thyroxin. The control of this hormone is on the rate of body metabolism. When thyroxin is administered, the rate of oxygen consumption increases, the amount of heat produced is also increased.

Several human diseases are associated with the improper functioning of the thyroid gland. Some are associated with excessive production of thyroxin i.e. hyperthyroidism and some with insufficient production of hormone i.e. hypothyroidism.

Hypotheroidism before maturity results in cretinism. The victim of cretinism fails to attain either normal physical or mental development. Cretinism is prevalent in areas where insufficient iodine is present in diet. Symptoms of creatinism can be prevented by early and regular administration of thyroxin.

Hypothyroidism in adults causes myxedeme. The symptom of this disease is low metabolic rates, overweight and a coarsening of the features. It is also prevalent in iodine deficient areas.

Sample Goiter: is a disease associated with deficiency of iodine. A goiter is a swelling of neck caused by swelling of the thyroid gland. This occurs when the thyroid gland is stimulated by TSH (Throid stimulating hormone from the pituitary gland) to produce thyroxin under a condition of insufficient iodine.

PARATHYROID GLANDS: These are four tiny structures imbedded in the near surface of the thyroid glands. They secrete PTH parathyroid hormone. This hormone promotes (a) the release of Ca^{++} from the bones (b) the absorption of Ca^{++} from the food in the intestine (c) reabsorption of Ca^{++} in the tubules of the kidney.

Parathyroid hormone inhibits the reabsorption of PO_4 in the kidney tubules and thus helps rid the body of excess PO_4 produced.

A hormone which also controls the excess of Ca^{++} in the blood is calcitonim which is produced in the thyroid gland. This prevents the overshooting of Ca^{++} level in the body.

THE SKIN

When ultraviolet radiation strikes the skin, it trigger the conversion of dehydrocholesterol into calciferol (Vitamin D). in its chemical structure and mode of action, calciferol meets all criteria of a hormone. After synthesis in the skin, it is released into the blood where it is carried into the liver where it is modified and then into the kidney where it undergoes second modification into 1, 2-dihydroxy vitamin D. This enhances the absorption of Ca^{++} from the intestinal contents. Thus this hormone teams up with PTH (Parathyroid hormone) and calcitonin in the regulation of calcium metabolism. Lack of calciferol prevent normal deposition of calcium in bone. In child hood lack of calciferol leads to deformed bones characteristics of rickets. In adult inadequate amounts of calciferol lead to a weakening of the bones, a condition known as osteomalacia.

STOMACH AND DUODENUM Gastrin a polypeptide is a hormone secreted into the blood by cells in the stomach wall. This stimulates the production of HCL by the parietal cells of the stomach secretin and Pancreozymin is secreted by cells in the stomach. These hormones when in the pancrease, stimulate the secretion of the various component of the pancreatic digestive juice and when in the liver and gall bladder they stimulate secretion and release of bile.

ISLETS OF LANGERHAQNS

These are specialized clusters of cells in the pancrease. They secrete the hormone insulin, a protein. Insulin acts to lower the level of glucose in the blood stream. One of the ways in which this is achieved is through the speeding up of the conversion of glucose into glycogen and fats in the liver.

Insulin also stimulates the synthesis of proteins, including enzymes that participate in carbohydrates metabolism.

Insufficient production of insulin results in the disease diabetes mellitus. Victim of this disease are unable to cope with excess glucose in the blood, through conversion of glucose to glycogen. Moreover glycogen, body fat and protein are

converted to glucose. Victims also urinate copiously and frequently. The second pancreatic hormone is glucogen which also stimulates the conversion of liver glycogen into glucose. Glucogen may act to present insulin from lowering the blood sugar level excessively. Glucagen thus play a role in establishing a constant level of glucose in the blood.

PITUITARY GLAND

The pituitary gland is a pea-sized structured located at the base of the brain. In adult vertebrate it consists of the interior and posterior lobes, the intermediate lobe being vestigial.

The pituitary gland play a vital role in the chemical coordination of the body. It is often called the "master" gland because many of its secretion control the activity of other endocrine glands.

(a) Hormones of the interior lobe

(i)Human Growth Hormone (HGH): This hormone is a protein. It promotes growth of the skeleton and the body as a whole. This is done by stimulating the liver to produce Somatomedin which promotes the growth of muscle, cartilage, bone and other connecting tissues. HCH is normally active in this respect only during the years of childhood and adolescence. Hyposecretion i.e. undersecretion of HGH in the child results in stunted growth or dwarfism. A hyposecretion of HGH during this same period results in giantism.

