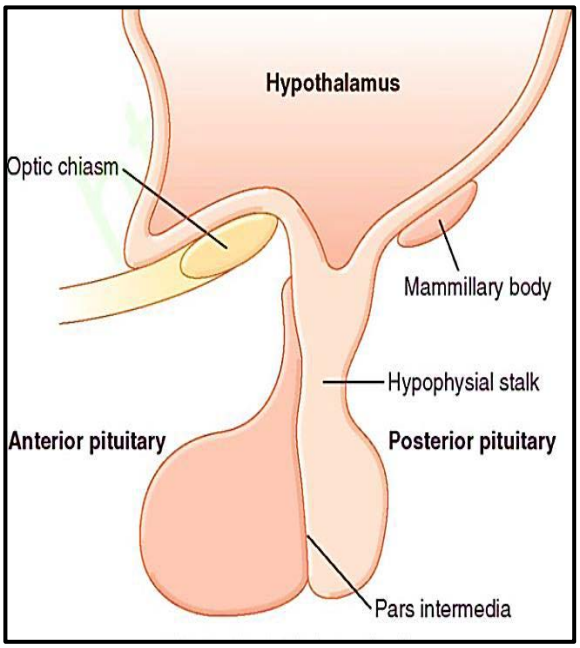
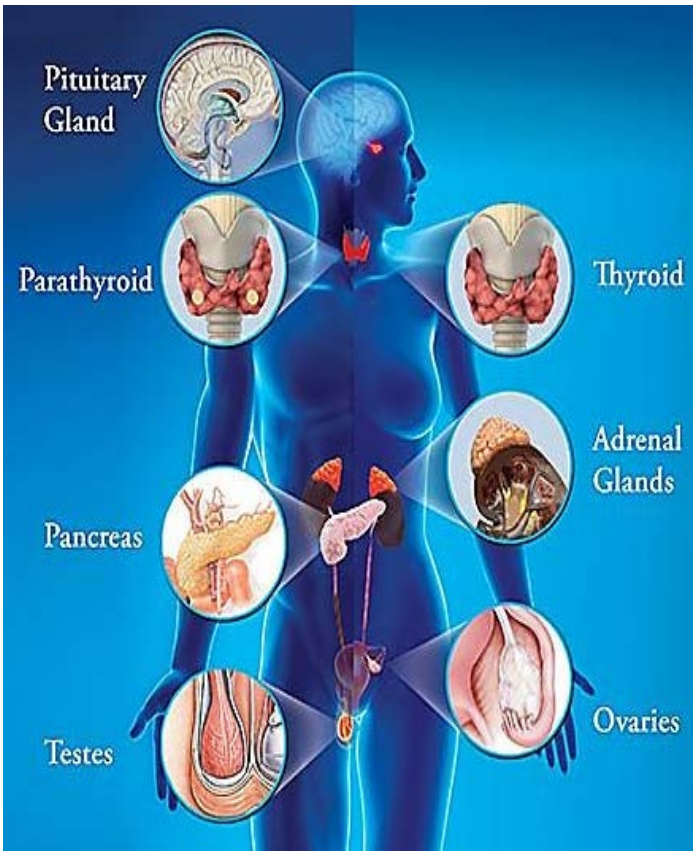
Major Endocrine Glands

Many different glands make up the endocrine system. The hypothalamus, pituitary gland, and pineal gland are in the brain. The thyroid and parathyroid glands are in neck. The thymus is between lungs, the adrenals are on top of kidneys, and the pancreas is behind stomach. Ovaries (in woman) or testes (in man) are in pelvic region.

The pituitary gland also called the hypophysis, is a small gland that lies at the base of the brain, and is connected to the hypothalamus by the pituitary stalk or hypophysial stalk. Whilst the pituitary gland is known as the *master endocrine gland*, both of the lobes are under the control of the hypothalamus.

Hypothalamus gland: The main job of this organ is to tell pituitary gland to start or stop making hormones. One of the most important functions of the hypothalamus is to link the nervous system to the endocrine system via the pituitary gland. It synthesizes and secretes certain neurohormones, called hypothalamic hormones, and these in turn control the secretion of pituitary hormones.





Physiologically, the pituitary gland is divided into two distinct portions:

1- The anterior pituitary gland, (adenohypophysis).

