22. Chemical Coordination and Integration

1. Glands

The various activities in the body of a living organism are controlled and coordinated by nerves and chemicals. We shall study the chemical control and coordination.

1.1. Glands

A gland is a group of cells in an animal's body that synthesizes substances (such as hormones) for release into the bloodstream or into cavities inside the body or its outer surface.

(1) Exocrine glands- are those which drain out their secretion through a duct, e.g., liver, intestinal glands, gastric glands, salivary glands. Examples of exocrine glands include sweat, salivary, mammary, ceruminous, lacrimal, sebaceous, and mucous.

(2) Endocrine glands. The glands which lack duct and discharge their secretions into the blood stream and called as Endocrine glands. They are also called as ductless glands. The chemical secretions of endocrine glands are called hormones and are popularly called the chemical messengers of the body. They affect definite part of the body and prepare it for a specific function. The part of the body where a hormone produces its effect is called the target. The major glands of the endocrine system include the pineal gland, pituitary gland, pancreas, ovaries, testes, thyroid gland, parathyroid gland, hypothalamus and adrenal glands. The hypothalamus and pituitary gland are neuroendocrine organs.

(3) Heterocrine glands are those glands which are exocrine as well as endocrine in function e.g., testes, ovaries, pancreas.

Important -

Endocrine secretion - Target organ lies at a distance or is far located from the site of origin of hormone
Paracrine secretion - Acting on cells in near vicinity.
Autocrine secretion - Acting on same cell which secretes it.

2. Hormones

Hormones are non nutrient chemicals which act as intercellular messengers and are produced in trace amounts. Hormones are required in specific amount. Their hyposecretion (secretion in lesser amount than normal) As well as hypersecretion (secretion in larger amount than normal) produce serious physiological disturbances in the body.

2.1. Discovery

The English physician E.H. Starling discovered in collaboration with the physiologist W.M. Bayliss secretin, the first hormone, in 1902. Three years later they introduced the hormone concept with recognition of chemical regulation, early regulatory physiology took a major step forward. The isolation and subsequent synthesis of secretin in the 1960s prepared the way for immunological techniques. Radio immuno assays in the 1970s enabled demonstration of a direct endocrine role of secretin.

2.2. Endocrinology

Endocrinology is a branch of biology and medicine dealing with the endocrine system, its diseases, and its specific secretions known as hormones. It is also concerned with the integration of developmental events proliferation, growth, and differentiation, and the psychological or behavioural activities of metabolism, growth and development, tissue function, sleep, digestion, respiration, excretion, mood, stress, lactation, movement, reproduction and sensory perception caused by hormones. Specializations include behavioural endocrinology and comparative endocrinology.

2.3. Properties of Hormones

The hormones have the following properties:

(1) They have low molecular weight
(2) They are soluble in water and blood.
(3) They have no cumulative effect.
(4) Hormones are required in very small amounts and their effect may be excitatory or inhibitory depending upon their concentration and the physiological state of the responding tissue.
(5) Hormones belong to different types of chemical structure. They may be steroids, proteins, peptides or amino acid derivatives.
(6) They can act in very low concentration.
(7) They are non-antigenic.
(8) They are organic catalysts.
(9) The hormones are generally slow in action
(10) The specificity of hormones may vary widely.

2.4. Kinds of Hormones

Based on their influence on physiological activities and control, the hormones may be divided into following 5 categories.

(1) Hormones concerned with metabolism e.g., Insulin etc.

(2) Hormones for growth and development e.g., Somatotropin etc.

(3) Hormones of digestion e.g., Gastrin, Secretin etc.

(4) Hormones for reproduction e.g., Gonadotropin and Sex hormones.

(5) Hormones that control other endocrine glands e.g. Thyrotropin etc.

2.5. Biochemical Classification of Hormones

All hormones, depending upon their chemical structure, may be classified under the following categories.

(1) Phenolic hormones are derived from -amino acid tyrosine. e.g. Thyroxine, Adrenaline and Noradrenaline etc.

(2) Proteinaceous or Polypeptide hormones e.g. Oxytocin, Vasoprcssin, Parathormone, Prolactin, Somatotropin, Glucagen, Secretin, Relaxin etc.

(3) Glycoproteinaceous hormones e.g., Thyrotropin, Follicle stimulating hormone, Luteinizing hormone etc.

(4) Steroid hormones : Pass directly through plasma membrane because of lipid affinity and bind to receptors in cytoplasm which inturn acts on DNA. e.g., Estrogen, Aldosterone, Cortisol, Estradiol, Progesterone, Testosterone, Cortisone.

Important -

RIA - Radioimmunoassay - technique to measure the hormones, their precursor and their metabolic end products quantitatively in a living body.

Differences between nervous system and Endocrine system

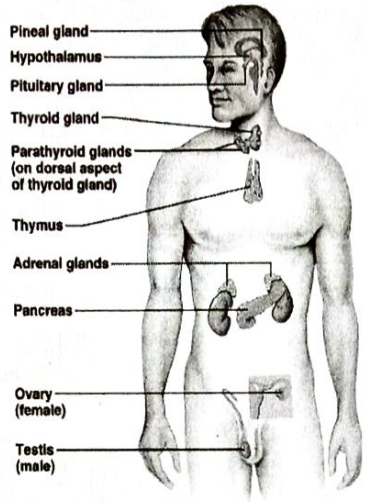
Characteristic	Nervous System	Endocrine System
Mechanism of Control	Neurotransmitters are released in response to nerve impulses	Hormones are secreted in blood
Cells affected	Muscle cells, gland cells and other neurons	Virtually all body cells
Types of action	Muscular contraction or glandular secretion	Changes in metabolic rate
Time to onset of action	Typically within milliseconds	Seconds to hours or days
Duration of action	Generally brief	Generally long

Difference between hormones and enzymes

S.N.	Enzymes	Hormones
1.	Mostly enzymes perform reactions at the place of origin i.e. in cells where they are produced.	Hormones perform activity at some distance away from the site of origin.
2.	Enzymes are biological catalyst. They catalyze the biological reactions.	Hormones are not catalyst. They simply initiate biochemical reactions.
3.	All enzymes are generally proteins. There are some exceptions like ribozymes (RNA with catalytic activity).	The hormones may be polypeptides, terpenoids, steroids, phenolics compounds or amines.
4.	Enzymes are not translocate from one part to another part of cell.	Most of the hormones show polar translocation.
5.	As enzymes are catalyst, at the end of reaction they remain unchanged and can be reutilized.	As hormones are not catalyst, they participate in biological reaction and their chemical composition is changed and cannot be reutilized as such.
6.	They are macromolecules with higher molecular weight.	They have only low molecular weight.
7.	They are non-diffusible through cell membrane.	They are diffusible through cell membrane.
8.	They either act intracellularly or carried by some ducts to another site.	Generally carried by blood to a target organ.
9.	It increases the rate of metabolic physiological processes.	They may be either excitatory or inhibitory in their action.
10.	They catalyze reversible reactions.	Hormone controlled reactions are not reversible.

3. Human Endocrine System

In Man the following major endocrine glands are present. Pituitary gland or Hypophysis, Thyroid gland ,Parathyroid gland ,Adrenal gland, Islets of Langerhans in Pancreas, Gastro-intestinal lining, Pineal gland, Thymus gland, Gonads and Placenta



Endocrine cells also occur in the heart, alimentary canal, kidney, skin, placenta, and elsewhere

Fig : Location of the major Endocrine Glads

4. Hypothalamus

4.1. Position

Basal part of diencephalon

4.2. Origin

Hypothalamus develops from the ectoderm of the embryo. It is' the major integrating link between nervous and endocrine system.

4.3. Structure

It basal part of diencephalon contains several groups of neurosecretory cells called nuclei which produce hormones. It is connected with the anterior lobe of the pituitary gland by hypophysial portal blood vessels and with the posterior lobe of the pituitary gland by axons of its neurons.

4.4. Hormones of Hypothalamus

(1) Releasing hormones or Trophic hormone (which stimulate secretion of pituitary hormones)
(2) Inhibiting hormones (which inhibit secretions of pituitary hormones)
(3) These hormones reach anterior pituitary lobe-through hypohysial portal system. The posterior pituitary is under direct neural regulation of the hypothalamus.

Releasing or inhibiting Hormones of Hypothalamus and their Roles, Factors and Specific Hormones they Control

Releasing or Inhibiting Hormone	Control and Regulation of Specific Hormone Secretion
Thyrotropin releasing hormone (TRH)	Stimulates thyrotropin stimulating hormone release
Growth hormone releasing hormone (GHRH) (Somatocrinin)	Stimulates growth hormone release
Growth hormone inhibiting hormone (GHIH) (Somatostatin)	Inhibits growth hormone release
Gonadotropin releasing hormone (GnRH)	Stimulates release of follicle stimulating hormone and luteinizing hormone
Prolactin releasing hormone (PRH)	Stimulates prolactin release.
Prolactin inhibiting hormone (PIH)/Dopamine (Produced by tubero-infundibular neurons)	Inhibits prolactin release
Adrenocorticotropic hormone releasing hormone (CRH)	Stimulates adrenocorticotropic hormone
Melanocyte stimulating hormone releasing hormone (MRH)	Stimulates melanocyte stimulating hormone release
Melanocyte stimulating hormone inhibiting - hormone (MIF1)	Inhibits melanocyte stimulating hormone release

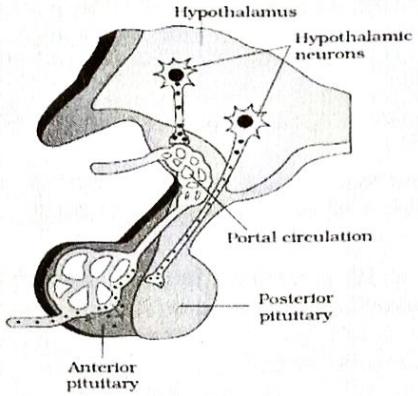


Fig: Diagrammatic representation of pituitary and its relationships with hypothalamus.

5. Pituitary Gland

5.1. Position

It is located in a bony cavity called sella turcica of sphenoid bone and is attached to hypothalamus via infundibulum.

5.2. Origin

Pituitary gland originates from the ectoderm of the embryo.

5.3. Structure

It is pink coloured pea-sized gland about 1.3 cm in diameter and weighs only 0.5 g. The pituitary gland has two anatomically and functionally separate lobes the much larger anterior lobe or adenohypophysis and posterior lobe or neurohypophysis. Adenohypophysis consists of two portions pars distalis and pars intermedia. The pars distalis produces cluster of hormones whereas pars intermedia secretes only one hormone called melanocyte stimulating hormone (MSH). However in humans the pars intermedia atrophies and merges with pars distalis during foetal development.

Important -

GH. is the only adenohypophysis hormone which is linked directly to body whereas other adenohypophysis hormones mostly control other glands.

GH stimulates hepatocytes to release glucose into blood. In this respect GH is an insulin antagonist and thus can be related to have diabetogenic effect.

Pitocin is a synthetic oxytocin which is often given to induce labor.

5.4. Hormones of Pituitary Gland and their Action on Target Organs

Part of Pituitary	Principal Cell type	Hormones	Principal Action	Target Organs
Adeno-hypophysis	**Somatotroph**	Human growth hormone (hGH) (Somatotrophin)	Growth of body cells specially of bones limbs, stimulates protein synthesis and inhibits protein breakdown; hydrolysis of fats, retards use of blood glucose for ATP production	General
	Thyrotroph	Thyroid stimulating hormone (TSH)	Growth of thyroid gland and controls secretion of thyroid hormones	Thyroid gland
	Corticotroph	Adrenocorti-cotropic hormone (ACTH)	Growth of adrenal cortex and secretion of glucocorticoids from it	Adrenal cortex
		Melanocyte stimulating hormone (MSH)	Stimulates cutaneous pigmentation by dispersion of melanin granules	Melano-cytes in skin
	Lactotroph	Prolactin (PRL)	Stimulates milk production and secretion, participates in control of reproduction, osmoregulation, growth and metabolism	Mammary glands
	Gonadotroph	Follicle stimulating hormone (FSH)	In males, stimulates spermatogenesis in females, growth of ovarian follicles	Gonads
		Interstitial cell stimulating hormone (ICSH) Luteinizing hormone (LH)	In males, secretion of testosterone In females, together with FSH, it triggers ovulation, stimulates conversion of ovarian follicles into corpus luteum	Gonads Gonads
Neuro-hypophysis	No hormones synthesized here. Its hormones are synthesized in hypothalamus	Oxytocin (OT)	Stimulates contraction of uterine muscles during birth; initiates ejection of milk	Mammary glands
		Antidiuretic hormone (ADH) or Vasopressin	Stimulates reabsorption of water and reduction of urine secretion; stimulates constriction of blood vessels and thus increases blood pressure	Kidneys

5.5. Disorders related to GH

(1) **Dwarfism** : The failure of secretion of growth hormone from an early age stops the growth of bones and of the body prematurely, this makes the patient dwarf.