(ii) Prolactin: This is a protein hormone secreted by the females during and after pregnancy. It stimulates the development of the mammary glands during pregnancy and following child birth, and the production of milk by them.

i. Thyroid-stimulating hormone (TSH): This hormone stimulates the thyroid gland to secrete thyroxin. The secretion of TSH is in turn depressed by thyroxin, thus there exist a homeostatic control mechanism over the level of thyroxin in the blood.

ii. Adrenocorticotropic Hormone (ACTH): This is a protein hormone, and it stimulate the cortex and the adrenal gland to release some of its hormone into the blood.

iii. Follicle stimulating Hormone (FSH): This acts upon the gonads or sex organs. In females FSH promotes development follicles within the ovary. In conjunction with another pituitary hormone luteinizing hormone (IH), it stimulates the secretion of estrogen by the follicle and the ripening of the egg within it. FSH in human male stimulates the development of seminiferous tubules and the production of sperm.

iv. Lentinizing hormone (LH): This hormone triggers the transformation of the cells of the follicles (after the eggs have been released) into corpus luteum. This LH also stimulates the corpus luteum to secrete its hormone progesterone. LH in males stimulates the release of male sex hormones (androgens) (by the interstitial cells of the testes) into the blood stream.

v. Melanocyte stimulating hormone (MSH): This is a protein hormone whose target cells are the melanocytes, cells which contain the black pigment melanin. Increase in MSH cause some darkening of human body during pregnancy.

(B) Hormone of the posterior lobe

(i) Oxytocin: This is protein hormone which stimulates contraction of smooth muscles, especially those of the uterus. Infection of oxytocin hastens delivery of the baby and also hasten the return of the uterus to its normal size.

(ii) Antidiuretic hormone (ADH) or Vasopressin: This is also a protein hormone. It causes the muscular walls of the arterioles to contract in human thus causing increase in blood pressure. ADH also stimulates reabsorption of water from the tubules of the kidney insufficient production of ADH causes enormous loss of water through the kidneys.

This disease is known as diabetes insipidus. Copius urine produced by hyposecretion of ADH is very watery and has no marked taste.

HYPOTHALAMUS: This is a region of the brain of the hypothalamus is connected with the pituitary gland. There is a direct nerve connection between the hypothalamus and the posterior lobe of the pituitary gland. The release of hormone by the pituitary gland is partly influenced by the nervous activity in the hypothalamus. Three of the hormones secreted by the hypothalamus are: (i) Thyrotropin releasing hormone (TRH). This hormone stimulates the anterior lobe to secrete TSH (Thyroxin, stimulating hormone) (ii) gonadotropin releasing hormone (GNRH) stimulates the anterior lobe to secrete LH (luteinizing hormone) and FSH. Hence it can be called LH-releasing hormone (LH RH) (iii) Somatotropin-release-inhibiting-factor SRIF or stomatostatin: This polypeptide inhibits the secretion of growth hormone. It also suppresses the secretion of TSH, prolactin, insulin and glucagon.

THE ADRENAL GLANDS

These are two small structures situated one at the top of each kidney. Each consist of two parts the exterior portion is the adrenal cortex while he interior portion of the gland is adrenal medulla.

(A) Hormones of the Adrenal medulla

Apart from being an endocrine gland and adrenal medulla is also considered to be a part of the nervous system. Its secretory cells seem to be modified nerve cells. Two hormones secreted by adrenal medulla are adrenaline and noradrenaline.

(i)Adrenalin

Large quantities of this hormone are released into the blood stream when the organism is suddenly subjected to stress such as anger, fright or infury. Once in the body, adrenaline promotes a wide variety of responses for example the rate and strength of heart beat is increased, thus increasing the blood pressure. A

larger part of the blood supply of the skin and viscera is shunted to the skeletal muscles, coronary arteries, liver and brain. The level of blood sugar rises and metabolic rate increases. The bronchi dilates, permitting easier passage of air to and from the lungs. The pupils of the eye dilate and there is tendency for the body hair to stand.

(ii) Noradrenaline also causes an increase in blood pressure by stimulating the contraction of the arterioles. Almost all the body responses to these two hormones can be seen to prepare the body for violent physical action.

(B) Hormones of the adrenal cortex:

Most of the hormones of this gland are steroids (lipids). These hormones fall into the two major groups viz: glucorticoids and mineralocorticoids.

(i)Glucoritcoids: The most important members of this group are the cortisol and corticosterone. These hormones promote the conversion of fat and protein into intermediary metabolites that are ultimately converted into glucose thus causing the level of blood glucose to rise. One of the chief target organs in this response is the liver. The glucorticoids also act to suppress inflammation in the body. They are needed to maintain the body during period of stress after the fruit brief adrenaline stimulated response when the levels of glucose and salt in the blood drop sharply.

(ii) Mineralocorticoids: The chief cuntion of these hormones of which Aldosterone is the most important in humans, is to promote the reabsorption of Na^+ and Ci^- ions in the tubules of the kidneys. Retention of these ions in the blood keeps its osmotic pressure high. This in turn, assures normal blood pressure.

