ENDOCRINE SYSTEM

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Medical Terminology

Essential of Human Anatomy & Physiology

Mosby’s Dictionary
Overview

- The word endocrine derives from the Greek words "endo," meaning within, and "crinis," meaning to secrete.
- Compared to other organs of the body, the organs of the endocrine system are small and unimpressive.
- The endocrine system also lacks the structural or anatomical continuity typical of most organ systems.
- Instead, bits and pieces of endocrine tissue are tucked away in separate regions of the body.
- However, functionally the endocrine organs are impressive, and when their role in maintaining body homeostasis is considered, they are true giants.
Introduction

- The endocrine system is a network of glands in our body that make the hormones that help cells talk to each other.
- It is the collection of glands that produce hormones that regulate metabolism, growth and development, tissue function, sexual function, reproduction, sleep, and mood, among other things.
- They’re responsible for almost every cell, organ, and function in your body.
- If your endocrine system is not healthy, you might have problems developing during puberty, getting pregnant, or managing stress.
- You also might gain weight easily, have weak bones, or lack energy because too much sugar stays in your blood instead of moving into your cells where it’s needed for energy.
- Glands are organs that makes and puts out hormones that do a specific job in our body.
- Endocrine glands release the substances they make into your bloodstream.
<table>
<thead>
<tr>
<th>Combining form</th>
<th>Meaning</th>
<th>Medical term</th>
<th>Meaning of medical term</th>
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</thead>
<tbody>
<tr>
<td>aden/o</td>
<td>gland</td>
<td>adenoma</td>
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<tr>
<td>adren/o</td>
<td>adrenal glands</td>
<td>adrenocortical</td>
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<td>adrenal/o</td>
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<td>adrenalectomy</td>
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<td>andr/o</td>
<td>male</td>
<td>androgynous</td>
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<td>calc/i</td>
<td>calcium</td>
<td>hypocalcaemia</td>
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<td>chrom/o</td>
<td>colour</td>
<td>chromatic</td>
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<tr>
<td>cortic/o</td>
<td>cortex, outer layer of organ</td>
<td>corticoid</td>
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<td>crin/o</td>
<td>secrete</td>
<td>endocrinology</td>
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<td>dem/o</td>
<td>people</td>
<td>endemic</td>
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<td>dips/o</td>
<td>thirst</td>
<td>polydipsia</td>
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<td>gluc/o</td>
<td>glucose, sugar, sweet(ness)</td>
<td>glucogen</td>
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<td>glyc/o</td>
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<td>hyperglycaemic</td>
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<td>glycos/o</td>
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<td>glycosuria</td>
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<td>gonad/o</td>
<td>gonads, sex glands (ovaries and testes)</td>
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<td>gonadoblastoma</td>
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<tr>
<td>home/o</td>
<td>same, alike</td>
<td>homeostasis</td>
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<td>hormone</td>
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<td>insulin/o</td>
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<td>hyperinsulinaemia</td>
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<td>iod/o</td>
<td>iodine</td>
<td>iodism</td>
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Check page 146-147 from the book “Mastering Medical Terminology” for the complete list of combining form.
<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
<th>Medical term</th>
<th>Meaning of medical term</th>
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<tbody>
<tr>
<td>acro-</td>
<td>extremities</td>
<td>acromegaly</td>
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<tr>
<td>endo-</td>
<td>within, inside, inner</td>
<td>endocrinology</td>
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<tr>
<td>eu-</td>
<td>good, normal</td>
<td>euthyroid</td>
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<tr>
<td>exo-</td>
<td>outward, outside</td>
<td>exocrine</td>
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<td>oxy-</td>
<td>quick, sharp</td>
<td>oxytocic</td>
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<tr>
<td>pan-</td>
<td>all, entire</td>
<td>panhypopituitarism</td>
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<tr>
<td>para-</td>
<td>beside, near, alongside</td>
<td>parathyroid</td>
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<tr>
<td>tri-</td>
<td>three</td>
<td>triiodothyronine</td>
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<table>
<thead>
<tr>
<th>Suffix</th>
<th>Meaning</th>
<th>Medical term</th>
<th>Meaning of medical term</th>
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<tbody>
<tr>
<td>-aemia</td>
<td>condition of blood</td>
<td>hypercalcaemia</td>
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<tr>
<td>-agon</td>
<td>assemble, gather together</td>
<td>glucagon</td>
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<tr>
<td>-crine</td>
<td>secrete</td>
<td>endocrine</td>
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<tr>
<td>-in, -ine</td>
<td>made of, having the nature of, relating to</td>
<td>adrenaline</td>
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<tr>
<td>-megaly</td>
<td>enlargement</td>
<td>pancreatomegaly</td>
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<td>-physis</td>
<td>growth</td>
<td>hypophysis</td>
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<tr>
<td>-trophin</td>
<td>stimulating the effect of (a hormone)</td>
<td>somatotrophin</td>
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<tr>
<td>-uria</td>
<td>urination, urine condition, presence of substance in urine</td>
<td>polyuria</td>
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<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>ACTH</td>
<td>adrenocorticotropic hormone</td>
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<td>ADH</td>
<td>antidiuretic hormone</td>
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<td>DI</td>
<td>diabetes insipidus</td>
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<td>DM</td>
<td>diabetes mellitus</td>
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<td>FBG</td>
<td>fasting blood glucose</td>
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<td>FBS</td>
<td>fasting blood sugar</td>
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<td>FSH</td>
<td>follicle stimulating hormone</td>
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<td>GH</td>
<td>growth hormone</td>
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<td>GTT</td>
<td>glucose tolerance test</td>
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<td>hCG</td>
<td>human chorionic gonadotrophin</td>
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<td>IDDM</td>
<td>insulin dependent diabetes mellitus</td>
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<td>LH</td>
<td>luteinising hormone</td>
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<tr>
<td>NIDDM</td>
<td>non insulin dependent diabetes mellitus</td>
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<tr>
<td>RAIU</td>
<td>radioactive iodine uptake test</td>
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<tr>
<td>SIADH</td>
<td>syndrome of inappropriate antidiuretic hormone</td>
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<tr>
<td>T1DM</td>
<td>type 1 diabetes mellitus</td>
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<td>T2DM</td>
<td>type 2 diabetes mellitus</td>
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<tr>
<td>TFTs</td>
<td>thyroid function tests</td>
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</table>