(2) **Gigantism** : On the other hand, excessive secretion of this hormone from childhood turns the patient into a giant with abnormal elongation of all long bones.

(3) **Acromegaly** : Over secretion of the growth hormone after adolescence causes abnormal elongation of long bones of arms, hands, legs and lower jaw, and a gorilla-like appearance, but no giant stature.

5.6. Intermediate Lobe of Pituitary

It secretes a hormone named melanocyte-stimulating hormone (MSH). It stimulates the synthesis of black pigment melanin in the skin, and also causes dispersal of melanin granules in the pigment cells, thereby darkening the colour in certain animals such as fishes, amphibians etc.

5.7. Hormones of Posterior Pituitary

The posterior pituitary release two hormones vassopressin and oxytocin. In fact, they are synthesized in some hypothalamic neurons and remain stored in their axon terminals inside the posterior lobe called Herring bodies. Nerve impulses that propagate along axon and reach axon terminals trigger exocytose of the secretory vesicles storing these hormones.

(1) **Vasopressin** : Whenever the blood osmotic pressure rises due to the loss of water from the body, these neurons are stimulated to release vasopressin into the blood in the posterior lobe. Vasopressin is also known as Antidiuretic Hormone (ADH) because it reduces the volume of urine by increasing the reabsorption of water from the urine in the distal convoluted tubules, collecting tubules and collection ducts in the kidney. This it does by rendering the walls of those tubules permeable to water. Failure of secretion of vasopressin leads to a reduced renal reabsorption of water and a consequent elimination of a large volume of very dilute (hypotonic) urine; this disease is known as Diabetes insipidus although the volume of urine is increased, no glucose appears in the urine of such patients. Besides its antidiuretic effect of reducing the urinary volume, 'vasopressin also enhances arterial blood pressure by causing constriction or narrowing of arterioles.

(2) **Oxytocin (Pitocin)** : The other posterior lobe hormone, viz. oxytocin is secreted into the blood when the hypothalamic neurons are stimulated either due to the distension of uterus by the full term foetus or due to the sucking of the breast by the infant. Oxytocin contracts the smooth muscles of uterus and mammary glands. Uterine contractions, stimulated by oxytocin at the end of pregnancy, help in the child-birth. The oxytocin induced contractions of the mammary gland muscles help in the flow of stored milk from the mammary gland to the mouth of the suckling infant. Even sight and sound of baby can cause a nursing mother to secrete this hormone. Therefore, oxytocin is also called 'milk ejection hormone' and 'birth hormone'.

6. Thyroid

6.1. Position

It is largest butterfly shaped endocrine organ situated in the neck close to the trachea.

6.2. Origin

The thyroid gland originates from the endosperm of the embryo.

6.3. Structure

The gland consists of two elongated oval lobes joined by a narrow band called Isthmus. It is a highly vascular organ and contains. many spherical or oval sac-like follicles. Cells lining the thyroid follicles secrete two thyroid hormones,

6.4. Hormones of Thyroid Glands

(1) **Thyroxine or tetraiodothyronine (T4) and triiodothyronine (T3)** : Both are iodinated forms of an amino-acid called tyrosine and remain stored in the jelly like semifluid material (colloid) in the lumen of follicles. T3 is more active and several times more potent than T4 From the thyroid mainly T4 is secreted and converted to T3 in peripheral tissues e.g., Liver. Thyroid is the endocrine gland which stores its secretory product in large quantity also involve in iodine metabolism. When necessary, the hormones are released from the colloid to the blood. T3 and T4 have similar effects, hence they are collectively known as Thyroid Hormone (TH).

(2) **Calcitonin (TCT)** : In between thyroid follicle are present C-cells or parafollicular cells which release Calcitonin (TCT) or parafollicular hormone. It is involved in calcium homeostasis. It is hypocalcemic and hypophosphatemic. Both parathormone and calcitonin help in the maintenance of calcium ions in blood plasma.

6.5. Functions of Thyroid Hormone

(1) Thyroid hormones greatly increase the metabolic rate of the body and consequently, enhance heat production (Calorigenic effect) and maintain BMR (basal metabolic rate).

(2) Thyroid hormones also promote growth of body tissues-both physical growth and development of mental faculties are stimulated.

(3) They stimulate tissue differentiation. Because of this action, they promote metamorphosis of tadpoles into adult frogs.

(4) To enhance some actions of neurotransmitters : adrenaline and nor-adrenaline.

(5) Support process of red blood cells formation.

(6) Maintenance of water and electrolyte balance is also influenced by thyroid hormones.

6.6. Disorders Due to Thyroid Hormone imbalances

(1) **Hypothyroidism**- It can develop due to inactivity of thyroid itself or hyposecretion of TRH or TSH or insufficient dietary intake of iodine.

- **Cretinism** : Failure of thyroid secretion from infancy or childhood slows body growth and mental development and reduces metabolic rate markely. The child remains physically stunted and mentally retarded low intelligence quotient, abnormal skin deaf mutism. The body temperature, heart rate and blood pressure lower than normal. The patient is pot-bellied and pigeon chested and has a protruding tongue. Other features include neonatal jaundice, lethargy, respiratory

problems and constipation. This disease is called cretinism Normal growth and development may be restored in certain cases by an early administration of thyroid hormones.

- **Myxedema (Gull's diseases) :** Deficiency of thyroid hormones produces myxedema in adults. The patient has a puffy appearance and lacks alertness, intelligence and initiative. The patient also suffers from low metabolic rate, slow heart rate, low body temperature and reproductive failure. Administration of thyroid hormones cures the symptoms. It occurs more commonly in females.
- **Simple Goitre :** In mountainous regions, the dietary deficiency of iodine frequently produces thyroid enlargement (Iodine Deficiency Goitre), accompanied by cretinism or myxoedema.

(2) Hyperthyroidism

- **Exophthalmic Goitre :** In Grave's disease or Exophthalmic goitre, a thyroid enlargement (goitre) is accompanied by a bulging of eyeballs (exophthalmos). The enlarged thyroid is overactive and secretes - excessive amount of thyroid hormones. So, the goitre is associated with symptoms of thyroid over activity such as high metabolic rate, rapid heart rate, rise in body temperature, emaciation, nervousness, irritability, tremor and restlessness. It also occurs more often in females. It is an autoimmune disorder in which the person produces antibodies that mimic the action of TSH, but are not regulated by normal negative feedback control.

7. Parathyroid gland

7.1. Position

These are four small pea sized glands situated very close to the thyroid.

7.2. Origin

This gland develops from the endoderm of the embryo.

7.3. Structure

It develops as epithelial buds from third and fourth pairs of pharyngeal pouches.

7.4. Hormone of Parathyroid gland

It secrete a hormone called parathormone (Collip's hormone). They are under the feedback control of blood calcium level A fail in blood calcium stimulates them to secrete parathormone, a rise in blood calcium inhibits parathormone secretion from them

(1) Function of Parathormone

- Parathormone increases the concentration of calcium ions in the blood plasma, because it mobilises more calcium from the bones to the plasma and reduces urinary elimination of calcium.
- It is secreted whenever the plasma ca^{+2} concentration falls and restores the ca^{+2} concentration to normal in the plasma
- On the other hand, it increases phosphate elimination in the urine and consequently lower the phosphate concentration in the plasma
- Thus, parathormone regulates the metabolism of calcium and phosphorus.

7.5. Calcium homeostasis

(1) A higher than normal level of calcium ions (Ca) in blood stimulates parafollicular 'cells of the thyroid gland.
(2) They release more calcitonin as blood Ca^{+2} level rises.
(3) Calcitonin promotes deposition of blood Ca^{+2} into the matrix of bone tissue. This decreases blood Ca^{+2}level.
(4) A lower than normal level of Ca^{+2} in blood stimulates principal cells of the parathyroid gland.
(5) They release more .parathyroid hormone (pth) as blood Ca^{+2} level falls.
(6) It promotes release of Ca^{+2} from bone matrix into the blood and retards loss of Ca^{+2}in the urine. These actions help raise the blood level of Ca^{+2}.
(7) It also stimulates the kidneys to release another hormone called calcitriol.
(8) calcitriol stimulates increased absorption of $Ca^{+2}$from foods in the gastrointestinal tract, which helps increase the blood level of Ca^{+2}

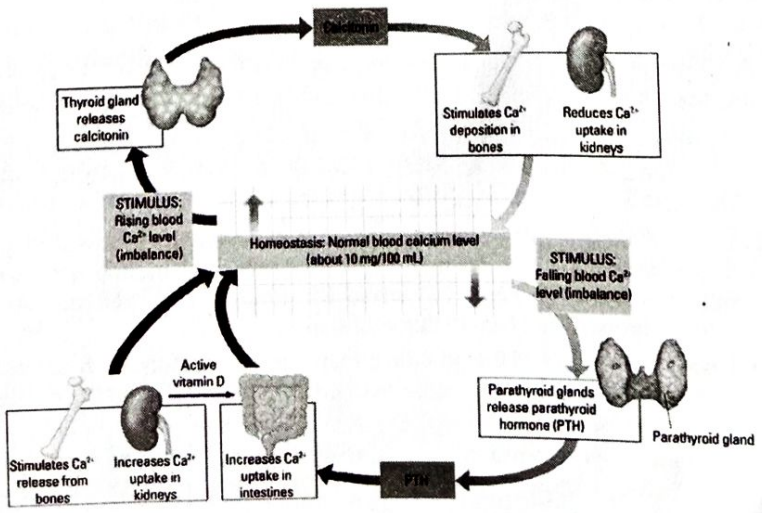


Fig: Hormonal regulation of calcium homeostasis by calcitonin, PTH and calcitrol

7.6. Disorder of Parathyroid

(1) **Hypoparathyroidism** : Parathyroid Tetany : If the parathyroids fail to secrete sufficient amount of parathormone, the concentration of calcium ions falls abnormally in the plasma. This increases the excitability of nerves and muscles due to deficiency of Ca^{2+} which causes depolarization without usual stimulus. Consequently, sustained contractions (tetany) of the muscles of larynx, face, hands and feet are produced. This disease is palled parathyroid tetany. It can also develop due to accidental damage to the parathyroid or their blood supply during thyroidectomy surgery:

(2) **Hyperparathyroidism** : The parathyroid tumours secrete excessive amount of parathormone, which causes increased mobilisation of bone minerals into the blood, softening of bones, rise in the concentration of calcium ions in the plasma, and deposition of calcium in kidney tubules and other soft tissues.

It may cause Osteitis Fibrosa Cystica. / Osteoporosis.

8. Adrenal Gland

8.1. Position

Adrenals are two conical pyramid-shaped glands, one immediately above each kidney.

8.2. Origin

Each adrenal is made up of an outer layer mesodermal in origin called Adrenal cortex and a central portion ectodermal in origin called Adrenal medulla.

8.3. Structure

The adrenals are conical, yellowish bodies. Each has two distinct regions having different embryonic origin, structure and function. The two regions are called adrenal cortex and adrenal medulla.

(1) **Adrenal Cortex** : It is the external part of the adrenal gland. This part of adrenal is vitally important for life and its destruction or removal kills the animals.

It is divided into three layers.

- Zona glomerulosa (outermost)
- Zona fasciculate (middle)
- Zona reticularis (innermost)

It secretes three groups of hormones viz. mineralocorticoicis, glucocorticoids and sexcorticoids.