2- The posterior pituitary gland, (neurohypophysis).

Seven major peptide hormones are secreted by the anterior pituitary gland, and two important peptide hormones are secreted by the posterior pituitary gland. Secretion of anterior pituitary hormones is regulated by hypothalamus. Hypothalamus secretes some releasing and inhibitory hormones which are transported from hypothalamus to anterior pituitary. Many of the hormones produced by the anterior pituitary stimulate other endocrine glands to secrete their hormones. The hormones of the anterior pituitary play major roles in the control of metabolic functions throughout the body.

The posterior pituitary gland secretes tow hormones. Actually, the posterior pituitary does not secrete any hormone; rather, it stores and secretes two hormones made in the hypothalamus. Antidiuretic hormone (ADH) and oxytocin are synthesized in the hypothalamus. Hence, these two hormones are called neurohormones.

The control of release hormones from the pituitary is via negative feedback from the target gland. For example homeostasis of thyroid hormones is achieved by the following mechanism; TRH from the hypothalamus stimulates the release of TSH from the anterior pituitary. The TSH, in turn, stimulates the release of thyroid hormones form the thyroid gland. The thyroid hormones then cause negative feedback, suppressing the release of TRH and TSH.

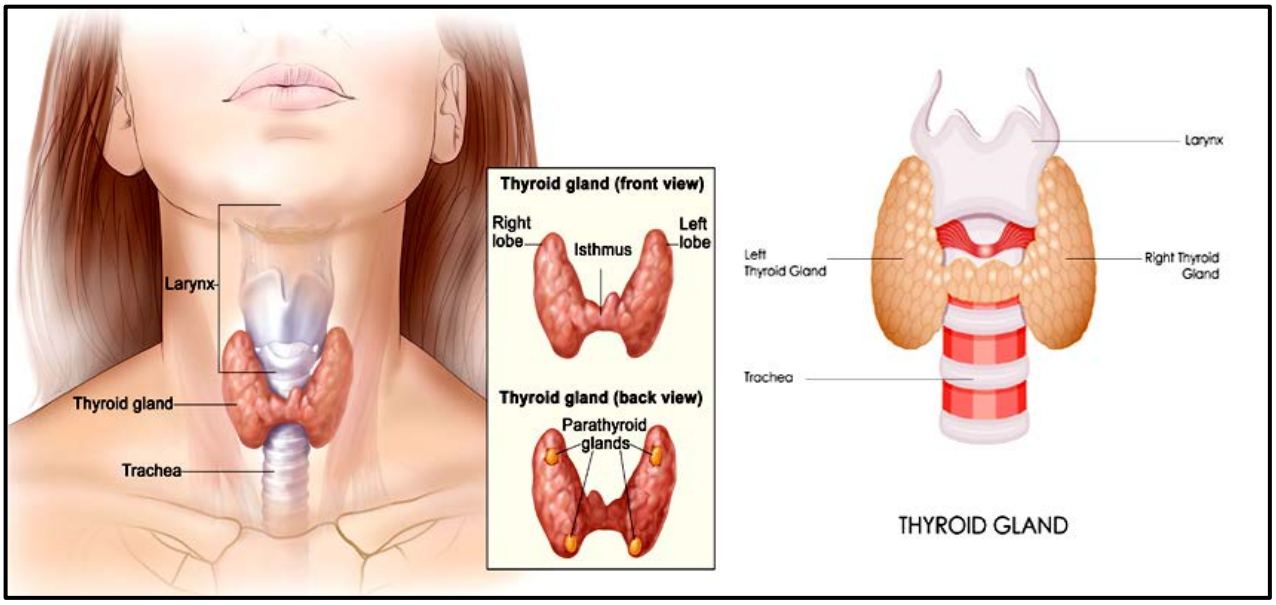
Oral manifestations of endocrine dysfunction

The effects of over and under-secretion of each endocrine gland is showing an influence on the development and maintenance of the health of the teeth and supporting structures.

Thyroid gland

Thyroid gland is largest classic endocrine organ consist of two lobes , shaped like a butterfly, synthesizes and secretes Thyroxin (T_4) and Triiodothyronin (T_3) that influences most and every cell of the body's organ which helps regulate growth and the metabolic rate of the body. Also, help the body to control body temperature, make energy and helps control organ function. The amount of T_4 being secreted is controlled by thyroid stimulating hormone (TSH) made in the pituitary gland through a negative feedback mechanism.