Abbreviations

Check page 148 from the book “Mastering Medical Terminology” for the complete list of abbreviations.
Hormones

- Hormones are chemical substances secreted by endocrine cells into the extracellular fluids that regulate the metabolic activity of other cells in the body.
- Although the body produces many different hormones, nearly all of them can be classified chemically as either amino acid–based molecules (including proteins, peptides, and amines) or steroids.
- Steroid hormones (made from cholesterol) include the sex hormones made by the gonads (ovaries and testes) and the hormones produced by the adrenal cortex.
- All other hormones are nonsteroidal amino acid derivatives.
- If we also consider the hormones that act locally, called prostaglandins we must add a third chemical class.
- The prostaglandins are made from highly active lipids released from nearly all cell membranes.
Hormone Actions

- Although hormones circulate to all the organs of the body via blood, a given hormone affects only certain tissue cells or organs, referred to as its target cells or target organs.
- For a target cell to respond to a hormone, specific protein receptors to which that hormone can attach must be present on the cell’s plasma membrane or in its interior.
- Only when this binding occurs can the hormone influence the workings of a cell.
- Hormones can do:
  - Change plasma membrane permeability or membrane potential (electrical state) by opening or closing ion channels
  -Activate or inactive enzymes.
  -Stimulate or inhibit cell division.
  -Promote or inhibit secretion of a product.
  -Turn on or turn off transcription of certain genes (such as those encoding proteins or regulatory molecules).
Stimuli for Hormone Release Control

- The stimuli that activate endocrine glands fall into three major categories:
  - Hormonal
  - Humoral
  - Neural

- These three mechanisms represent the most common systems that control hormone release, but they by no means explain all of them.
- Some endocrine organs respond to many different stimuli.
Hormonal Stimulus

