How tall can a person become?

This may be an exaggeration, but the world’s tallest person, Robert Pershing Wadlow, stood almost nine feet tall when he died at the age of 22. Is growing that tall due to a problem with the endocrine system?

Homeostatic Imbalance: Endocrine System Disorders

Diseases of the endocrine system are common and include diseases such as diabetes, thyroid disease, and obesity. An endocrine disease is usually characterized by hyposecretion or hypersecretion of hormones and an inappropriate response to hormone signaling by cells.

Cancer can occur in endocrine glands, such as the thyroid, and some hormones are involved in signaling distant cancer cells to multiply. For example, the estrogen receptor has been shown to be involved in certain types of breast cancers.
**Hyposecretion**

**Hyposecretion** is the production of no hormone or too little of a hormone. It can be caused by the destruction of hormone-secreting cells, such as in Type 1 diabetes, or by a deficiency in a nutrient that is important for hormone synthesis. Hyposecretion can be treated with hormone-replacement therapies. Type 1 diabetes is an autoimmune disease that results in the destruction of the insulin-producing beta cells of the pancreas. A person with Type 1 diabetes needs insulin replacement therapy, usually by injection or an insulin pump, in order to stay alive. An insulin pump is shown in Figure 1.1.

**FIGURE 1.1**

In the treatment of Type 1 diabetes, an insulin pump is an alternative to multiple daily injections of insulin. The pump is usually used along with the monitoring of blood glucose concentration and carbohydrate intake.

Diabetes insipidus is characterized by the excretion of large amounts of very dilute urine, even if liquid intake is reduced. It is caused either by an inability of the kidneys to concentrate urine due to a lack of antidiuretic hormone (ADH), also called vasopressin, or by an insensitivity of the kidneys to that hormone. Blood glucose levels are not affected in diabetes insipidus.

Growth hormone deficiency is caused by a lack of GH production by the pituitary. GH deficiency affects bone growth, and people with growth hormone deficiency tend to have, among other things, low bone density and a small stature—a condition called pituitary dwarfism. GH deficiency is treated by growth hormone replacement.

Hypothyroidism is the state in which not enough thyroid hormones are made. Thyroiditis is an autoimmune disease where the body’s own antibodies attack the cells of the thyroid and destroy it. Thyroid hormones play an important role in brain development during fetal growth, and cells of the brain are a major target for the T3 and T4 hormones. As a result, hypothyroidism in children, either due to a thyroid problem from birth or a lack of iodine in their diet, is a major cause of physical and mental growth impairment in developing countries. In fact, iodine deficiency disorders are the single most common causes of preventable mental retardation and brain damage in the world.
There are many causes of goiter, but the most common in the world is iodine deficiency. Today, iodine deficiency remains mostly a problem in poorer countries that lack the means to add iodine to foods. Iodized salt has helped reduce the amount of iodine deficiency in the developed world. Governments of some countries add iodine to cattle feed to ensure that dairy foods will contain iodine.

Hypersecretion of a hormone happens when the body produces too much of a hormone. A hormone can be hypersecreted if the gland develops a tumor and grows out of control or if the gland is signaled to produce too much of a hormone.

Hyperthyroidism is the result of excess thyroid hormone production, which causes an overactive metabolism and increased speed of all the body’s processes. Hyperthyroidism is the most common cause of goiter in the developed world, which is shown in Figure 1.2.

Hypersecretion of growth hormone causes acromegaly. A common cause of acromegaly is a benign tumor in the pituitary glands that releases too much GH. In some cases, acromegaly is also caused by overproduction of the hypothalamic hormone growth hormone releasing hormone (GHRH). Acromegaly most commonly affects middle-aged adults and can result in serious illness and premature death. Symptoms include enlarged hands and feet, protrusion of the brow and chin, and enlarged internal organs. However, the disease is hard to diagnose in the early stages and is frequently missed for many years due to its slow progression. If the pituitary produces too much GH during childhood, the person will be taller than normal—a condition called pituitary gigantism. Pituitary gigantism is very rare, and some of the tallest people on record had this condition.