Thyroid hormones provide negative feedback to the hypothalamus and anterior pituitary gland. When thyroid levels in the blood are elevated TSH and TRH production is reduced. Excessive TSH can also inhibit the production of further TRH.



The thyroid also produces and releases calcitonin hormone (thyrocalcitonin) that contributes to the regulation of blood calcium levels. It is involved, with parathyroid hormone and vitamin D, in regulating serum calcium and phosphorus levels.

Thyroid dysfunction can affect any system of the body; the oral cavity can be adversely affected by either an excess (hyperthyroidism) or deficiency of these hormones (hypothyroidism).

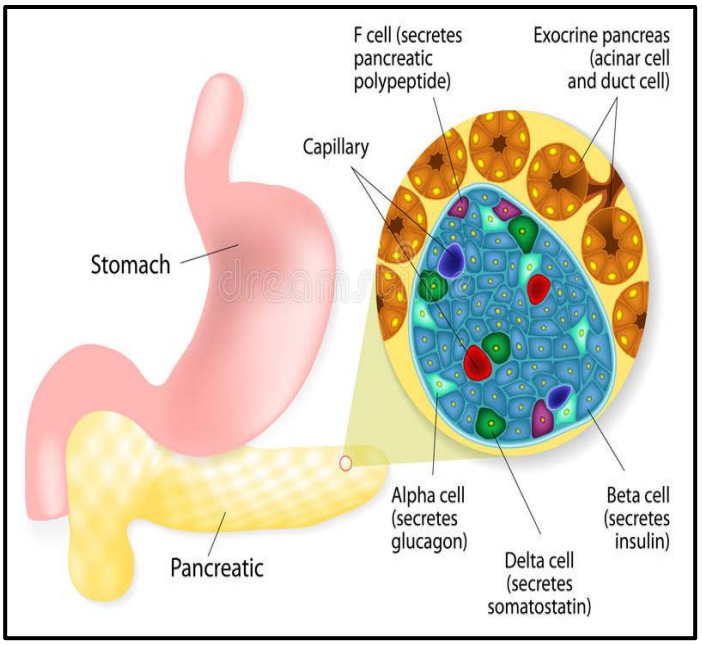
Oral manifestation of thyroid gland disorder	
Hyperthyroidism	**Hypothyroidism**
1. Accelerated dental eruption 2. Increased susceptibility to caries 3. Increased susceptibility to Periodontal disease 4. Burning mouth syndrome 5. Development of connective-tissue diseases like Sjögren's syndrom 6. Maxillary or mandibular osteoporosis 7. Enlargement of extraglandular thyroid tissue (mainly in lateral posterior tongue)	1. Delayed dental eruption 2. Salivary gland enlargement 3. Compromised Periodontal health 4. Macroglossia 5. Micrognathia 6. Thick lips 7. Mouth breathing 8. Enamel hypoplasia

