Human Anatomy and physiology

★ Endocrine system ★

- The endocrine system consist of ductless glands which secrete hormones.
- The hormones (chemical messenger) diffused into blood stream (circulation)
- From the blood stream hormones reached to target tissue and organs where they effect cellular growth and metabolism
- The following are endocrine glands present in body

Diagram ★★★★

1. Pituitary gland ✓
2. Thyroid gland ✓
3. Parathyroid gland ✓
4. Adrenal gland ✓
5. Pancreas ✓
6. Gonads or sex glands ✓
7. Thymus gland
8. Pineal glands ✓

1. Pituitary gland: (Master gland) :- It is situated at the base of the brain.
- It is a size of a pea.
- It weight about 500 mg
- It consist of 3 different lobes that originates from different type of cell.
- The two lobes are main
  - Anterior lobe (Pituitiary)
  - Posterior lobe. (Pituitiary)

Anterior pituitary or Anterior lobe:- The cell have been divided into two types on the basis of their staining

i. Granular → i. Acidophillous (75%) - produce growth hormones
ii. Agranular → ii. Basophillous (25%) - The remaining are produced by it

Hormones of Anterior pituitary - GH, Thyroid stimulating hormone, (TSH), ACTH, FSH, LH and Gonadotropin hormones (GTH)

Posterior pituitary: It secretes two hormones

i. Vasopresin or ADH
ii. Oxytocin.

Endocrine gland or hormone	Target Tissue	Principle Action
i) Anterior lobe of pituitary.		
1) GH	General	i. Stimulates production of insulin like growth factors ii. Stimulate growth by promoting protein synthesis.
2) Prolactin	mammary glands	i. Stimulates milk production
3) TSH. Thyroid stimulating hormone	Thyroid glands	i. Stimulates secretion of thyroid hormone ii " increase in size of thyroid gland
4) Adeno cartico tropic hormone (ACTH)	Adrenal cortex	i. Stimulates secretion of adrenal cortical hormones.

5) Gonadotropic hormone (GTH) — Gonads — i. Stimulates gonads function and growth.
   - → FSH
   - → LH

ii. Posterior lobe of pituitiary

Hormone	Target Tissue	function
1) Oxytocin	utreus and mammary glands	i. Stimulate contraction of utreus ii. Stimulate ejection of milk into ducts
2) ADH or vasopresin	Kidney	i. Stimulate reabsorbtion of water. (inside Kidney especially renal tubules)

Thyroid gland ~~General~~

1) Thyroxin (T_4)	General	i) Stimulate metabolic rate
2) Triiodothyronine (T_3)	General	ii) Essential to normal growth and developement
3) Calcitonine	Bone	i) Decrease blood calcium level by inhibiting calcium ion release from bones

Parathyroid Gland — Bone, Kidney & digestive tract (or GIT.)
i) Increase blood calcium level by stimulating calcium ion relase from bones.
ii) stimulates calcium ion reabsorbtion by kidney

iii) Activates with vitamin D which increase intestinal absorbtion of calcium ion.

Pancreas: Islets of Langerhans of pancreas:

i) insulin — General → Lowers Glucose concentration to normal value in blood by facilitating glucose uptake and utilization by cells
→ Stimulates Glycogane production.
→ stimulates fat storage and protein synthesis

ii) Glucagone — Liver and Adipose tissue → increase glucose concentration in the blood.
→ Stimulates glycogen breakdown and metabolism of fat

Adrenal Medulla and Cortex

i) Epinephrine (Adrenaline) — Skeletal Muscles, Cardiac & Blood vessels → help body to cope with stress.
→ increase heart rate

ii) Non-epinephrine (non-adrenaline) — Liver and Adipose tissue → Increase blood pressure
→ Decrease metabolic rate
→ Reroute blood
→ Metabolism of fat
→ Increase blood sugar level

Adrenal Cortex

i. Aldosterone — Kidney tubules — i) Maintain Na, K balance
ii) Increase Na reabsorbtion
iii) " K. exerection

ii. Cortisol — General — i) Help body to cope with long term stress
ii) Increase blood glucose level.
iii) Mobilise fat

Pineal gland

i. Melatonin — Thalamus — i) Imp. in biological rhytm.
ii) Influence reproductive process in some animals
iii) May help control onset of puberity in womens

Ovary (gonads)

i. Oestrogen — General & Uterus — i) Develope and maintain sex characteristics in female
ii) Stimulate growth of uterine lining

ii. Progestrone — Utreus & Mammary gland — i) Stimulate developement of utrine lining.
ii)

Testes

i. Testosterone — General & reproductive structure — i) Develope and maintain Sex characteristics in male

ii) Promote spermatogenesis

iii) Responsible for aldoresent growth

ii. Inhibin — Anterior lobe of pituitary — i) Inhibits FSH release in male

Pancreas.

