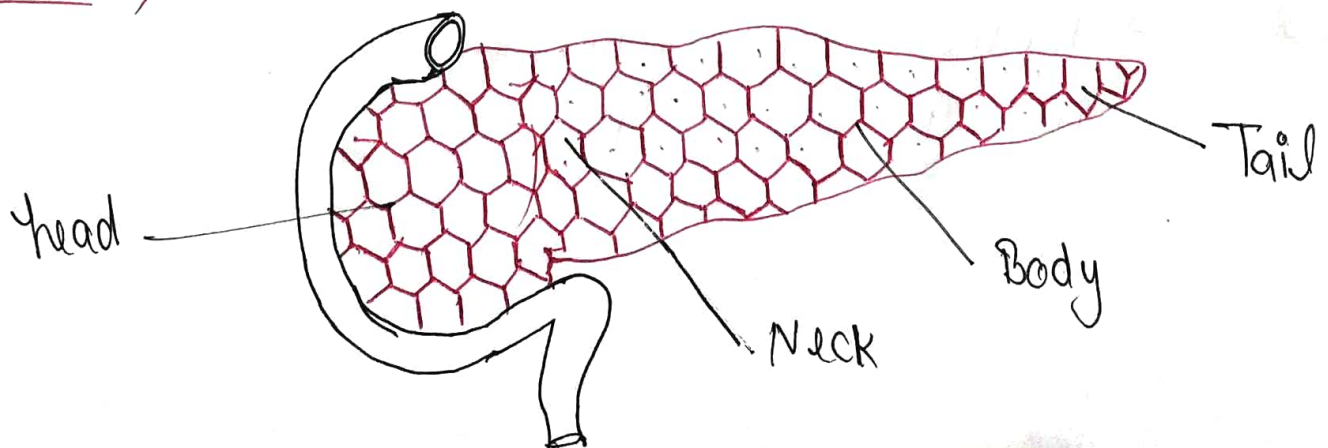
Noradrenaline (or)

Nor-Epinephrine $\Rightarrow$ Nor-Epinephrine exerts almost the same biological effects as adrenaline. The only difference is that it operates during normal state.

Pancreas

- $\Rightarrow$ The Endocrine part of pancreas consists of a collection of cells called the ^(दोला या दीपा) islets of Langerhans. There are about 1 to 2 million islets of Langerhans, which have a rich blood supply. [1 million $\Rightarrow$ 10 Jaks]
- $\Rightarrow$ The pancreas lies on the posterior abdominal wall in front of abdominal. It extends between the C-shaped ^(कली होती है) curvature of duodenum and the spleen.
- $\Rightarrow$ There are four types of
- $\Rightarrow$ The islets Langerhans contain four types of cells.
 - (1) Alpha cells $[\alpha]$ $\Rightarrow$ ~~secrete~~ which produce glucagon
 - (2) Beta cells $[\beta]$ $\Rightarrow$ which produce Insulin
 - (3) Delta cells $[\delta]$ $\Rightarrow$ which produce Somatostatin.
 - (4) PP cells $[PP]$ $\Rightarrow$ which produce Pancreatic polypeptide.

Structure $\Rightarrow$



The bulk of pancreas contains exocrine cell called "Acini". These acini secrete the pancreatic juice which is digestive in function. In between the acini, there are some endocrine cells, called "islets of Langerhans".

Hormones :-

(1) Glucagon $\Rightarrow$ It is a hormone secreted by the alpha cells of islets of Langerhans. This hormone contains 29 amino acid.

Function $\Rightarrow$ Increase in blood sugar level by mobilising glycogen from the liver.
 $\Rightarrow$ mobilisation of stored fat
 $\Rightarrow$ Release of Insulin from pancreas.

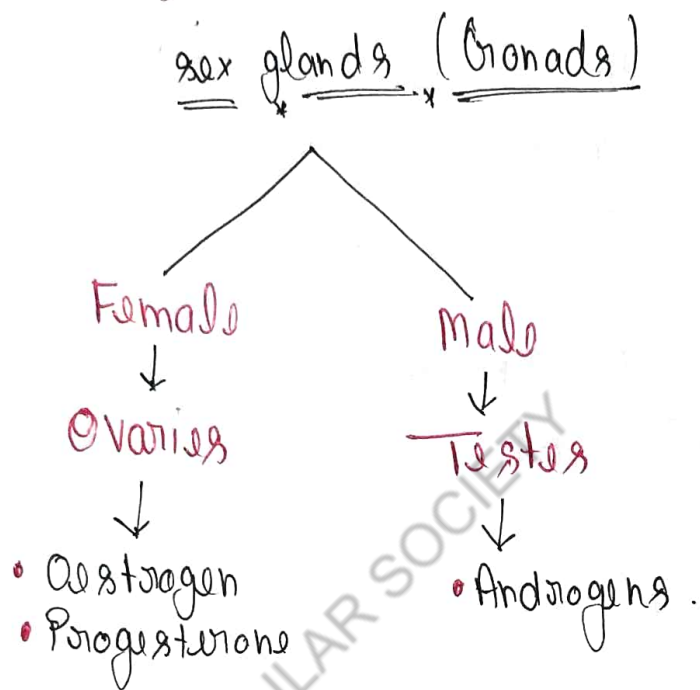
(2) Insulin $\Rightarrow$ It is a hormone secreted by the beta cell of islets of Langerhans. It contains 51 amino acids. The important action of Insulin to $\downarrow$ decrease the level of glucose in the blood.

Function $\Rightarrow$ Increasing glycogen synthesis but preventing glycogen breakdown in the liver.

$\Rightarrow$ Promoting the conversion of glucose into fat in the adipose tissue.

Sex glands (Gonads)

The sex glands are "Ovaries" in the female which secrete Oestrogen & Progesterone and "Testes" in the male which secrete Androgens.



(1) Oestrogen $\Rightarrow$ It is the female sex hormone secreted by the ovaries. its function are:

- (1) Regulation of the menstrual cycle.
- (2) Development of secondary sexual characters.

The secretion of oestrogen is controlled by follicle stimulating hormone (FSH) of anterior pituitary.

(2) Progesterone :- It is also a female sex hormone secreted by the ovary. its function are

- (1) Maturation and development of uterus and breast.
- (2) Preparation of the uterus to receive the fertilised ovum and to maintain pregnancy.

Androgens $\Rightarrow$ They are male sex hormones secreted by "Interstitial cells" of the testes. The most important androgen is "Testosterone". The important function of androgens are:

- (1) Growth of penis, scrotum and prostate (मसूर)
- (2) Stimulation of spermatogenesis (शुक्राणु जनन)
- (3) Development of secondary sexual characters.

The secretion of androgens is controlled by Luteinising hormone [LH] of anterior pituitary.

Disorders of sex glands :-

Androgenital syndrome :- This syndrome is due to excess secretion of androgens in females. This syndrome is characterised by the development of hair in face and over the body.