Pancreas gland

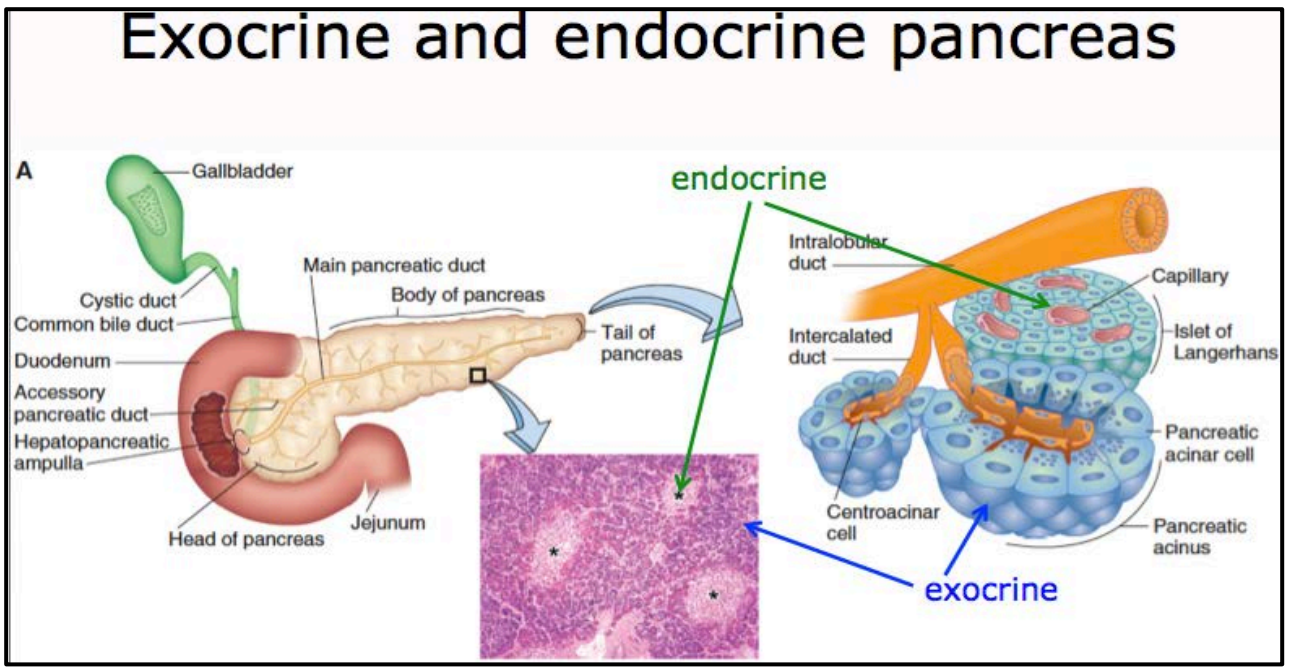
The pancreas, in addition to its digestive functions, secretes two important hormones, *insulin and glucagon, that are essential for normal regulation of glucose, lipid, and protein metabolism.* Pancreas contains about 1 to 2 million islets of Langerhans. It has both endocrine and exocrine functions, secrete several digestive enzyme.

The endocrine function of pancreas is performed by the islets of Langerhans which consist of four types of cells:

1) A cells or α cell secrete glucagon
2) B cells or β cells secrete insulin
3) D cells or δ cells secrete somatostatin.
4) F cells or PP cells which secrete pancreatic polypeptide.



Insulin is secreted by β cells in the islets of Langerhans of pancreas. It is the important hormone that is concerned with regulation of carbohydrate metabolism and blood sugar level. It is also concerned with metabolism of proteins and fats.



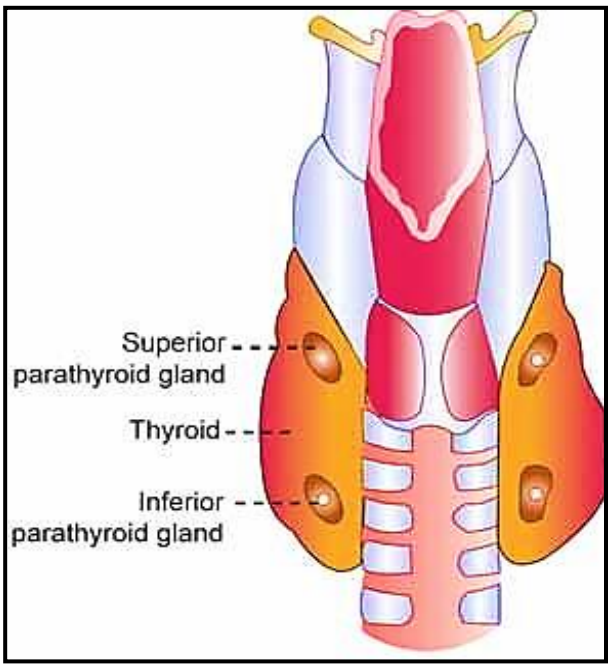
Diabetes mellitus (DM) represents a group of metabolic diseases that are characterized by hyperglycaemia due to a total or relative lack of insulin secretion or insulin resistance or both. The metabolic abnormalities involve carbohydrate, protein and fat metabolism. DM affects all age groups, but is more common in adults with an incidence of 3%. Diabetic patients have a risk of periodontitis 3 times greater than in general population.