- Mineralocorticoids are secreted from the outermost cellular layer zona glomerulosa of-adrenal cortex Aldosterone is the principal mineralocorticoid in man, other mammals and birds. Mineralocorticoids regulate the metabolisms of sodium and potassium. Their secretion is stimulated by a fall in plasma Na^+ concentration, or a fall in circulating volume of blood. Aldosterone reduces the elimination of Na^+ in the urine, sweat, saliva and bile by enhancing the active reabsorption of this ion from those fluids. It also increases the elimination of K^+ in those fluids in exchange of the reasorbed Na^+. By retaining more Na^+ in the blood, it increases the reabsorption of water from the urine by the osmotic effect of Na. Due to the same reason, it increases the volumes of blood and other extracellular fluids.
- **Glucocorticoids** such as cortisol are secreted from the middle cellular layer (zona fasciculata) of the adrenal cortex. Glucocorticoides stimulaate gluconeogenesis, lipolysis and proteolysis and inhibit cellular uptake and utilisation of amino acids. Cortisol is also involved in maintaining the cardio vascular system as well as kidney functions. The anterior pituitary hormone called corticotropin stimulates glucocorticoid secretion, glucocorticoids on the other hand exert a feedback inhibitory effect on corticotropin secretion. Glucocorticoids are also anti inflammatory in nature as they act as stabilizer of lysosomes of phagocytic cells. Prolonged use of glucocorticoids suppress the immune response.
- **Sex corticoids** are secreted from both the middle and the inner layer (zona reticularis) of the adrenal cortex. Their secretion is believed to be stimulated by corticotropin of anterior pituitary. They include steroids which may stimulate the development of external-sex-characters of the male type such as the male pattern of distribution of body hair (role in growth of axial hair, pubic hair and facial hari during puberty). Examples of sex corticoids are Androstenedione, Dehydroepiandrosterone and estrogens.

Important -

(1) Glucocorticoids include 3 main hormones Cortisol, Corticosterone and Cortisone of the three, cortisol is the most abundant (about 95%)

(2) Glucocorticoids are immunosuppressive so also used in transplantation surgery to avoid tissue rejection by immune system of the recipient.

(3) Zona fasciculata is the widest layer adrenal cortex.

8.4 Disorder of Adrenal Cortex

- **Addison's Disease** : A destruction of adrenal cortex by diseases like tuberculosis produces Addison's disease due to the deficiency of both glucocorticoids and mineralocorticoids. Symptoms include a bronze like pigmentation of skin, low blood sugar, low plasma Na+, high plasma K+ increased urinary Na+, nausea, vomiting and diarrhoea. Deficiency of glucocorticoids causes a bronze –like pigmentation of skin.
- **Cushing's Syndrome** : A tumour of the adrenal cortex may secrete too much cortisol to produce cushing's syndrome High blood sugar, appearance of sugar in the urine, obesity, wasting of limb' muscle, rise in plasma Na+, fall in plasma K+, rise in blood volume and high blood pressure are observed in the patient
- **Aldosteronism (Conn's Syndrome)** : Excessive secretion of aldosterone from an adrenal cortical tumour produces aldosteronism. This disease is characterized by a high plasma Na', low plasma K+, rise in blood volume and high blood pressure.

- **Adrenal Virilism :** An excessive secretion of sex--corticoids produces the male-type external sex characters such as beard and moustaches and male voice in women. The disease is called adrenal virilism. Excess in early age may produce early abnormal sexual maturity in male.

(2) **Adrenal medulla** -This part of adrenal helps the body to combat against stress or emergency conditions. But it is not vital for survival and may be removed without causing death.

- Adrenal medulla secretes two hormones, viz. adrenaline and noradrenaline. The proportion of the two hormones varies from species to species in man, much more adrenaline is secreted than noradrenaline.
- The secretion of these hormones is stimulated when nerve impulses reach the adrenal medulla through sympathetic nerve fibres.
- These hormones act on organs and tissues supplied by sympathetic fibres and produce effects like those of sympathetic stimulation.
- Noradrenaline is also released at sympathetic nerve terminals to transmit nerve impulses from them to smooth muscles and glands.
- Both sympathetic nerves and adrenal medulla are stimulated in physical stress like fall in blood pressure or blood sugar, pain, cold or injury; both are also stimulated in emotional stress such as anger, fear and grief.
- All these indicate that the adrenal medulla and the sympathetic nervous system function as a closely integrated system, this may be called sympatheticoadrenal system and is another instance of close coordination, between nerves and hormones.

Important-

Fight or Flight Reaction: The adrenaline and noradrenaline is often called "fight or flight reaction". It prepares the body to face stress or danger. The adrenals are known as the "glands of emergency".

Hormones of Adrenal Medulla and their Action

Adrenal medulla Hormones	Principal Action	Target Tissue
Adrenaline	Stimulates elevation of blood glucose by converting liver glycogen to glucose; rise in blood pressure acceleration of rate and force of heartbeat; constriction of skin and visceral smooth muscle capillaries; dilation of arterioles of heat and skeletal muscles; dilation of bronchioles; increase in breakdown of lipids; increase in oxygen consumption; erection of hairs; dilation of pupils; initiates stress responses	Skeletal muscles, cardiac muscles, smooth muscles, blood vessel, fat cells
Noradrenaline	Stimulates reactions similar to those produced adrenaline	

9. Pancreas

9.1. Position

The pancreas is situated above the stomach.

9.2. Origin

The pancreas develops from the endoderm of the embryo

9.3. Structure

The pancreas is about 15 cm (6 in) long. It is surrounded by other organs including the small intestine, liver, and spleen. It is spongy, about six to ten inches long, and is shaped like a flat pear or a fish extended horizontally across the abdomen.

9.4. Pancreas and its Hormones :

The pancreas comprises both exocrine and endocrine parts. The endocrine part consists of small masses of hormone secreting cells called islets of Langerhans

9.5. Disorder caused by Pancreatic hormone (Insulin)

(1) **Diabetes mellitus** - Failure of insulin secretion produces Diabetes mellitus. In this disease, blood sugar is abnormally high and exceeds the renal threshold for glucose. Consequently, glucose appears in the urine (glucosuria). The utilization of glucose is decreased; instead, catabolism of fats and proteins are enhanced. Increased oxidation of fat produces ketone bodies such as acetoacetate and acetone. Also the blood cholesterol rises. The osmotic effect of glucose in the urine considerably increases the volume of urine (polyuria). Thirst is enhanced due to urinary loss of water. Injuries take a long time to heal and may turn into gangrenes. In extreme cases, the patient suffers from coma and may die. Administration of insulin reduces the blood sugar and checks other symptoms of diabetes.

Important -

Diabetes Mellitus (Type-I) : It is insulin dependent diabetes mellitus (IDDM) and also known as juvenile onset diabetes because it most commonly develops in people younger than 20, it is an autoimmune disorder in which immune system destroys β cells

Diabetes mellitus (Type –II) : It is non-insulin dependent diabetes mellitus (NIDDM) it is also known as maturity onset diabetes because it occurs later in life. If arises not from shortage of insulin but because of target cells became less sensitive to insulin.

Fig : Chart of Hormones of Pancreas and its work

Endocrine Cells of Pancreas	Hormone	Principal Action	Target Tissue
α cells	Glucagon (polypeptide)	Raises blood glucose level by (i) accelerating breakdown of glycogen into glucose in liver. (ii) Promoting conversion of other nutrients, such as amino acids and lactic acid, into glucose in liver. (iii) enhancing release of glucose into blood	Liver adipose tissue
β cells	Insulin (polypeptide)	Lowers blood glucose level by (i) Stimulating transport of glucose from blood to muscle and adipose cells, and indirectly causing the liver to take up glucose. (ii) promoting both oxidation of glucose and conversion of glucose into glycogen in muscles as well as liver cells; (iii) inhibiting metabolic breakdown of stored glycogen in liver and muscle cells; (iv) Promoting synthesis of fats from glucose by adipose tissue and also inhibiting metabolic breakdown of fat: (v) promoting uptake of amino acids by liver and muscle cells, and stimulating protein synthesis while inhibiting protein breakdown	Liver, muscles adipose tissue
δ cells	Somatostain (polypeptide)	Inhibits secretion of glucagon and insulin; decreases secretion, motility and absorption in the digestive tract.	Pancreas
F cells	Pancreatic Polypeptide	It inhibits the release of pancreatic juice.	Pancreas

10. Pineal Glan

10.1. Position

It is attached to the roof of third ventricle in the rear portion of brain.

10.2. Origin

It develops from the ectoderm of the embryo.

Structure- Pineal gland is regarded as vestige of third eye as well as functional endocrine gland, It is known as the pineal gland, named for its resemblance to a pine cone. It has no direct connection with central nervous system. It is variable in size and weighs about 150 mg.

10.3. Hormones of Pineal gland

Pineal Gland is richly vascularised and secretes several hormones, including melatonin, serotonin, adpenoglome rulothopin

(1) Melatonin - In humans, it has no light-sensitive cells, like lower vertebrates, where pineal is eye-like and responds to light. Pineal gland functions as a biological clock and a neurosecretory transducer, converting neural information. More melatonin is produced during darkness. Its formation is interrupted when light enters the eyes and stimulates the retinal neurons. They transmit impulses to the hypothalamus, and finally to the pineal gland. The result is inhibition of melatonin secretion. In this way, the release of melatonin is governed by the diurnal dark-light cycle. Melatonin also influences body temperature, metabolism, pigmentation, menstrual cycle and defense capability.

(2) Serotonin - It acts as vasoconstrictor and helps to decrease the diameter of blood vessel.

(3) Adrenoglomerulotropin - It stimulates the zona glomerulosa of adrenal cortex to secrete aldosterone.

11. Thymus

11.1. Position

It is situated in the upper chest near the front side of the heart.

11.2. Origin

The thymus originates from the endoderm of the embryo.

11.3. Structure

It is soft bilobed structure where the two lobes lie side by side and joined in the middle by connective tissue. It is pyramidal in children with maximum size reaching at about 15 years of age.

- Its size is reduced somewhat later due to decrease of its lymphoid content. The weight at birth is 15 - 20 g in children remaining at that level thereafter.
- It is deep red in young age becoming thinner and greyer with age and later yellowing due to infiltration of adipose tissue.
- Thymus is covered on the outside by a capsule of loose connective tissue which also penetrates the interior of gland forming septa and irregular lobules.
- There is an outer cortex of densely packed thymocytes or T-lymphocyte lineage) and inner medulla having connective tissue with fewer lymphoid cells. Balls of flattened epithelial cell called Hassal's corpuscles occur here and there in the medulla. Thymocytes also occur along with some B-lymphocytes.
- Thymosin- Hormone produced by the thymus gland is called thymosin. Thymosin released in the bloodstream has a stimulating effect on the entire immune system. It promotes proliferation and maturation of T-lymphocytes. It is also called "the throne of immunity", or training school of T-lymphocytes

12. Sex organs and their hormones

12.1. Gonads

The gonads, the primary reproductive organs, Testes in males and ovaries in females secrete sex hormones at puberty. These organs are responsible for producing the sperm and ova, but they also secrete hormones and are considered to be endocrine glands.

Testes-The testes (testicles) are the male gonads, they are the primary male reproductive organs. They serve two key functions, the production of gametes (sperm) and the secretion of hormones, particularly the male hormone testosterone. Other structures in the male reproductive system, including the male duct system and penis are termed accessory reproductive organs, because rather than producing gametes, they play an accessory role in the reproductive cycle, by transporting sperm out of the testes.

- **Appearance and location** - The testes are firm, mobile organs. A typical man has two testes approximately 5 cm long, 3 cm wide and 2.5 cm thick. Weighing 10-15 g each, the testes are suspended outside the body in a fleshy sac called the scrotum. The scrotum attaches to the body between the base of the penis and anus. The left testis lies slightly lower than the right.
- **Structure and function of the testes** - The testes consist of a series of tubules containing testosterone and sperm-producing cells, which are covered by a multi-layered tunica. The primary function of the testes is sperm production and the main components of the testes which play a role in sperm production are the seminiferous tubules, Sertoli and Leydig cells. There are also a series of ducts and tissues within the testis which play an accessory role in producing and/or transporting sperm from the testes.

(1) **Ovary** - Ovaries are the female gonads - the primary female reproductive organs. These glands have three important functions: they secrete hormones, they protect the eggs a female is born with and they release eggs for possible fertilization.