THE GONADS

Both the male and female gonads possess endocrine activities in addition to their prime function of producing the sex cells.

(a) The Testes: The interstitial cells of the testes are the endocrine tissue. When stimulated by the LH hormone from the pituitary gland, these cells release androgens (e.g. testosterone) into the blood stream. These responses start at beginning of adolescence. Testosterone triggers the development of the so called secondary sexual characteristics found in adult male.

(b) The Ovaries

The ripening follicle in the ovary not only contains a ripening egg but also act as an endocrine gland. The necessary cells of the follicle liberate several steroid hormones called oestrogens. They are stimulated to do so by the combined influence of FSH and LH from the anterior lobe of the pituitary gland.

The oestrogens in female body, promote the development early in adolescence of the secondary sexual characteristics. They also participate in the monthly preparation of the body for possible pregnancy. This includes the preparation of endomentrium (inner living in the uterus).

The corpus luteum is also an endocrine gland stimulated by LH. It secretes progesterone into the blood stream. This hormone continues the preparation of the uterus for pregnancy and inhibits the development of new follicle. As the time of birth approaches in the mother, secretion of progesterone declines and is replaced by another hormone relaxin. This hormone causes the ligaments between the pelvic bones to loosen which provides a more flexible passage way for the baby during birth.

The secretion of estrogens is stimulated by PSH and LH, while the secretion of progesterone is stimulated by LH alone.

THE PLACENTA

After pregnancy is established, the placenta takes on the secondary function of serving as endocrine gland. It secretes strogens, progesterone and hormone called human chorionic gonadotropin (HCG) quite similar to the gonad

stimulating hormone of the anterior lobe of the pituitary gland. These hormones supplement those produced by the corpus luteum and the pituitary gland.

PINEAL GLAND

The pineal gland is a small, pea-sized structure attached to the brain far above the cerebellum. It produces hormone called melatonin. The role of this in human is not certain.

THYMUS GLAND

The thymus gland consists of the lobes of tissue similar to that found in lymph modes. It is located high in the chest cavity just under the breast bone. It is large during childhood but then shrinks after the start of adolescence.

There is good evidence that the thymus in the infant animal plays a major role in setting up the lymphocyte producing machinery of the lymph nodes, thus providing the basis for the development of antibodies. This seems to involved among other things production of one or more hormones called (thymosins). Once the job is completed the thymus is ordinarily no longer needed.

KIDNEY: Apart from other functions the kidney secretes erythropoietin into the blood stream especially in response to anaemia. Erythropoietin acts on the bone marrow to increase the production of red blood cells.

Pituitary (below the brain) secretes many different hormones	Trophic hormones: stimulate the following endocrine glands to release their hormones 1. Thyroid – thyrotropin 2. Adrenal – corticotrophin 3. Ovaries and testes gonadotropins Growth hormone: Somatotropin promotes growth of whole body neuro secretions (1) ADH, antidiuretic hormone vasopressin kidney water reabsorption (2) Oxytocin – uterus contraction	Disorders or normal gland function Excess: gigantism Deficiency: dwarfism Disorders of normal function e.g. water diabetes

	prolactin – milk secretion	
Thyroid	Throxine (a) Controls body metabolism, energy release in mitochondrion (b) Influence growth (tadpole metamorphosis)	Deficiency: cretinism in children Deficiency in adults, slowing down metabolism sluggishness Excess: eyeballs protrude metabolism, increased restlessness
Adrenals (close to kidneys)	Medulla hormones: mainly adrenaline 1. Affects blood circulation by increased heartbeat, blood flow vasodilation prepares body for fight or flight 2. Slows down kidney function 3. Increases blood sugar conversion from glycogen Cortex hormones: Hydrocortisone in metabolism of lipid, protein and carbohydrates	Deficiency: blood sugar disorder, combats stress
Pancreas	Mainly insulin: controls blood sugar, converts glucose to glycogen. Glucagon converts glycogen to glucose	Deficiency: sugar diabetes increase in blood sugar level. Excess nerve cell starvation and coma
Gonads (male and female reproductive organs)	Oestrogen (female ovary) secondary sexual features, pubic hair mammary gland and menstrual cycle. Progesterone = change in uterus after ovulation and testosterone in pregnancy (male testes) secondary sexual features, voice change, pubic hair, facial hair	General personality and sexual changes, sterility and abortion
Adrenal cortex	Sex hormone producing body changes as for gonads	Excess sexual desire changes
Digestive tract 1. Stomach 2. Intestine wall	Gastrin: stimulates gastric juice secretion Secretion/stimulates pancreatic juice flow	

Endocrine systems in Human being (diagram)