- The pancreas consist of exocrine part and endocrine part.
- The islet of "langerhans" which is the endocrine part consist of about 2% of granular tissue and are dispersed throughout the pancreas.
- The exocrine cell produce digestive enzyme
- About 70% of the iselets cell are -
  - i) "β cells" release - Insulin
  - ii) "α cells" relase - Glucagon
  - iii) "δ cells" release - Somatostatin.

NOTE.

i. The normal blood glucose level is between 60-144 mg/100ml of blood.

ii. The blood glucose level is controlled by the antagonistic action of insulin and glucagon.

iii. Glucagon increase blood glucose level and insulin decrease blood glucose Level.

function of Insulin

i) Increase the permeability of cell membrane for utilization.

ii) Insulin promotes the entry of glucose into all cells of body except cells of liver, brain cells & RBC

iii) Insulin also promote the entry of fatty acids and amino acids into the cells

iv) It helps the entry of potassium inside the cell and promote the synthesis of glycogen from glucose.

v) Insulin promote lipogenesis (lipid formation)

vi) Inhibit the formation of Ketones

vii) Promote the protein synthesis

viii) Increase the synthesis of DNA and RNA

ix) Onee glucose enter muscles cells it is either used immediately as fuel or stored as glycogen

x) It also inhibit liver cells for releasing glucose

function of Glucagon:-

The action of glucagon is opposite to those of insulin, so the effect of glucagon increse blood glucose level by-

i. stimulating conversion of Glycogen to Glucose in liver and skeletal muscle

ii. Promoting glyconeogeneesis (formation of new glucose molecule)

iii. Increase Adipose tissue (lipolysis) other than carbohydrate.

Regulation

- Secretion of Insulin and glucagon directly controlled by blood glucose level.
- After a meal the conc^n of glucose in the blood increase its stimulates the β cells to increase the insulin secretion.

- Glucose concn too high (in blood)

↓

β cells secretes insulin

↓

Blood glucose concentration decrease

↓

Homeostatis (Balanced condition)

- When one has not eaten for several hours the glucose concn in the blood begins to fall.

- when it falls from its normal fasting level of about 90 mg/dm to 70mg/dm the α-cell of isdets secrets Glucagon.

- Glucose concn too low (in blood)

↓

α-cells secretes Glucagon

↓

Blood glucose concn. increases

↓

Homeostasis (Balanced condition)

Diabetes Mellitus (DM) < Insulin dependent DM + Injection
Non Insulin dependent DM + (oral hypoglycemic agents)

The main disorder Associated with pancreas hormone is "Diabetes Mellitus". Diabetes Mellitus may be of two types.

Type I and Type II
↓ ↳ Non-Insulin dependent Diabetes Mellitus
Insulin dependent Diabetes Mellitus

- The insulin is not sufficient to the amount of carbohydrate digestion
- The insulin not able to penetrate the cells.

Parathyroid Gland (4) consist of connective tissue and surrounds the thyroid gland. Usually there are four(4) glands but the number may vary from 2 to 10.

- The parathyroid gland secretes parathyroid hormone (PTH) is small protein that regulate the calcium level of blood & tissue fluid

- Function: Increase the blood calcium level when its low.
  - It is achieved by indirectly increasing amt. of calcium absorbtion from small intestine and reabsorb from renal tubule.
  - In this source in adequate supply that Parathyroid stimulate osteoclast from bones

- This is needed for
  i. Muscle contraction

II. Blood clotting
III. Nerve impulse transmission

Regulation of PTH secretion:

The Parathyroid glands are regulated by the calcium ion concentration in the blood and tissue fluid.

Calcium concentration too high
↓
Low PTH secretion from parathyroid gland
↓
Calcium concentration decrease

when concentration of calcium ion in tissue fluid falls very slightly PTH secretion increase

Calcium concentration too low
↓
Increase PTH secretion from parathyroid gland
↓
Calcium concentration increase

NOTE: when calcium concentration becomes very high "calcitonine" is released from thyroid gland and these hormone quickly inhibits removal of calcium ion from bones.