- **Size & Location** - Human females are typically born with two ovaries stemming from the uterus. Before puberty, ovaries are just long bundles of tissue. As the female matures, so do her ovaries. When mature, ovaries are about the size of a large grape. The ovaries lie on either side of the uterus against the pelvic wall in a region called the ovarian fossa. They are held in place by ligaments attached to the uterus.
- **Function** - At puberty, the ovary begins to secrete increasing levels of hormones. Secondary sex characteristics begin to develop in response to the hormones. The ability to produce eggs and reproduce develops. The ovary changes structure and function beginning at puberty.

Hormones Regulating Reproduction

Endocrine Gland	Hormones	Principal Action
Ovarian follicle	Estrogen	Stimulates development and maintenance of female sexual characteristics like high pitch, female voice and female pattern of body hair distribution at puberty, together with gonadotropic hormones of the anterior pituitary gland, they also regulate the menstrual cycle.
Corpus luteum	Progesterone and Estrogen	Stimulate uterine lining for embryo implantation to maintain pregnancy (foetal development), prepare the mammary glands for lactation and regulate oogenesis, progesterone inhibits ovulation.
	Relaxin	Relaxes pubic symphysis and help dilate uterine cervix near the end of pregnancy.
	Inhibin/actin	Inhibition/activation of FSH and GnRH production
Testes	Testosterone	Stimulates the descent of testes and male pattern of development (before birth), stimulates development and maintenance of male sexual characteristics and expression of secondary characteristics, such as beard, moustaches and low-pitch voice; starting at puberty; stimulation of spermatogenesis; growth spurt
	Inhibin/actin	Activation/inhibition of LH and FSH production
Placenta	Human chorionic gonadotropin	Stimulates progesterone release from the corpus luteum and maintains it.
	Human placental lactogen	Stimulates mammary growth.

12.2. Disorders of Gonads

(1) **Eunuchoidism :** This results from the failure of testosterone secretion. For this disorder, secondary sex organs, such as prostate gland, seminal vesicles and penis, remains infertile and small in size and fail to function. Spermatozoa fail to be produced. External sex characters like beards, moustaches and low-pitch male voice fail to develop.

(2) **Gynaecornastia :** It is the development of breast tissue in males, and is usually due to perturbation of estrogen to androgen ratio. In the neonatal period and during puberty, gynaecomastia is due to temporary increase in circulating estrogen. Decreased testosterone in later life may also lead to gynaecomastia

(3) **Castration :** Removal of testes in male is called castration. It will lead to decline in the androgen level and secondary characters fail to appear. It can lead to retention of high pitch juvenile voice in a male.

(4) **Hypogonadism :** Defects in, or injury to, the hypothalamus, the pituitary, or the testes or ovary, result in hypogonadism. Male hypogonadism can consist of deficient androgen production (hypofunction of Leydig cell), deficient sperm formation (hypofunction of Sertoli cell), or both, before puberty. It results in the lack of development of secondary sexual characteristics and male musculature.

Female hypogonadism results from hyposecretion of estrogen, resulting in cessation of reproductive cycles. Such hypogonadism can result from a shortage of pituitary gonadotropins (LH, FSH or both) or can represent primary testicular/ovary failure.

(5) **Precocious puberty :** True sexual precocity, i.e., early maturation of ovaries and testes with production of ova before the age of 9 years in girls, or sperm before 10 years in boys, occurs without evident cause. Sexual pseudoprecocity results from excesses of sex hormones from the adrenal cortex, testis, ovary or from other sources, including extragonadal tumours. **Sexual pseduoprecocity** in boys occurs as a consequence of excess of testosterone produced by. tumours of the testis or adrenals. In such cases, enlargement of the penis, accelerated appearance of sexual characteristics, such as, pubic and axillary hair, masculinisation, faster body growth, and ultimate stunting are present. Sexual pseudoprecocity in girls arises from increased supply of estrogen secreted by tumours of the ovaries or adrenals. The external manifestations of sexual maturation, for example, breast formation and appearance of pubic hair, appear early, but the maturation and discharge of ova do not occur.

13. Hormones of Heart, Kidney and Gastrointestinal Tract

- In addition to endocrine glands, hormones are also secreted by some tissues which are not endocrine glands. For example, the atrial wall of heart secretes a very important peptide hormone called atrial natriuretic factor (ANF) which decrease blood pressure. When blood pressure is increased, ANF is secreted which causes dilation of blood vessels. This reduces the blood pressure.
- Juxta glomerular cells of kidney produces peptide hormone called erythropoietin which stimulates erythropoiesis. (Formation of RBC).
- Endocrine cells present in different part of the gastro intestinal tract secrete four major peptide hormones namely gastrin, secretin, cholecystokinin (CCK) and gastric inhibitory peptide (mentioned in animal nutrition).

14. Placenta and its Hormones

The placenta connects the developing fetus to the wall of the mother's uterus during pregnancy. It grows in the wall of the uterus and is attached to the fetus within the uterine cavity by the umbilical cord. The placenta is formed by cells that originate from the fetus and is therefore the first of the fetal organs to develop.

The placenta produces two steroid hormones – oestrogen and progesterone.

14.1. Progesterone

Progesterone acts to maintain pregnancy by supporting the lining of the uterus (womb), which provides the environment for the fetus and the placenta to grow. Progesterone prevents the shedding of this lining (similar to that which occurs at the end of a menstrual cycle) this would result in pregnancy loss. Progesterone also suppresses the ability of the muscular layer of the uterine wall to contract, which is important in preventing labour from occurring before the end of pregnancy.

14.2. Oestrogen

Oestrogen levels rise towards the end of pregnancy. Oestrogen acts to stimulate the growth of the uterus to accommodate the growing fetus and allows the uterus to contract by countering the effect of progesterone. In this way, it prepares the uterus for labour. Oestrogen also stimulates the growth and development of the mammary glands during pregnancy, in preparation for breastfeeding.

14.3. Human Chorionic gonadotropin

Human Chorionic gonadotropin Other hormone secreted by placenta is Human Chorionic gonadotropin (HCG). It stimulates the corpus luteum in mother's ovary to enlarge and secrete progesterone during pregnancy.

15. Molecular Mechanism of Hormone Action

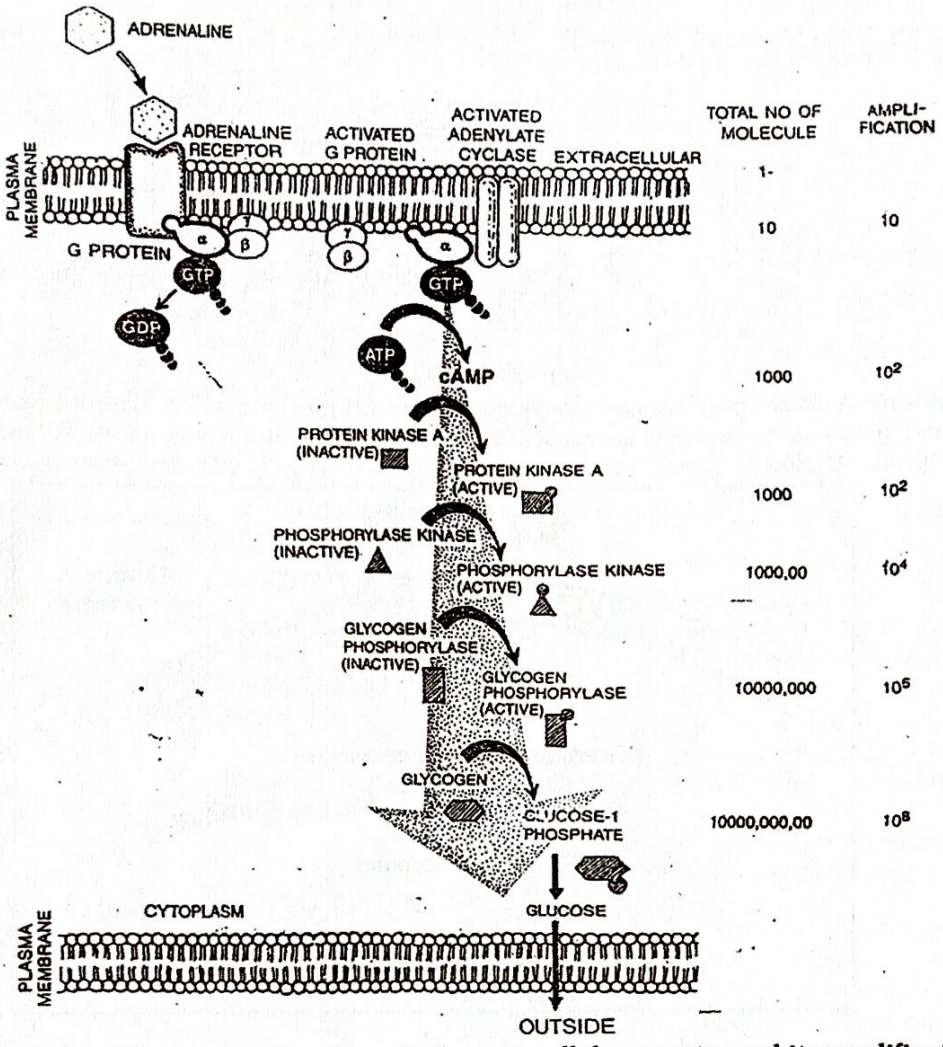
15.1. Peptide Hormone action

(1) **Catecholamines, peptide and protein :** hormones are not lipid-soluble, and so, cannot enter their target cells through the bilipid layer of plasma membrane. Instead, these water soluble hormones interact with a surface receptor, usually a glycoprotein, and thus, initiate a chain of events within it. The hormone insulin provides a well-studied example.

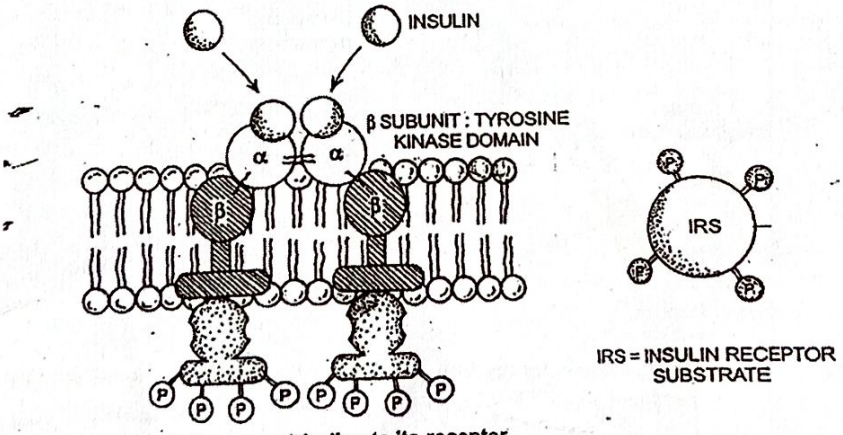
(2) **Extracellular Receptor :** The membrane bound receptors of insulin is a heterotetrameric protein consisting of four subunits, two a-subunits protrude out from surface of the cell and bind insulin, and two b-sub-unit-that span the membrane and protrude into the cytoplasm.

(3) **Binding to the receptor :** Binding of insulin to the outer subunits of the receptor causes a conformational change in the membrane spanning b-subunits, which is also an enzyme, a tyrosine kinase. The activated b-subunits add phosphate groups of specific tyrosine residues located in Cytoplasmic domain of the receptor as well as a variety of insulin receptor substrates.

(4) **Second messengers-the mediator :** As a result of b-subunit activity, a transducer G-protein activates enzyme phosphodiesterase. This enzyme breaks phosphatidylinositol 4, 5- biphosphate (PIP2) into a pair of mediators inositoltriphosphate (IP3) and diacylglycerol (DG). In turn, IP3, which is water-soluble and so diffuses into cytoplasm and triggers the release of another messenger Ca2+ ions for intracellular calcium-mediated processes. While DG remains within the membrane where it activates an enzyme called protein kinase C, which in turn, activates many other enzymes, such as pyruvate dehydrogenase, and so brings about the physiological effects.



Mode of hormone action through, the extracellular receptor and its amplification



Insulin hormone binding to its receptor

(5) Amplification of Signal : Amplification by enzyme cascades results when an enzyme associated with a signal receptor is activated and, in turn, catalyzes the activation of many molecules of a second enzyme, each of which activates many molecules of a third enzyme and so on. Amplifications of several orders of magnitude can be produced in milliseconds by such cascades.