Oral signs and symptoms of diabetes can include:

1- Neurosensory disorder (burning mouth syndrome), and abnormal wound healing
2- Dental carries and tooth loss.
3- Can lead to complications include periodontal diseases (periodontitis and gingivitis)
4- Salivary dysfunction leading to a reduction in salivary flow and changes in saliva composition, and taste dysfunction.
5- Oral fungal and bacterial infections have been reported in patients with diabetes.

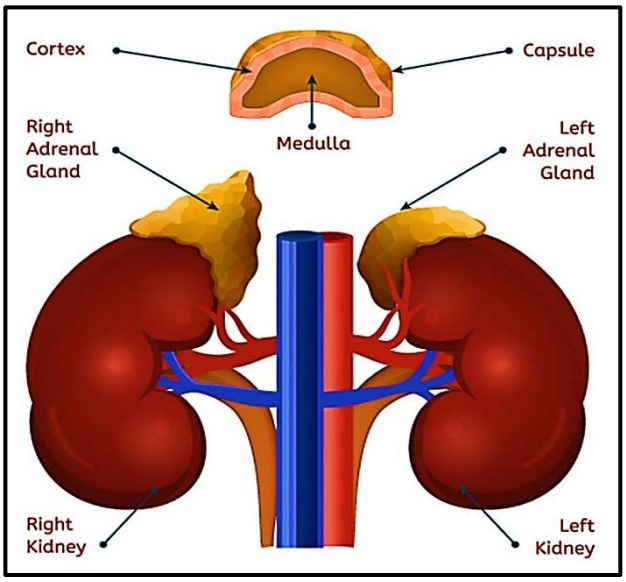
Parathyroid glands

There are four parathyroid glands located immediately behind thyroid gland at the upper and lower poles. The parathyroid glands are very small in size, secret parathyroid hormone (PTH) involved in regulating the metabolism of calcium and phosphorus. PTH plays an important role in tooth development and bone mineralization and increases bone resorption. In the kidneys, it stimulates formation of active metabolite of vitamin D, which promotes the intestinal absorption of calcium and decreases renal reabsorption of phosphate.



Oral manifestation of parathyroid gland disorder	
Hyperparathyroidism	**Hypoparathyroidism**
1. Dental abnormalities: - Enlarged pulp chambers - Development defects - Alterations in dental eruption - Weak teeth - Maloclussions 2. Brown tumor 3. Loss of bone density 4. Soft tissue calcifications	1. Dental abnormalities: - Enlarged pulp chambers - Delay or stop dental development - Poorly calcified dentin - Dental pulp calcifications - Shortened roots 2. Chronic candidiasis 3. Paresthesia of the tongue or lips 4. Alteration in facial muscles

Adrenal glands



There are two adrenal glands. Each gland is situated on the upper pole of each kidney. Because of the situation, adrenal glands are otherwise called *suprarenal glands*. Each gland is made of two parts, the adrenal cortex and adrenal medulla. Adrenal cortex is the outer portion constituting 80% of the gland. Adrenal medulla is the central portion of gland constituting 20%.

Adrenal glands produce hormones that help regulate body metabolism, immune system, blood pressure, response to stress and other essential functions. Adrenal medullary hormones are called ***catecholamines***. The adrenal medulla produces:

1- Epinephrine (adrenaline)
2- Norepinephrine (noradrenaline)
3- Dopamine.

While the cortex, responsible for the production of steroid hormones, collectively known as ***adrenocortical hormones*** or ***corticosteroids***.

Based on their functions the corticosteroids are classified into three groups:

1- Mineralocorticoids (Aldosterone and 11-deoxycorticosterone)
2- Glucocorticoids (Cortisol and Corticosterone)
3- Sex hormones (Androgens, Estrogen and Progesterone).

Addison's disease or primary adrenal insufficiency: the disease with a deficiency in the secretion of glucocorticoid and mineralocorticoid hormones by the adrenal cortex. The oral mucosa can develop black-bluish plaques, mainly affecting buccal mucosa but it can also be seen on the gums, palate, tongue and lips.