- It is the most common stimulus in which endocrine organs are prodded into action by other hormones.
- For example, hormones of the hypothalamus stimulate the anterior pituitary gland to secrete its hormones, and many anterior pituitary hormones stimulate other endocrine organs to release their hormones into the blood.
- As the hormones produced by the final target glands increase in the blood, they "feedback" to inhibit the release of anterior pituitary hormones and thus their own release.
- Hormone release promoted by this mechanism tends to be rhythmic, with hormone blood levels rising and falling again and again.
Humoral Stimulus

- Changing blood levels of certain ions and nutrients may also stimulate hormone release.
- For example, a decreasing blood calcium ion level in the capillaries serving the parathyroid glands prompts the release of parathyroid hormone (PTH).
- Because PTH acts by several routes to reverse that decline, the blood Ca2+ level soon rises, ending the stimulus for PTH release.
- Other hormones released in response to humoral stimuli include calcitonin, released by the thyroid gland, and insulin, produced by the pancreas.
Neural Stimulus

- In isolated cases, nerve fibers stimulate hormone release, and the endocrine cells are said to respond to neural stimuli.
- The classic example is sympathetic nervous system stimulation of the adrenal medulla to release the catecholamines norepinephrine and epinephrine during periods of stress.
Major Endocrine Organs

- The major endocrine organs of the body include the pituitary, pineal, thyroid, parathyroid, thymus, adrenal glands, pancreas, and gonads (ovaries and testes).
- The hypothalamus, which is part of the nervous system, is also recognized as a major endocrine organ because it produces several hormones.
- Some hormone-producing glands (the anterior pituitary, thyroid, parathyroids, and adrenals) have purely endocrine functions, but others (pancreas and gonads) have both endocrine and exocrine functions and are thus mixed glands.
- Both types of glands are formed from epithelial tissue, but the endocrine glands are ductless glands that produce hormones that they release into the blood or lymph.
- Conversely, the exocrine glands release their products at the body’s surface or into body cavities through ducts.
The pituitary gland is the body’s master controller and is located at the base of the brain. It is connected to the hypothalamic region by a stalk. It has two functional lobes: anterior pituitary (glandular tissue) and posterior pituitary (nervous tissue). The anterior pituitary gland controls the activity of so many other endocrine glands that it has often been called the “master endocrine gland.” Its removal or destruction has a dramatic effect on the body. However, the anterior pituitary is not as all-powerful as it might appear, because the release of each of its hormones is controlled by releasing hormones and inhibiting hormones produced by the hypothalamus. The hypothalamus acts to determine the amount of circulating hormones in the body. If it identifies either an increase or decrease in hormone levels, the hypothalamus sends a message via the stalk to the pituitary gland which produces hormones and sends them to the appropriate receptors instructing them to either increase or decrease tissue activities. Problems in the endocrine system often originate in the pituitary gland.
Pituitary Gland

- The hypothalamus also makes two additional hormones, oxytocin and antidiuretic hormone, which are transported along the axons of the hypothalamic neurosecretory cells to the posterior pituitary for storage.
- The posterior pituitary is not an endocrine gland in the strict sense because it does not make the peptide hormones it releases. Instead, it acts as a storage area for hormones made by hypothalamic neurons.
- They are later released into the blood in response to nerve impulses from the hypothalamus.
- The hormones produced in the pituitary are:
  - Thyroid stimulating hormone (TSH) which acts on the thyroid gland
  - Adrenocorticotrophic hormone (ACTH) which stimulates the adrenal glands
  - Follicle stimulating hormone (FSH) and luteinizing hormone (LH) which act to stimulate the production of oestrogen, progesterone and testosterone by the gonads
  - Prolactin for the production of breast milk
  - Oxytocin which aids the contraction of the uterus during childbirth
  - Growth hormone (GH) which acts on all the cells of the body
  - Antidiuretic hormone (ADH) which regulates urine production.
Posterior Pituitary

- **Oxytocin**
  - It is released in significant amounts only during childbirth and nursing.
  - It stimulates powerful contractions of the uterine muscle during sexual relations, during labor, and during breastfeeding. It also causes milk ejection (the let-down reflex) in a nursing woman.
  - Both natural and synthetic oxytocic drugs (Pitocin and others) are used to induce labor or to speed labor that is progressing at a slow pace.