E.g. one molecule of adrenaline hormone activates adenyl cyclase which can generate about 100 cAMP molecules. cAMP activates protein-kinase A enzyme which in turn activates several molecules of phosphorylase kinase. This enzyme activates glycogen phosphorylase which converts glycogen into glucose-1 phosphate. The later changes to glucose and is released into blood. As a result single molecule of adrenaline hormone leads to the release of 100 million glucose molecules within 1 to 2 minutes.

Antagonistic effect : Many cells use more than one second messenger. In heart cells, cAMP serves as a second messenger, speeding up muscle cell contraction in response to adrenaline, while cyclic guanosine monophosphate (cGMP) serves as another second messenger, slowing muscle contraction in response to acetylcholine. It is in this way that the sympathetic and parasympathetic nervous systems achieve antagonistic erect on heartbeat. Another example of antagonistic effect is insulin, which lowers blood sugar level, and glucagon,, which raises it.

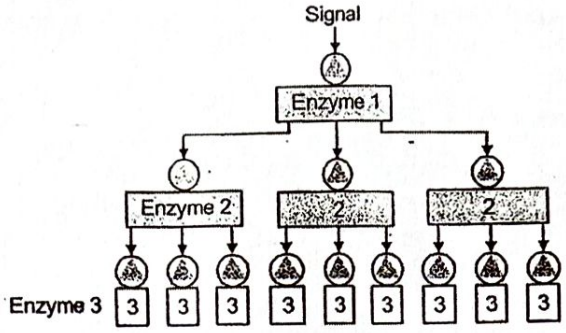
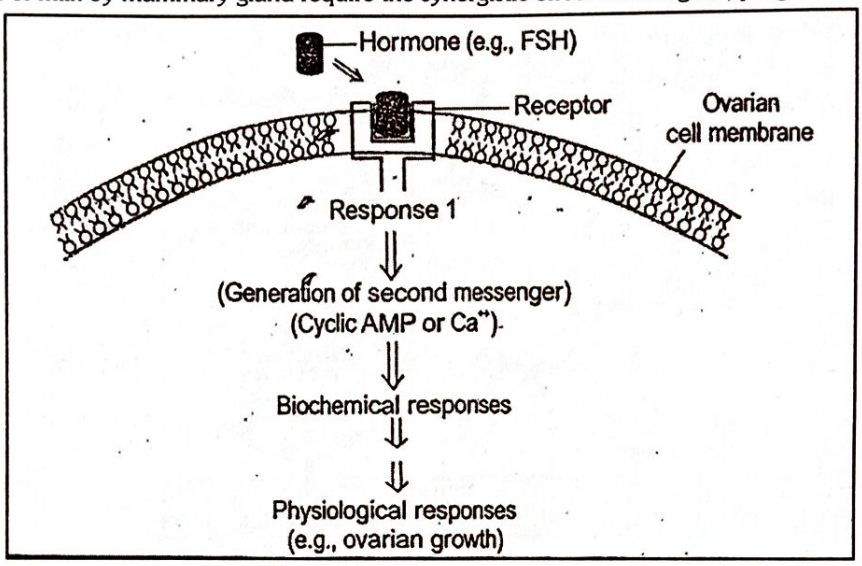
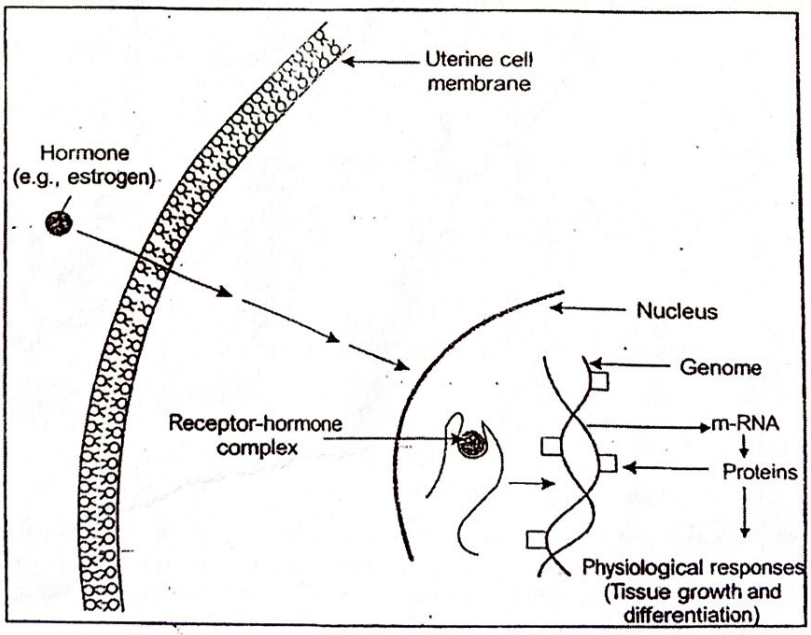


Fig. : Amplification

Synergistic effect : Another type of hormonal interaction is known as synergistic effect. Here, two or more hormones complement each other's actions and both are needed for full expression of the hormone effects. For example, the production, secretion and ejection of milk by mammary gland require the synergistic effect of estrogens, progesterone, prolactin and oxytocin.



(a)



(b)

Fig : Diagrammatic representation of mechanism of protein hormone action : (a) Protein hormone (b) Steroid hormone

22. Chemical Coordination and Integration – Multiple Choice Questions

1. Hormones and their mechanism

1. The name second messenger is given to
(a) ATP (b) Cyclic AMP
(c) GTP (d) Both ATP and AMP

2. Which is not involved as 2nd messenger in Ca^{+2} mediated hormone
(a) c-AMP (b) DAG
(c) Phospholipase (d) IP_3

3. Who is the "Father of Endocrinology"
(a) Whittaker (b) Einthoven
(c) Pasteur (d) T. Addison

4. Endocrine glands produce or Action of endocrine glands is mediated through
(a) Hormones (b) Enzymes
(c) Minerals (d) Vitamins

5. Which one of the following is not a gland
(a) Pancreas (b) Pituitary
(c) Adrenal (d) Kidney

6. Endocrine glands
(a) Do not possess ducts
(b) Sometimes do not have ducts
(c) Pour their secretion into blood through ducts
(d) Always have ducts

7. Estrogen and testosterone are steroid hormones, and are most likely bind to
(a) Membrane ions channels
(b) Enzyme-linked membrane receptors
(c) G-protein linked membrane receptors
(d) Cytoplasmic receptors

8. Steroid hormones regulate gene activity through
(a) Transcription
(b) Binding with specific DNA sites
(c) Removing the repressor molecules
(d) The formation of a receptor complex

9. In the mechanism of action of a protein hormone, one of the second messengers is
(a) Cyclic AMP (b) Insulin
(c) T_3 (d) Gastrin

10. Consider the given diagrammatic representation of the mechanism of action for 2 categories of hormones. In which of the following option correct answers for blanks A to I are indicated

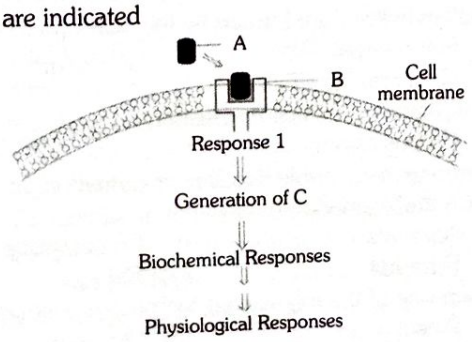


Fig. I

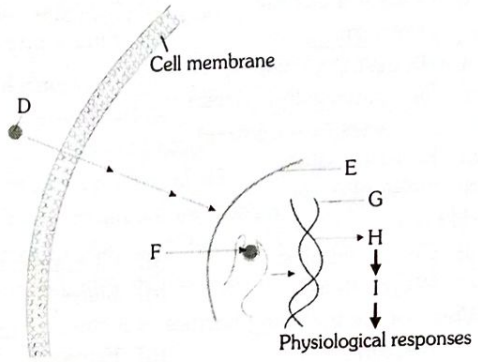


Fig. II

(a) A - Steroid hormone, B - Enzyme, C - Secondary messenger, D - Non- steroid hormone, E - Nucleus, F – Hormone - enzyme complex, G - Genome, H - mRNA, I - protein
(b) A - Steroid hormone, B - Receptor, C - Primary messenger, D - Non- steroid hormone, E - Nucleus, F - Hormone- receptor complex, G - Genome, H - mRNA, I - protein
(c) A - Non -Steroid hormone, B - Receptor, C - Secondary messenger, D - Steroid hormone, E - Nucleus,
F - Hormone receptor complex, G - Genome, H - mRNA, I - Protein
(d) A - Steroid hormone, B - Receptor, C - Secondary messenger, D - Non- steroid hormone, E - Nucleus, F - Hormone - receptor complex, G - Genome, H - mRNA, I – protein

2. Different glands and their hormones

1. A person suffering from diabetes insipidus will pass what amount of urine per day
(a) 1 litre (b) $\frac{1}{2}$ litre
(c) 3 litres (d) 1.5 liters

2. Which hormone stops the release of FSH from the pituitary after fertilization
(a) Placental hormone (b) Fertilizin
(c) Estradiol (d) Luteinizing hormone

3. The chemical nature of hormones secreted by α and β cells of pancreas is
(a) Glycolipid (b) Glycoprotein
(c) Steroid (d) Polypeptide

4. Which of the following hormones are produced in the hypothalamus and stored in the posterior pituitary
(a) FSH and LH (b) ADH and oxytocin
(c) TSH and STH (d) ACTH and MSH

5. Vasopressin is concerned with
(a) General metabolism
(b) Regulation of heart beat
(c) Urine formation
(d) Child birth

6. Posterior lobe of pituitary gland is also known as
(a) Hypophysis (b) Adenohypophysis
(c) Neurohypophysis (d) Pars intermedia

7. The anterior lobe of pituitary affects
(a) Protein metabolism
(b) Fat metabolism
(c) Carbohydrate metabolism
(d) All of the above

8. Complete failure of adenohypophysis of pituitary causes
(a) Addison's disease (b) Cushing's disease
(c) Dwarfism (d) Simmond's disease

9. Growth hormone activity
(a) Decreases with thyroxin
(b) Increases with thyroxin
(c) Remains same
(d) None of these

10. FSH is a
(a) Catecholamine (b) Glycoprotein
(c) Polypeptide (d) Steroid

11. Which of the following hormones is steroid
(a) Relaxin (b) Estrogen
(c) Thyroxin (d) Insulin

12. Depict the correct site of hormone
(a) α – glucagon, β – insulin, δ – somatostatin
(b) α – insulin, β – glucagon, δ – somatostatin
(c) δ – insulin, α – somatostatin, β – glucagon
(d) α – somatostatin, β – insulin, δ – glucagons

13. Glycosuria is the condition, where a man
(a) Eats more sugar
(b) Excretes sugar in urine
(c) Sugar is excreted in faeces
(d) Has low sugar level in blood

14. RAAS secretes which of the following hormone
(a) Mineralocorticoids (b) Glucocorticoids
(c) Both (a) and (b) (d) None of these

15. At cellular level GH affects growth by controlling the production of
(a) *r*-RNA (b) *t*-RNA
(c) *m*-RNA (d) None of the above

16. Somatostatin is secreted by
(a) Hypothalamus (b) Pituitary
(c) Pineal (d) Thyroid

17. Which disease is caused by the deficiency of thyroxin in the adults
(a) Diabetes insipidus (b) Diabetes mellitus
(c) Myxoedema (d) Exopthalmic goiter

18. Which one of the following hormone never reaches to cytoplasm
(a) Estrogen (b) FSH
(c) Progesterone (d) Testosterone

19. Find the odd one out
(a) Parathyroid – tetany
(b) Pancreas – diabetes insipidus
(c) Adrenal cortex – Cushing's syndrome
(d) Thyroid – goiter

20. Which of the following glands is associated with the consumption of iodized salt
(a) Thyroid (b) Thymus
(c) Pituitary (d) Ovary

21. Relaxin is released from
(a) Pituitary gland (b) Ovary
(c) Testis (d) Adrenals

22. Why thyroxin is a hormone not an enzyme
(a) It is secreted in small quantity
(b) It is not a polypeptide
(c) It has no special effect
(d) It is directly poured into blood

23. The other name for autoimmune thyroiditis is

Or

An autoimmune disease where the body's own antibodies attack the cells of thyroid is
(a) Addison's disease (b) Simmond's disease
(c) Hashimoto's disease (d) Cushing's disease