Gland/Tissue	Hormones	Major Functions	Chemical Structure
Hypothalamus	**Thyrotropin-releasing hormone (TRH)**	Stimulates secretion of thyroid-stimulating hormone and prolactin	Peptide
	Growth hormone - releasing hormone (GRH)	Causes release of growth hormone	Peptide
	Growth hormone inhibitory hormone (somatostatin) (GHRH)	Inhibits release of growth hormone	Peptide
	Corticotropin-releasing hormone (CRH)	Causes release of adrenocorticotropic hormone	Peptide
	Gonadotropin-releasing hormone (GnRH)	Causes release of luteinizing hormone and follicle-stimulating hormone	Peptide
	Dopamine or prolactin-inhibiting factor	Inhibits release of prolactin	Amine
Anterior pituitary	**Growth hormone (GH)**	Stimulates protein synthesis and overall growth of most cells and tissues	Peptide
	Thyroid-stimulating hormone (TSH)	Stimulates synthesis and secretion of thyroid hormones (thyroxine and triiodothyronine)	Peptide
	Endorphin	reduces the pain by stopping the pain signals and gives a good mood and happy	Peptide
	Adrenocorticotropic hormone (ACTH)	Stimulates synthesis and secretion of adrenocortical hormones (cortisol, androgens)	Peptide
	Follicle stimulating hormone (FSH)	Causes growth of follicles in the ovaries and sperm maturation in Sertoli cells of testes	Peptide
	Luteinizing hormone (LH)	Stimulates testosterone synthesis in Leydig cells of testes; stimulates ovulation, formation of corpus luteum, and estrogen and progesterone synthesis in ovaries	Peptide
	Prolactin	Promotes development of the female breasts and secretion of milk	Peptide
Posterior pituitary	**Antidiuretic hormone (called *vasopressin*)**	Increases water reabsorption by the kidneys and causes vasoconstriction and increased blood pressure	Peptide
	Oxytocin	Stimulates milk ejection from breasts and uterine contractions	Peptide
Thyroid	**Thyroxine (T4)and Triiodothyronine (T3)**	Increases rates of chemical reactions in most cells, thus increasing body metabolic rate.	Amine
	Calcitonin	Promotes deposition of Ca^{+2} in bones and decreases extracellular fluid Ca^{+2} concentration	Peptide
Adrenal cortex	**Cortisol**	Control metabolism of proteins, carbohydrates, and fats; also has anti-inflammatory effects	Steroid
	Aldosterone	Increases renal sodium reabsorption, potassium secretion, and hydrogen secretion	Steroid

Adrenal medulla	**Norepinephrine, epinephrine**	Same effects as sympathetic stimulation	Amine
Pancreas	**Insulin (β cells)**	Promotes glucose entry in many cells, and in this way controls carbohydrate metabolism	Peptide
	Glucagon (α cells)	Increases synthesis and release of glucose from the liver into the body fluids	Peptide
Parathyroid	**Parathyroid hormone**	Controls serum Ca^{+2} ion concentration by increasing Ca^{+2} absorption by the gut and kidneys and releasing Ca^{+2} from bones	Peptide
Testes	Testosterone	Promotes development of male reproductive system and male secondary sexual characteristics	Steroid
Ovaries	Estrogens	Promotes growth and development of female reproductive system, female breasts, and female secondary sexual characteristics	Steroid
	Progesterone	Stimulates secretion of "uterine milk" by the uterine endometrial glands and promotes development of secretory apparatus of breasts	Steroid
Placenta	Human chorionic gonadotropin	Promotes growth of corpus luteum and secretion of estrogens and progesterone by corpus luteum	Peptide
	Human somatomammotropin	Probably helps promote development of some fetal tissues, as well as the mother's breasts	Peptide
	Estrogens	See actions of estrogens from ovaries	Steroid
	Progesterone	See actions of progesterone from ovaries	Steroid
Kidney	Renin	Catalyzes conversion of angiotensinogen to angiotensin I (acts as an enzyme)	Peptide
	1,25-Dihydroxycholecalciferol	Increases intestinal absorption of calcium and bone mineralization	Steroid
	Erythropoietin	Increases erythrocyte production	Peptide
Heart	Atrial natriuretic peptide	Increases sodium excretion by kidneys, reduces blood pressure	Peptide
Stomach	Gastrin	Stimulates hydrogen chloride secretion by parietal cells	Peptide
Small intestine	Secretin	Stimulates pancreatic acinar cells to release bicarbonate and water	Peptide
	Cholecystokinin	Stimulates gallbladder contraction and release of pancreatic enzymes	Peptide
Adipocytes	Leptin	Inhibits appetite, stimulates thermogenesis	Peptide