- **Antidiuretic Hormone**
  - Diuresis is urine production. Thus, an antidiuretic is a chemical that inhibits or prevents urine production.
  - ADH causes the kidneys to reabsorb more water from the forming urine; as a result, urine volume decreases, and blood volume increases.
  - Water is a powerful inhibitor of ADH release.
  - Drinking alcoholic inhibits ADH secretion and results in output of large amounts of urine.
  - The dry mouth and intense thirst experienced “the morning after” reflect this dehydrating effect of alcohol.
Anterior Pituitary

- **Growth Hormone**
  - Growth hormone (GH) is a general metabolic hormone.
  - However, its major effects are directed to the growth of skeletal muscles and long bones of the body, and thus it plays an important role in determining final body size.
  - GH is a protein-sparing and anabolic hormone that causes the building of amino acids into proteins and stimulates most target cells to grow in size and divide.
  - At the same time, it causes fats to be broken down and used for energy while it spares glucose, helping to maintain blood sugar homeostasis.

- **Prolactin**
  - Prolactin (PRL) is a protein hormone structurally similar to growth hormone.
  - Its only known target in humans is the breast (pro = for; lact = milk).
  - After childbirth, it stimulates and maintains milk production by the mother’s breasts.
  - Its function in men is not known.
Anterior Pituitary

- **Gonadotropic Hormone**
  - The gonadotropic hormones regulate the hormonal activity of the gonads (ovaries and testes).
  - In women, the gonadotropin follicle-stimulating hormone (FSH) stimulates follicle development in the ovaries.
  - As the follicles mature, they produce estrogen, and eggs are readied for ovulation.
  - In men, FSH stimulates sperm development by the testes.
  - Luteinizing (lu"te-in-i"zing) hormone (LH) triggers ovulation of an egg from the ovary and causes the ruptured follicle to produce progesterone and some estrogen.
  - In men, LH stimulates testosterone production by the interstitial cells of the testes.

- **Thyrotropic Hormone**
  - Thyrotropic hormone (TH), also called thyroid-stimulating hormone (TSH), influences the growth and activity of the thyroid gland.
  - Adrenocorticotropic hormone (ACTH) regulates the endocrine activity of the cortex portion of the adrenal gland.
Summary

- **Hypothalamus**
  - **Posterior Pituitary**
    - Oxytocin
    - Antidiuretic Hormone
  - **Anterior Pituitary**
    - Growth Hormone
    - Prolactin
    - Gonadotrophic Hormone
      - Follicle Stimulating Hormone (FSH)
      - Luteinizing Hormone (LH)
    - Thyrotropin Hormone
Pituitary Gland
Thyroid Gland

- The thyroid gland regulates growth, metabolism and energy use.
- The thyroid is located in the throat in front of the larynx and consists of two butterfly-shaped lobes which are found on either side of the trachea.
- The hormones produced by the thyroid are thyroxine (T4) and triiodothyronine (T3), with the numbers referring to the number of iodine atoms in each of the hormones.
- Iodine is vital for the production of the thyroid hormones.
- Thyroid hormone controls the rate at which glucose is “burned,” or oxidized, and converted to body heat and chemical energy (ATP).
- Because all body cells depend on a continuous supply of ATP to power their activities, every cell in the body is a target.
- Thyroid hormone is also important for normal tissue growth and development, especially in the reproductive and nervous systems.
Parathyroid Gland

- There are four parathyroid glands in the human body, located around the thyroid gland and shaped like small peas.
- The main function of the parathyroid glands is the production of parathyroid hormone, which acts to regulate levels of calcium (Ca+2), phosphorous and magnesium in the blood and bones.
Thymus

- The thymus is located in the upper thorax, posterior to the sternum.
- Large in infants and children, it decreases in size throughout adulthood.
- By old age, it is composed mostly of fibrous connective tissue and fat.
- The thymus produces a hormone called thymosin and others that appear to be essential for normal development of a special group of white blood cells (T lymphocytes) and the immune response.
Adrenal Gland