24. Tetany (Irregular muscle contraction) and osteoporosis are caused due to the deficiency of
(a) Cortisone (b) Estrogen
(c) Insulin (d) Parathormone

25. Parathormone is secreted during
(a) Increased blood calcium level
(b) Decreased blood calcium level
(c) Increased blood sugar level
(d) Decreased blood sugar level

26. The mineralocorticoid hormone of the adrenal cortex which causes the *Na* retention and *K* excretion is
(a) Corticosol (b) Corticosterone
(c) Progesterone (d) Aldosterone

27. The hormones that initiate ejection of milk, stimulates milk production and growth of ovarian follicles are respectively known as
(a) PRL, OT and LH (b) OT, PRL and FSH
(c) LH, PRL and FSH (d) PRH, OT and LH
(e) PRH, OT and FSH

28. Which is not a gonadal hormone
(a) Progesterone (b) Testosterone
(c) Adrenalin (d) Estrogen

29. Blood pressure is controlled by
(a) Adrenal (b) Thyroid
(c) Thymus (d) Corpus luteum

30. Adrenal glands are found located in abdominal cavity in close association with
(a) Testes (b) Spleen
(c) Liver (d) Kidneys

31. Which of the following is correctly matched
(a) Thyroxin - tetanus
(b) Insulin-diabetes insipidus
(c) Adrenaline – hepatitis
(d) Parathyroid – tetany

32. The genetic deficiency of ADH-receptor leads to
(a) Diabetes mellitus (b) Glycosuria
(c) Diabetes insipidus (d) Nephrogenic diabetes

33. Which one affects liver, muscle and adipose tissue
(a) Androgen (b) Insulin
(c) Progesterone (d) Glucagon

34. Nor epinephrine is secreted from
(a) Zona glomerulosa (b) Zona fasciculata
(c) Zona reticularis (d) Medulla of adrenal

35. Hassall's bodies/corpuscles
(a) Adrenal medulla (b) Thyroid
(c) Thymus (d) Parathyroid

36. Graffian follicles are formed by the active division of
(a) Peritoneum
(b) Generative epithelium
(c) Columnar epithelium (sensory)
(d) Corpus cavernosa

37. Hormone responsible for the implantation of embryo in uterus and formation of placenta is
(a) Adrenalin (b) Progesterone
(c) Estradiol (d) FSH

38. Which one of the following is temporary endocrine gland
(a) Pineal (b) Pancreas
(c) Placenta (d) Parathyroid

39. Which of the following is known as master endocrine gland
(a) Adrenal gland (b) Thyroid gland
(c) Pituitary gland (d) Pineal gland

40. Cholesterol is necessary for the synthesis of
(a) Vitamin C (b) Vitamin B
(c) Oestradiol (d) Insulin

41. Insulin was isolated from dog by
(a) M. Bayliss (b) E.H. Sterling
(c) Banting and Best (d) Von Mering

42. During pregnancy which of the following is secreted through urine of mother

Or

The persistence of corpus luteum during pregnancy is due to a hormone known as
(a) Progesterone
(b) Luteinizing hormone
(c) FSH
(d) Chorionic gonadotropin

43. Hormone prolactin was discovered by
(a) Riddle (b) Hisaw
(c) Leonard (d) Hisaw and Leonard

44. When mammary glands of male develop similar to that of female, then this condition is known as
(a) Gonochorism (b) Gynaecomastia
(c) Feminism (d) Gynaecism

45. The name of hormone secreted by the ovary, which facilitates growth of ovarian follicle is
(a) Progesterone (b) LH
(c) FSH (d) Estradiol

46. 'Mammalian thymus' is mainly concerned with
(a) Regulation of body temperature
(b) Regulation of body growth
(c) Immunological functions
(d) Secretion of thyrotrophin

47. Gluconeogenesis is controlled by
(a) Cortisol (b) Corticosterone
(c) Thyroxin (d) All the above

48. Which hormone(s) of the following endocrine glands lacks peptides, amines and sulphur
(a) Hormone of anterior pituitary
(b) Hormone of posterior pituitary and pancreas
(c) Hormone of thyroid and adrenal gland
(d) Hormone of testes and ovary

49. With reference to the pituitary, which of the following statements is true
(a) Neurohypophysis secretes vasopressin and oxytocin
(b) Neurohypophysis secretes TSH and STH
(c) Neurohypophysis collects and stores vasopressin and oxytocin
(d) Adenohypophysis secretes vasopressin and oxytocin

50. Diabetes mellitus is caused due to the deficiency of insulin which is secreted by
(a) Alpha cells (b) Beta cells
(c) Pituitary (d) Thyroid

51. An overdose of intravenous insulin may lead to the death of an individual due to
(a) An excessive increase of blood glucose
(b) An excessive decrease of blood glucose
(c) An inhibition of glucagon secretion
(d) An over production of histamine

52. "Islets of Langerhans" are found in
(a) Pancreas (b) Pituitary
(c) Stomach (d) Spleen

53. Which of the following hormones has no effect on heart beat
(a) Thyroxin (b) Oxytocin
(c) Adrenaline (d) Noradrenaline

54. _____ is a globular protein of ~6 *kDa* consisting of 51 amino acids, arranged in 2 polypeptide chains held together by disulphide bridge
(a) Insulin (b) Keratin
(c) Glucagon (d) Fibrinogen

55. Melanin is secreted by
(a) Erythroblasts of blood
(b) Chromatophores of skin
(c) Cells of stratum compactum
(d) Ganglia of sensory nerves

56. The co-ordinator between Nervous and endocrine system is
(a) Thalamus (b) Hypothalamus
(c) Epithalamus (d) Colliculus

57. Serotonin and Melatonin are hormones, secreted by
(a) Pancreas (b) Pineal body
(c) Pituitary gland (d) Thymus

58. The steroid responsible for balance of water and electrolytes in our body is
(a) Insulin (b) Melatonin
(c) Testosterone (d) Aldosterone

59. Thymosin is responsible for
(a) Raising the blood sugar level
(b) Raising the blood calcium level
(c) Increased production of T lymphocytes
(d) Decrease in blood RBC

60. Cortisol is secreted from
(a) Pancrease (b) Thyroid
(c) Adrenal (d) Thymus

61. One of the following conditions is not linked to deficiency of thyroid hormones
(a) Cretinism (b) Goiter
(c) Myxoedema (d) Exophthalmoses

62. Growth hormone is also known as
(a) LH (b) STH
(c) CTH (d) None of the above

63. Which of the following pair of hormones is responsible for the growth and maturation of the graffian follicle
(a) GH–ADH (b) ACTH–LH
(c) FSH–LH (d) FSH–LTH

64. Which of the following is both (mixed) exo and endocrine gland
(a) Thyroid (b) Pancreas
(c) Payer's patches (d) Thymus

65. Which hormone promotes cell division, protein synthesis and bone growth
(a) GH (STH) (b) PTH
(c) ADH (d) ACTH

66. Which endocrine gland becomes inactive in old age
(a) Adrenal (b) Pineal
(c) Thymus (d) Pituitary

67. Thyroxin is
(a) An enzyme (b) A hormone
(c) A vitamin (d) An excretory product

68. When an animal is angry and wants to fight; the hormone that is secreted is
(a) Adrenalin (b) Androgen
(c) Corticosterone (d) Gluco-corticoids

69. The hormone responsible for the regulation of metabolism of calcium and phosphorus is secreted by
(a) Thyroid
(b) Parathyroid and thyroid both
(c) Thymus
(d) Pancreas

70. Hyper secretion of GH from pituitary in the adult causes a disease called
(a) Gigantism (b) Acromegaly
(c) Cushing's disease (d) Addison's disease

71. Epinephrine is
(a) Nephrostomal part of mesoderm
(b) Clusters of glomeruli in mammalian kidney
(c) Hormone of the adrenal gland
(d) Frontal lobe of nephridia

72. Which hormone is produced in women only during pregnancy
(a) Human Chorionic Gonadotropin (HCG)
(b) Human Placental Lactogen (HPL)
(c) Relaxin
(d) All of the above

73. Excess of which of the following hormones causes Cushing's syndrome
(a) Thyroxin (b) Cortisol
(c) Adrenaline (d) Noradrenaline

74. Which is a 32 amino acid water soluble peptide hormone
(a) Gastrin (b) Calcitonin
(c) Glucagon (d) Insulin

75. Which of the following hormones regulates growth and metamorphosis in insects
(a) Juvenile hormone
(b) Brain hormone
(c) Ecdysone
(d) Prothoracicotropic hormone

76. Match the hormones with its source of secretion

(A)	Somatostatin	(1)	Pineal gland
(B)	Melatonin	(2)	Corpus luteum
(C)	Aldosterone	(3)	Placenta
(D)	Progesterone	(4)	Adrenal cortex
(E)	HCG	(5)	Islet of Langerhans
		(6)	Adenohypophysis

(a) (A) — (5), (B) — (1), (C) — (6), (D) — (3), (E) — (2)
(b) (A) — (1), (B) — (2), (C) — (4), (D) — (3), (E) — (5)
(c) (A) — (2), (B) — (6), (C) — (4), (D) — (5), (E) — (3)
(d) (A) — (5), (B) — (1), (C) —(4), (D) — (2), (E) — (3)
(e) (A) — (1), (B) — (3), (C) — (4), (D) — (2), (E) — (5)

77. Match list I with list II and choose the correct answer

	List I		List II
(A)	Hypothalamus	(1)	Sperm lysine
(B)	Acrosome	(2)	Estrogen
(C)	Graffian follicle	(3)	Relaxin
(D)	Leydig cells	(4)	GnRH
(E)	Parturition	(5)	Testosterone

(a) (A) — (4), (B) — (1), (C) — (2), (D) — (3) , (E) — (5)
(b) (A) — (2), (B) — (1), (C) — (4), (D) — (3) , (E) — (5)
(c) (A) — (2), (B) — (1), (C) — (5), (D) — (4) , (E) — (3)
(d) (A) — (4), (B) — (1), (C) — (2), (D) — (5) , (E) — (3)
(e) (A) — (5), (B) — (1), (C) — (3), (D) — (2) , (E) — (4)

78. In case the islets of Langerhans stop functioning which hormone will be in short supply and what will be its effect
(a) Insulin–Blood glucose level will rise
(b) Adrenaline–Heart beat will increase
(c) Thyroxin–Growth will be retarded
(d) Cortina–Tetany will develop

79. Hypothyroidism in adults and hyperparathyroidism will respectively lead to
(a) Myxoderma and Cretinism
(b) Grave's disease and Hashimoto's disease
(c) Myxoedema and Osteitis fibrosa cystica
(d) Addison's disease and Cretinism
(e) Cretinism and Osteitis fibrosa cystica

80. In a pregnant woman having prolonged labour pains, if child birth has to be hastened *i.e* to aid parturition, it is advisable to administer a hormone that can
(a) Activate the smooth muscles
(b) Increase the metabolic rate
(c) Release glucose into the blood
(d) Stimulate the ovary

81. Match the items in Column – I with Column – II and choose the correct alternative

	Column – I		Column – II
A.	Calcitonin	1.	Treatment of viral infections
B.	Gonadotropin	2.	Treatment of rickets
C.	Erythropoietin	3.	Enhancement of immune action
D.	Interferon	4.	Formation of erythrocytes
E.	Interleukin	5.	treatment of infertility

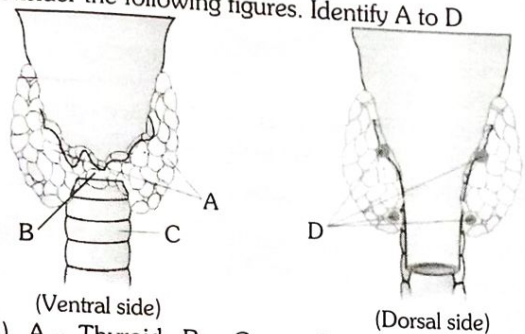
(a) A–3,B–1,C–4,D–2,E–5
(b) A–3,B–2,C–1,D–5,E–4
(c) A–4,B–3,C–2,D–1,E–5
(d) A–2,B–3,C–4,D–5,E–1
(e) A–2,B–5,C–4,D–1,E–3