Thyroid gland: It is situated in the neck in front of Larynx and trachea at the level of the 5th, 6th & 7th servical and 1st thoracic vertebrae. It is highly vasular gland weight about 25gram at is surround by fibrous caspule. It resemble a butterfly in shape consist of 2 lobes 1 one on either sides of the thyroid cartilage and upper cartilagenous rings of trachea.

- The gland is composed of Cuboidal epithelium that forms spherical follicles.

- Between the folicles "parafolicular cells" or "C-cells" also present which secrete the "hormone "Calcitonin"

- The thyroid gland produce three hormones they are
  i. Thyroxin (T4)
  ii. Tri-iodothionine (T3)
  iii. Calcitonin.

Thyroxin and Tri-iodothionine = Iodine is essential for the formation of T4 and T3.

- The Thyroid gland selectively take up iodine from the blood by a process known as "iodine traping"

- Thyroid hormone are synthesized as precursors molecule called Thyroglobulin

- The relase of T3 and T4 into the blood is regulated by TSH (Thyroid stimulating hormone) from the anterior pituitary

- The secretion of TSH is stimulated by Thyroid releasing hormone from the hypothalamus
- The level of secretion of TSH depends on the plasma level of T_3 and T_4
- By the -ve feedback mechanism increased Level of T_3 & T_4 decrease TSH secretion and vice-versa
- When the supply of iodine is unsufficient, excess TSH is secreted and there is polyfilation of Thyroid gland cells and enlargement of the gland. (Goiter)
- T_3 and T_4 effect most cells of the body by
  i. Increasing the BMR (Basal Metabolic Rate) and heat production.
  ii. Regulating metabolism of Carbohydrate, protein and fat
  iii. T_3 and T_4 are essential for normal growth and development of → especially - skeletal, and Nervous system
  → other - digestive, skin and reproductive system

Calcitonin

- The hormone is secreted by the C-cells of Thyroid gland.
- It act on the bones and our kidney to reduce the blood vessel level when it is about then normal.
- It reduce the reabsorbtion of calcium from bones and inhibits reabsorbtion of calcium by the renal tubule.

- It act antagonistically to parathyroid horomone.

Adrenal Gland

- Adrenal gland are also known as supra-renal Gland and consist of two gland
- One Situated on the upper lobe of each kidney
- They are about 4cm long and 3cm thick.
- The glands are ~~component~~ composed of two parts which has different structure and function.
- The outer part is "Cortex" and inner is the "Medulla"
- The adrenal cortex is essential to life

Adrenal Cortex

The adrenal cortex produce three groups of steroid hormone from closterol. Theeg are collectively called "Adreno corticoids". They are-

i. Glucocorticoids
ii. Mineralo corticoids
iii. Sex hormones - Testosterone & Oestogene.

i) Glucocarticoid (Cortisole):- The main function of Glucocarticoids are i) Gluconeogenesis, ~~tip~~
ii) liplysis
iii) Stimulating breakdown of protein
iv) Promoting absorbtion of sodium and water from renal tubules other effects anti-i

v) other action
- Anti-inflamatory action
- seperation of immune response
- Delayed wound healing

ii) Mineralo + Corticoids (Aldosterone):- Aldosterone is the main mineralo corticoids. Its functions are associated with maintance of water and electrolyte balance in body

The blood potassium level regulate the amount of aldosterone produced by adrenal cortex. when blood potassium level increased more aldosterone is secreted.

Low blood potassium have opposite effect.

iii) Sex-hormone:- Androgen male sex hormone relase from adrenal cortex.

iv) Adrenal Medulla :- The medulla is completely surrounded by the adrenal cortex

- It develop from nervous tissue in the embryo and is part of the sympthatic division of autonomous nervous system.

- It is stimulated by its intensive sympathatic nerve supply to produce the hormone, adrenaline and non-adrenaline.

- Both (Adrenaline & Non-adrenaline) responsible for fight and flight response by-

i. Increasing heart rate
ii. Increasing B.P

iii. Reroute of Blood to essential organs including the heart, brain and skeletal muscles by dilating their blood vessels and constricting those of use essential organs such as the skin.

iv. Increasing metabolic rate

v. Dilating the pupils

Note: Adrenaline has greater effect on heart and metabolic prozes

-Non-adrenaline has more effect on blood vessels