- The body contains two adrenal glands which are situated on the top of each of the kidneys.
- The adrenal glands are shaped like triangles and consist of a medulla in the center of the gland which is surrounded by a cortex.
- The medulla produces adrenaline (epinephrine) and noradrenaline (norepinephrine) which help the body to react to stress.
- The adrenal cortex produces cortisone and aldosterone which assist with fluid and electrolyte balance in the body.
- It also produces androgen, one of the sex hormones.
Pancreas

- It is located in the abdominal cavity behind the stomach, the pancreas has dual roles in both the endocrine system and the digestive system.
- When food is partially digested by the stomach and moved into the small intestine, the pancreas releases enzymes through a duct into the duodenum to aid in further digestive action by breaking down fats and carbohydrates and neutralizing stomach acids.
- This is referred to as the exocrine function of the pancreas.
- In addition, the pancreas has an important endocrine role by producing insulin which controls levels of blood sugar.
- Insulin is produced by beta cells in the islets of Langerhans, a small clump of cells in the pancreas.
- The pancreas also produces glucagon from alpha cells which helps with blood sugar regulation.
  - Gluconeogenesis
  - Glycogenolysis
Gonads

- The gonads produce gametes or sex cells.
- In the male, the gonads are the testes and in females, they are the ovaries.
- The testes are located behind the penis in a sac called the scrotum.
- In addition to producing sperm, they are also the principal source of production of the male hormone testosterone.
- Testosterone is responsible for the characteristic male traits, such as body and facial hair, a low voice and broad shoulders.
- The ovaries in females sit above the fallopian tubes on either side of the uterus.
- The role of the ovaries is to produce eggs for fertilization according to a monthly cycle.
- The ovaries also produce two groups of hormones, known as oestrogen and progesterone.
- Oestrogen creates the typical female characteristics during puberty — development of breasts, body shape and maturation of the reproductive organs.
- Oestrogen and progesterone, acting on instructions from the pituitary gland, prepare the body for pregnancy or, if fertilization does not occur, for the menstrual cycle.
- Levels of oestrogen fall rapidly at the time of menopause.
Pineal Gland

- The pineal gland is a small gland tucked in between the two hemispheres of the brain.
- It secretes the hormone melatonin, which acts to regulate the sleep/wake cycle.
- The level of melatonin rises and falls during the course of the day and night.
- The peak level occurs at night and makes us drowsy; the lowest level occurs during daylight around noon.
- Melatonin is believed to be a “sleep trigger” that plays an important role in establishing the body’s sleep-wake cycle.
- The production of melatonin is inhibited by exposure to light and stimulated by darkness.
Pathology & Diseases

Check page 151-157 from the book Mastering Medical Terminology for the complete list of pathology & diseases.
Acromegaly

- It occurs when there is an excess of growth hormone after puberty (usually between 30 and 50 years of age at a time when the bony growth plates have fused).
- Bones in the extremities (hands and feet), face and jaw grow abnormally large.
- Visceromegaly is also present.
- Acromegaly usually reduces life expectancy.
- It is usually caused by an adenoma of the pituitary gland.
- Treatment involves resection of the tumour in conjunction with medication.
Dwarfism

- Dwarfism results from a congenital hyposecretion of growth hormone.
- Bones remain small and underdeveloped, and the person is small all over.
- It is known as proportionate dwarfism and is caused by a congenital aplasia (a = no, plasia = tissue) or hypoplasia (hypo = under, plasia = tissue) of the pituitary gland.
- Intelligence is not affected.
- Treatment involves administration of growth hormone to try to stimulate bone growth.
- This type of dwarfism differs from achondroplastic dwarfism which has a genetic aetiology.
- People with achondroplasia have problem converting cartilage to bone while growing, especially in the long bones of the arms and legs.
- Head and trunk are generally normally sized.
Goiter

- Goiter is a generic term for the enlargement of the thyroid gland caused by a tumor, lack of a dietary iodine or more commonly by thyroid dysfunction.
- It presents as a swelling in the anterior neck.
- It could lead to a swelling of the larynx (voice box).
- Worldwide, over 90% cases of goiter are caused by iodine deficiency.
Graves’ Disease