82. Which of the following statements are false/true
A. Calcitonin regulates the metabolism of calcium
B. Oxytocin stimulates contraction of uterine muscles during birth
C. Grave's disease is caused by malfunctioning of adrenal gland
D. *ADH* stimulates absorption of water and increases the urine productions
(a) *A* and *C* are true; *B* and *D* are false
(b) *A* and *B* are true; *C* and *D* are false
(c) *A* and *D* are false; *B* and *C* are true
(d) *A B* and *C* are true; *D* only false
(e) *A* only true; *B, C* and *D* are false

83. Glucagon and insulin are
(a) Antagonistic secretions
(b) Secreted by same cells and perform similar function
(c) Secreted by different cells and perform antagonistic function
(d) Secreted by same cells and perform antagonistic functions
(e) None of the above

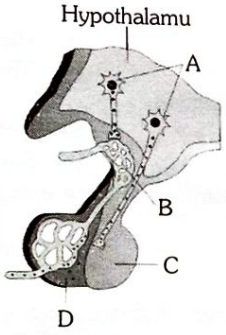
84. Gorilla like man with large head and hands and protruding jaws, is produced due to
(a) Over secretion of thyroxin
(b) Over secretion of growth hormone since maturity
(c) Excess of vitamin 'C' in diet
(d) Excess secretion of TSH

85. Consider the following figures. Identify A to D



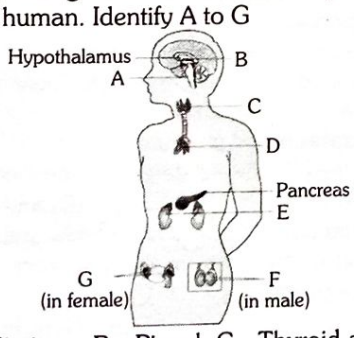
(a) A - Thyroid, B - Corpus luteum, C - Trachea, D - Parathyroid gland
(b) A - Thyroid, B - Isthmus, C - Larynx, D - Parathyroid gland
(c) A - Thyroid, B - Isthmus, C - Trachea, D - Parathyroid gland
(d) A - Parathyroid gland, B - Isthmus, C - Trachea, D – Thyroid

86. See the given diagrammatic representation. Identify A, B, C and D



(a) A - Hypothalamic neurons, B - Portal circulation, C - Posterior pituitary, D - Anterior pituitary
(b) A - Hypothalamic neurons, B - Portal circulation, C - Anterior pituitary, D - Posterior pituitary
(c) A - Epithalamic neurons, B - Hypothalamic vein, C - Pars distalis, D - Pars intermedia
(d) A - Hypothalamic neurons, B - Hypothalamic artery, C - Posterior pituitary, D - Anterior pituitary

87. See the given figure which related with principal endocrine glands in human. Identify A to G



(a) A - Pituitary, B - Pineal, C - Thyroid and parathyroid, D - Thymus, E - Adrenal, F - Testis, G - Ovary
(b) A - Pituitary, B - Pineal, C - Thyroid and parathyroid, D - Thymus, E - Kidney, F - Testis, G - Ovary
(c) A - Pituitary, B - Pineal, C - Thyroid and parathyroid, D - Thymus, E - Adrenal, F - Ovary, G - Testis
(d) A - Pineal, B - Pituitary, C - Thyroid and parathyroid, D - Thymus, E - Adrenal, F - Testis, G – Ovary

88. Mary is about to face an interview. But during the first five minutes before the interview she experiences sweating, increased rate of heart beat, respiration etc. Which hormone is responsible for her restlessness
(a) Estrogen and progesterone
(b) Oxytocin and vasopressin
(c) Adrenaline and noradrenaline
(d) Insulin and glucagons

89. Listed below are the hormones of anterior pituitary origin. Tick the wrong entry
(a) Growth hormone
(b) Follicle stimulating hormone
(c) Oxytocin
(d) Adrenocorticotrophic hormone

90. All the following tissues in mammals except one consist of a central 'medullary' region surrounded by a cortical region. Mark the wrong entry
(a) Ovary (b) Adrenal
(c) Liver (d) Kidney

91. Blood calcium level is a resultant of how much dietary calcium is absorbed, how much calcium is lost in the urine, how much bone dissolves releasing calcium into the blood and how much calcium from blood enters tissues. A number of factors play an important role in these processes. Mark the one which has no role
(a) Vitamin D (b) Parathyroid hormone
(c) Thyrocalcitonin (d) Thymosin

92. The urine of a man is very dilute and the quantity of urine is too much and dehydration has started in his body and he is very thirsty by the cause of
(a) Hypersecretion of ADH
(b) Hyposecretion of ADH
(c) Both (a) and (b)
(d) None of the above

93. Man with thick lips, dirt deposited on tongue, low heart beating rate, with excess amount of cholesterol in blood, is supposed to be suffering from which abnormality
(a) Cretinism (b) Hashimoto disease
(c) Myxoedema (d) Addison's disease

94. Androgens are secreted by
(a) Ovaries (b) Thyroid
(c) Pituitary (d) Testes

95. Development of secondary sexual characters in females are controlled by
(a) Estrogen (b) Oxytocin
(c) Progesterone (d) Androgen

96. Cyclic adenosine monophosphate was discovered by
(a) Bekhor *etal* (b) E.W. Sutherland
(c) Beerman (d) Weismann

3. NEET-AIMPT/CBSC-PMT

1. Action of the peptide hormone on a target cell is mediated by **[1991]**
(a) A cytoplasmic receptor (b) Cyclic AMP
(c) ATP (d) Epinephrin

2. Hormones may be **[2004]**
(a) Amino acid derivatives (b) Peptides
(c) Steroids (d) All the above

3. The feed back control mechanism is related with **[2000]**
(a) Bile secretion (b) *HCl* secretion
(c) Hormonal secretion (d) Hering breuer reflex

4. Which one of the following is not a second messenger in hormone action **[2006]**
(a) Sodium (b) cAMP
(c) cGMP (d) Calcium

5. Which of the following statements is correct in relation to the endocrine system **[2013]**
(a) Releasing and inhibitory hormones are produced by the pituitary gland
(b) Adenohypophysis is under direct neural regulation of the hypothalamus
(c) Organs in the body like gastrointestinal tract, heart, kidney and liver do not produce any hormones
(d) Non-nutrient chemicals produced by the body in trace amount that act as intercellular messenger are known as hormones

6. Which of the following hormones can play a significant role in osteoporosis **[2018]**
(a) Parathyroid hormone and Prolactin
(b) Estrogen and Parathyroid hormone
(c) Progesterone and Aldosterone
(d) Aldosterone and Prolactin

7. The letter T in T-lymphocyte refers to **[2009]**
(a) Thyroid (b) Thalamus
(c) Tonsil (d) Thymus

8. Which one of the following pairs of organs includes only the endocrine glands **[2008]**
(a) Thymus and Testes
(b) Adrenal and Ovary
(c) Parathyroid and Adrenal
(d) Pancreas and parathyroid

9. In human adult females oxytocin **[2008]**
(a) Stimulates pituitary to secrete vasopressin
(b) Causes strong uterine contractions during parturition
(c) Is secreted by anterior pituitary
(d) Stimulates growth of mammary glands

10. A health disorder that results from the deficiency of thyroxin in adults and characterized by (i) a low metabolic rate, (ii)increase in body weight and (iii) tendency to retain water in tissues is **[2009]**
(a) Hypothyroidism (b) Simple goiter
(c) Myxoedema (d) Cretinism

11. The blood calcium level is lowered by the deficiency of **[2008]**

Or

The hormone that increases the blood calcium level and decreases its excretion by kidney is
(a) Both calcitonin and parathormone
(b) Calcitonin
(c) Parathormone
(d) Thyroxin

12. The Leydig cells as found in the human body are the secretory source of **[2012]**
(a) Progesterone (b) Intestinal mucus
(c) Glucagon (d) Androgens

13. The intermediate lobe of the pituitary gland produces a secretion which causes a dramatic darkening of the skin of many fishes, amphibians and reptiles. It is **[1988]**
(a) Adrenocorticotropic hormone (ACTH)
(b) Follicle stimulating hormone (FSH)
(c) Melanocyte stimulating hormone (MSH)
(d) Luteinizing hormone (LH)

14. Which one of the following pairs of hormones are the examples of those that can easily pass through the cell membrane of the target cell and bind to a receptor inside it (Mostly in the nucleus) **[2012]**
(a) Insulin, glucagon (b) Thyroxin, insulin
(c) Somatostatin, oxytocin (d) Cortisol, testosterone

15. A substance called ADH is **[1991]**
(a) A hormone that promotes glycogenesis in liver cells
(b) An enzyme secreted by cell of intestinal wall; hydrolyses dipeptides into amino acids
(c) A pituitary secretion which promotes reabsorption of water from glomerular filtrate
(d) A high energy compound involved in muscle contraction

16. Gonadotrophic hormones are produced in the **[2010]**
(a) Posterior part of thyroid
(b) Adrenal cortex
(c) Adenohypophysis of pituitary
(d) Interstitial cells of testis

17. Calcitonin lowers the calcium level in the blood. This is secreted by **[1992; 2013]**
(a) Parathyroid (b) Hypothalamus
(c) Adrenal (d) Thyroid

18. Acromegaly results after adolescence due to excess production of one of the following hormones **[2002]**
(a) Prolactin (b) Thyroxin
(c) Insulin (d) STH

19. Which hormone causes dilation of blood vessels, increased oxygen consumption and glucogenesis **[2006]**
(a) Adrenalin (b) Glucagon
(c) ACTH (d) Insulin

20. Which hormone has the anti-insulin effect **[1988]**
(a) Calcitonin (b) Cortisol
(c) Oxytocin (d) Aldosterone

21. Which of the following radioactive isotopes is used in the detection of thyroid cancer **[1995]**
(a) Iodine–131 (b) Carbon–14
(c) Uranium–238 (d) Phosphorus–32

22. Which endocrine gland stores its secretion in the extracellular space before discharging it into the blood **[1995]**
(a) Adrenal (b) Pancreas
(c) Testis (d) Thyroid

23. Iodine is associated with **[1997]**
(a) Thyroxin (b) Calcitonin
(c) Oxytocin (d) Secretin

24. Hormones thyroxin, adrenaline and the pigment melanin are formed from **[1997]**
(a) Tryptophan (b) Glycine
(c) Tyrosine (d) Proline

25. Toxic agents present in food which interfere with thyroxin synthesis lead to the development of **[2010]**

Or

Disease related to thyroxin hormone
(a) Thyrotoxicosis (b) Toxic goiter
(c) Cretinism (d) Simple goiter

26. Cushing's syndrome and myxoedema are associated with these glands respectively **[1993]**
(a) Thyroid, adrenal (b) Adrenal, thyroid
(c) Parathyroid, thyroid (d) Adrenal, pituitary

27. Norepinephrine **[2013]**
(A) Is released by sympathetic fibers
(B) Is released by parasympathetic fibers
(C) Increases the heart rate
(D) Decreases blood pressure
Which of the above said statements are correct
(a) (A) and (C) (b) (B) and (C)
(c) (B) and (D) (d) (A) and (D)

28. Which part of the ovary in mammals acts as an endocrine gland after ovulation **[2007]**
(a) Stroma (b) Germinal epithelium
(c) Graffian follicle (d) Vitelline membrane

29. Progesterone hormone is secreted by **[2014]**
(a) Corpus luteum (b) Corpus callosum
(c) Corpus uteri (d) Corpus albicans

30. Signal from fully developed foetus and placenta ultimately lead to parturition(child birth) which requires the release of **[2010]**
(a) Estrogen from placenta
(b) Oxytocin from maternal pituitary
(c) Oxytocin from foetal pituitary
(d) Relaxin from placenta

31. The 24 hour (diurnal) rhythm of our body such as the sleep-wake cycle is regulated by the hormone **[2011]**
(a) Adrenaline (b) Melatonin
(c) Calcitonin (d) Prolactin

32. A disease characterized by raised levels of blood glucose as well as increased fat and protein metabolism is **[1993]**
(a) Diabetes
(b) Cancer
(c) Ulcer
(d) Enlargement of pancreas

33. A polypeptide secreted into the blood by the cells in the stomach wall, stimulates the production of *HCl* by the parietal cells of the stomach is **[1993]**
(a) Gastrin (b) Secretin
(c) Pancreozymin (d) Renin