- It is an autoimmune disorder where hyperplasia of the thyroid parenchyma leads to excess thyroid hormone being produced.
- There is an increase in the metabolic rate of cells resulting in thyrotoxic symptoms such as sweating, weight loss, rapid pulse, and warm moist skin.
Hyperinsulinism

- Occurs when excess insulin secreted from the pancreas draws glucose out of the bloodstream, leading to hypoglycemia.
- This can result in syncope, convulsions and loss of consciousness.
- It is usually caused by either an overdose of insulin or a tumor such as an adenoma or carcinoma of the pancreas.
Addison’s disease

- Occurs when deficient amounts of glucocorticoids and mineralocorticoids are produced by the adrenal glands.
- This results in hypoglycemia, hypotension, excess excretion of water and salts, weakness, weight loss and melanin pigmentation of the skin.
- It is thought to be caused by either an infection or by autoimmune adrenalitis.
SIADH

- Syndrome of Inappropriate Antidiuretic Hormone (SIADH) occurs when there is an excessive secretion of antidiuretic hormone (ADH).
- This results in excess water retention in the body.
- SIADH is caused by a tumour, drug reaction or head injury.
- Treatment is by dietary water restriction.
Diabetes Mellitus

- It occurs when there is a lack of insulin secreted by the pancreas or a problem with the way the body metabolises it.
- Glucose is prevented from leaving the bloodstream to enter body cells.
- This leads to hyperglycaemia, glycosuria, polyuria, loss of weight or weight gain and ketonuria.
- There are two main types of diabetes mellitus:
  - Type 1 most commonly occurs in childhood. It results from an underproduction of insulin caused by an autoimmune reaction of the body to the beta cells in the pancreas.
  - Type 2 most commonly occurs in adults who are overweight. It results from lifestyle factors, such as increased weight, high blood pressure and high cholesterol levels.
Hyperthyroidism

- Hyperthyroidism generally results from a tumor of the thyroid gland.
- Extreme overproduction of thyroxine results in a high basal metabolic rate, intolerance of heat, rapid heartbeat, weight loss, nervous and agitated behavior, and a general inability to relax.
- Graves' disease is one form of hyperthyroidism.
- In addition to the symptoms of hyperthyroidism described earlier, the thyroid gland enlarges, and the eyes may bulge, or protrude anteriorly.
- Hyperthyroidism may be treated surgically by removal of part of the thyroid (and/or a tumor if present) or chemically with thyroid-blocking drugs or radioactive iodine, which destroys some of the thyroid cells.
Hyperparathyroidism

- Hyperparathyroidism occurs when excessive quantities of parathyroid hormone are released.
- This causes excessive amounts of calcium to leave the bones and enter the bloodstream.
- Bones decalcify resulting in osteoporosis, fractures and cysts.
- There is an increased likelihood of renal calculus in these patients.
- Hyperparathyroidism is usually due to a tumour in one of the parathyroid glands.
- Treatment involves removal of the tumour.
Tests & Procedures

Check page 158 from the book Mastering Medical Terminology for the complete list of tests & procedures.
Fasting Blood Sugar

- It is a test that measures the blood sugar concentration or blood glucose level in the blood after the patient has refrained from eating and drinking for at least 8 hours.
Human Chorionic Gonadotrophin

- It is a hormone produced by the placenta in pregnancy to maintain progesterone levels in order to prevent break down of the corpus luteum.
- The test is performed to confirm pregnancy.
Thyroid Function Tests

- A number of tests are undertaken to measure thyroid function.
- They include:
  - TSH levels (testing of the level of thyroid-stimulating hormone in the blood, with a high level indicating that the thyroid is not functioning correctly and a low level indicating an overactive thyroid gland).
  - T3 and T4 tests (blood test to determine the presence of hyperthyroidism or hypothyroidism).
Thyroidectomy

- Thyroidectomy is a surgical procedure involving the complete removal of the thyroid gland.
- The procedure is performed to treat hyperthyroidism, thyroid cancer and compression from an enlarged thyroid gland.
Parathyroidectomy

- Parathyroidectomy is a surgical procedure to remove one or more of the parathyroid glands.
- The procedure is performed to treat hyperparathyroidism from tumours or hyperplasia of the parathyroid gland.
Questions?

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