34. Which hormone stimulates the secretion of milk during sucking of milk by bab **[1996]**

Or

Which hormone is responsible for milk ejection after the birth of the baby
(a) Oxytocin (b) Relaxin
(c) Prolactin (d) Progesterone

35. Low Ca^{++} in the body fluid may be the cause of **[2010]**
(a) Gout (b) Tetany
(c) Anemia (d) Angina pectoris

36. Diabetes is due to **[1999]**
(a) Na^{+} deficiency (b) Hormonal deficiency
(c) Enzyme deficiency (d) Iodine deficiency

37. Which of the following hormone governs the metabolism of carbohydrates **[1993]**
(a) Corticoids (b) Glucagon
(c) Insulin (d) Glucagon and insulin

38. Cholecystokinin and secretin are **[1997]**
(a) Hormones liberated by mucosa of duodenum and stimulate gall bladder and pancreas respectively
(b) Hormones stimulating liver
(c) Hormones stimulating pancreas
(d) Enzymes

39. Which one of the following hormones through synthesized elsewhere is stored and released by the master gland **[2015]**
(a) Luteinizing hormone
(b) Prolactin
(c) Melanocyte stimulating hormones
(d) Antidiuretic hormone

40. Which one of the following hormones is not involved in sugar metabolism **[2015]**
(a) Aldosterone (b) Insulin
(c) Glucagon (d) Cortisone

41. A chemical signal that has both endocrine and neural roles is **[2015]**
(a) Calcitonin (b) Epinephrine
(c) Cortisol (d) Melatonin

42. Secretion of progesterone by corpus luteum is initiated by **[1999]**
(a) MSH (b) LH
(c) Testosterone (d) Thyroxin

43. Which of the following is an accumulation and release centre of neurohormones **[2006]**
(a) Hypothalamus
(b) Anterior pituitary lobe
(c) Posterior pituitary lobe
(d) Intermediate lobe of the pituitary

44. The hormone which controls the rate of body metabolism is **[1993]**
(a) Thyroxin (b) Insulin
(c) ACTH (d) HGH

45. A steroid hormone which regulates glucose metabolism is **[2006]**
(a) 11-deoxycorticosterone (b) Cortisone
(c) Cortisol (d) Corticosterone

46. A person is having problems with calcium and phosphorus metabolism in his body. Which one of the following glands may not be functioning properly **[2007]**
(a) Parathyroid (b) Parotid
(c) Pancreas (d) Thyroid

47. What is correct to say about the hormone action in humans **[2012]**
(a) Glucagon is secreted by β-cells of Islets of Langerhans and stimulates glycogenolysis
(b) Secretion of thymosins is stimulated with aging
(c) In females, FSH first binds with specific receptors on ovarian cell membrane
(d) FSH stimulates the secretion of estrogen and progesterone

48. Select the correct matching of a hormone, its source and function **[2010]**

	Hormone	Source	Function
(a)	Vasopressin	Posterior Pituitary	Increases loss of water through urine
(b)	Norepinephrine	Adrenal medulla	Increases heart beat, rate of respiration and alertness
(c)	Glucagon	Beta-cells of Islets of langerhans	Stimulates glycogenolysis
(d)	Prolactin	Posterior Pituitary	Regulates growth of mammary glands and milk formation in females

49. A person entering an empty room suddenly finds a snake right in front on opening the door. Which one of the following is likely to happen in his neuro-hormonal control system **[2012]**
(a) Sympathetic nervous system is activated releasing epinephrin and norepinephrine from adrenal medulla
(b) Neurotransmitters diffuse rapidly across the cleft and transmit a nerve impulse
(c) Hypothalamus activates the parasympathetic division of brain
(d) Sympathetic nervous system is activated releasing epinephrin and norepinephrine from adrenal cortex

50. Angiotensin is derived from plasma protein "angiotensinogen" by the action of renin and other nervous stimuli. Angiotensin stimulates the following **[1992]**
(a) Thyroid (b) Adrenal
(c) Ovary (d) Thymus

51. Identify the hormone with its correct matching of source and function **[2014]**
(a) Progesterone – corpus-luteum, stimulation of growth and activities of female secondary sex organs
(b) Atrial natriuretic factor – ventricular wall increases the blood pressure
(c) Oxytocin – posterior pituitary, growth and maintenance of mammary glands
(d) Melatonin – pineal gland, regulates the normal rhythm of sleep wake cycle

52. Given below is an incomplete table about certain hormones, their source glands and one major effect of each on the body in humans. Identify the correct option for the three blanks A, B and C

Glands	Secretion	Effect on body
A	Estrogen	Maintenance of secondary sexual character
Alpha cells of Islets of Langerhans	B	Raises blood sugar level
Anterior pituitary	C	Over secretion leads to gigantism

Options **[2011]**

	A	B	C
(a)	Placenta	Glucago	Calcitonin
(b)	Ovary	Glucagon = Growth hormone	
(c)	Placenta	Insuli	Vasopressin
(d)	Ovary	Insulin	Calcitonin

53. Match the source gland with its respectively hormone as well as the function **[2011]**

	Source gland	Hormone	Function
(a)	Thyroid	Thyroxin	Regulates blood calcium level
(b)	Anterior pituitary	Oxytocin	Contraction of uterus muscles during child birth
(c)	Posterior pituitary	Vasopressin	Stimulates reabsorption of water in the distal tubules in the nephron
(d)	Corpus luteum	Estrogen	Supports pregnancy

54. Most of the contraceptive pills contain **[1998, 99]**
(a) Estrogen + FSH
(b) Progesterone + LH
(c) FSH + LH
(d) Estrogen + progesterone

55. Fight-or-flight reactions cause activation of **[2014]**
(a) The adrenal medulla, leading to increased secretion of epinephrine and norepinephrine
(b) The pancreas leading to a reduction in the blood sugar levels
(c) The parathyroid glands, leading to increased metabolic rate
(d) The kidney, leading to suppression of reninangiotensin-aldosterone pathway

56. Select the correct option describing gonadotropin activity in a normal pregnant female **[2014]**
(a) High level of hCG stimulates the synthesis of estrogen and progesterone
(b) High level of hCG stimulates the thickening of endometrium
(c) High level of FSH and LH stimulates the thickening of endometrium
(d) High level of FSH and LH facilitate implantation of the embryo

57. 'Exopthalmic goiter' (Grave's disease) is caused due to **[2016]**
(a) Hypofunction of the thyroid
(b) Hyperfunction of the thyroid
(c) Hypofunction of the parathyroid
(d) Hyperfunction of the parathyroid

58. Feeling the tremors of an earthquake a scared resident of seventh floor of a multistoryed building starts climbing down the stairs rapidly. Which hormone initiated this action **[2007]**
(a) Thyroxin (b) Adrenaline
(c) Glucagon (d) Gastrin

59. Injury to adrenal cortex is not likely to affect the secretion of which one of the following **[2010]**
(a) Cortisol
(b) Aldosterone
(c) Both Androstenedione and Dehydroepiandrosterone
(d) Adrenaline

60. Which one of the following is an example of negative feedback loop in humans **[2007]**
(a) Constriction of skin blood vessels and contraction of skeletal muscles when it is too cold
(b) Secretion of tears after falling of sand particles into the eye
(c) Salivation of mouth at the sight of delicious food
(d) Secretion of sweat glands and constriction of skin blood vessels when it is too hot

61. Addison's disease is characterised by **[1991]**
(a) Elongation of limb bones and jaw becomes broad
(b) Hypertension and enlargement of thyroid
(c) Loss of appetite, vomiting, muscular weakness, lowering of BMR, blood pressure and bronze coloured patches of skin
(d) Obesity, osteoporosis and glycosuria

62. Deficiency of adrenal cortex activity leads to **[1993]**
(a) Addison's disease (b) Conn's disease
(c) Cushing's disease (d) Simmond's disease

63. Which of the following is an amino acid derived hormone **[2018]**
(a) Estriol (b) Estradiol
(c) Ecdysone (d) Epinephrine

4. AIIMS

1. Which of the following is not necessarily a property of all hormones **[1993]**
(a) Information carrying
(b) Secreted in low amounts
(c) Short half-life
(d) Protein in nature

2. Damage to thymus in a child may lead to **[2007]**
(a) Loss of cell mediated immunity
(b) A reduction in the haemoglobin content in blood
(c) A reduction in the amount of plasma proteins
(d) Loss of antibody mediated immunity

3. The source of somatostatin is same as that of **[2003]**
(a) Thyroxin and calcitonin
(b) Insulin and glucagon
(c) Somatotropin and prolactin
(d) Vasopressin and oxytocin

4. Which of the following gland plays a key role in metamorphosis of frog's tadpole **[1999]**
(a) Adrenal (b) Thymus
(c) Pancreas (d) Thyroid

5. If parathyroid gland of a child is removed, which activity is disturbed **[2013]**
(a) Growth
(b) Calcium concentration
(c) Potassium concentration
(d) None of these

6. The secretion of aldosterone by adrenal cortex is directly controlled by [1992]
(a) Plasma K^+ concentration
(b) Plasma Ca concentration
(c) Level of blood angiotensin
(d) (a) and (c) are correct

7. Catecholamine in a normal person induces [2012]
(a) Intense salivation (b) Alertness
(c) Decrease in heart beat (d) Excessive urination

8. Cause of Addison's disease is [1998]
(a) Hyposecretion of aldosterone hormone
(b) Hypersecretion of aldosterone hormone
(c) Hyposecretion of cortisone hormone
(d) Hypersecretion of cortisone hormone

9. Conn's disease is caused by the over-secretion of [1999]
(a) ADH (b) ACTH
(c) Aldosterone (d) Oxytocin

10. Which of the following hormones is a derivative of amino acid [1999]
(a) Estrogen (b) Epinephrine
(c) Progesterone (d) Prostaglandin

11. Testosterone, a hormone responsible for the development of secondary sexual characteristics in male is produced by the [1992]
(a) Spermatogonia
(b) Seminiferous tubules
(c) Anterior lobe of the pituitary
(d) Cells that lie between seminiferous tubules

12. Which of the following is an emergency hormone [2000]
(a) Pituitary (b) Prolactin
(c) Progesterone (d) Adrenalin

13. Which one of the following four glands is correctly matched with the accompanying description [2008]
(a) Thyroid – Hyperactivity in young children causes cretinism
(b) Thymus – Starts undergoing atrophy after puberty
(c) Parathyroid – Secretes parathormone, which promotes move–ment of calcium ions from blood into bones during classification
(d) Pancreas – Delta cells of the islets of Langerhans secrete a hormone, which stimulates glycolysis in liver

14. A person passes much urine and drinks much water but his blood glucose level is normal. This condition may be the result of [2003]
(a) A reduction in insulin secretion from pancreas
(b) A reduction in vasopressin secretion from posterior pituitary
(c) A fall in the glucose concentration in urine
(d) An increase in secretion of glucagons

15. Similarity between the secretion of thyroid and adrenal is that both the secretions [1992]
(a) Are proteins
(b) Are steroid
(c) Increase glucose metabolism
(d) Control mineral metabolism

16. Match the columns

Column-I	Column-II
A. Adrenaline	1. Anger, fear, danger
B. Estrogen	2. Attracting partners through sense of smell
C. Insulin	3. Females
D. Pheromones	4. Glucose

[2010]

	A	B	C	D
(a)	3	1	4	2
(b)	1	3	2	4
(c)	1	3	4	2
(d)	3	1	2	4

5. Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion
(c) If the assertion is true but the reason is false
(d) If both the assertion and reason are false
(e) If the assertion is false but reason is true

1. Assertion : Adrenal cortex can be removed without causing death
Reason : Adrenal cortex is not vital for survival.

2. Assertion : Prolactin is also called the 'Milk ejection hormone'
Reason : Prolactin stimulates the smooth muscle contractions of the mammary glands.

3. Assertion : Diabetes insipidus is marked by excessive urination and too much thirst of water.
Reason : Anti–diuretic hormone (ADH) is secreted by the posterior lobe of pituitary.

4. Assertion : Adrenal cortex is called the gland for 'fight, fright and flight'.
Reason The hormones adrenaline and noradrenaline help the body to combat against stress and emergency conditions.

5. Assertion : Oxytocin is also known as Anti Diuretic hormone (ADH).
Reason : Oxytocin can cause an increase in the renal reabsorption of water.

6. Assertion : The tadpoles become giant tadpoles when fed on thiourea.
Reason : Thiourea is an antithyroid substance.