Hormone Insensitivity: Type 2 Diabetes

In some cases, the body makes enough hormones, but body cells do not respond. This can be due to missing or defective hormone receptors, or the body cells may become resistant to normal hormone concentrations and do not respond to it.
Type 2 diabetes is characterized by hyperglycemia (high blood glucose concentrations), body cells that do not respond to normal amounts of insulin (insulin resistance), and the resulting inability of the pancreas to produce enough insulin. Insulin resistance in cells results in high amounts of free fatty acids and glucose in the blood. High plasma levels of insulin and glucose due to insulin resistance often lead to metabolic syndrome and Type 2 diabetes. Type 2 diabetes can be controlled by improving one’s diet, increasing levels of activity, and sometimes medication.

Gestational diabetes is a form of diabetes that affects pregnant women. There is no known single cause, but it’s believed that the hormones produced during pregnancy reduce the ability of the cells in the pregnant woman’s body to respond to insulin, which results in high blood glucose concentrations.
Hormones as Medicines

Many hormones and molecules like them are used as medicines. The most common type of therapy is called hormone-replacement therapy (HRT). The most commonly prescribed hormones are estrogens and synthetic progesterone (as methods of hormonal contraception and as HRT therapy for post-menopausal women), thyroxine (as levothyroxine for hypothyroidism), and corticosteroids (for autoimmune diseases and several respiratory disorders). Progestin, a synthetic progesterone, is also used to prolong pregnancy in women who have experienced a miscarriage due to a premature drop in progesterone levels. Hydrocortisone is a synthetic form of cortisol that is used to treat allergies and inflammation as well as cortisol production deficiencies. Hydrocortisone cream is a common over-the-counter medication for the topical treatment of rashes. Insulin is used by many people with diabetes.

Epinephrine

Because of its anti-inflammatory effect on the immune system, epinephrine is used to treat anaphylaxis. Anaphylaxis is a sudden and severe allergic reaction that involves the entire body. After an initial exposure to a substance like a certain food (such as peanuts) or a bee sting, a person’s immune system can become sensitized to that substance, which is called an allergen. Upon second exposure, an allergic reaction occurs.

Histamines and other substances that are released by body cells cause the blood vessels to dilate, which lowers blood pressure and causes fluid to leak from the bloodstream into the tissues, lowering the blood volume. The release of histamines causes the face and tongue to swell. Swelling of the lining of the throat can lead to breathing difficulties. The hormone epinephrine causes blood vessels to constrict, which reduces swelling and causes blood pressure to increase. Epinephrine is used as a medicine in auto-injectors (see Figure 1.4), which a person can use on themselves should they have an anaphylactic reaction.

Anabolic Androgenic Steroids

Synthetic androgens, in the form of anabolic androgenic steroids (anabolic steroids), have many medical uses. They are used to stimulate bone growth and appetite, induce puberty in boys, and treat muscle-wasting conditions in patients that have diseases such as cancer or AIDS. Androgens, including testosterone, generally promote protein synthesis and the growth of muscles and other tissues. Androgens also block the effects of the stress hormone cortisol on muscle tissues, so the breakdown of muscles is greatly reduced.

Anabolic Steroid Abuse

As a result of their muscle-building action, anabolic steroids are used in sports and bodybuilding to increase muscle size and strength in order to gain a competitive edge or to assist in the recovery from an injury. Steroids used to
gain a competitive advantage are forbidden by the rules of the governing bodies of many sports. Serious health risks can be produced by long-term use or excessive doses of anabolic steroids. Most of these side effects are dose dependent, the most common being an increase in low density lipoprotein (bad cholesterol) and a decrease in high density lipoprotein (good cholesterol). Anabolic steroids also increase the risk of cardiovascular disease in men with high risk of bad cholesterol. Acne is fairly common among anabolic steroid users, mostly due to increases in testosterone, which stimulates the sebaceous glands to produce more oil. High doses of anabolic steroids have been linked to liver damage.

Teenagers, particularly boys, who take anabolic steroids are more likely to be involved in sports that emphasize weight and shape (such as football or wrestling, which is shown in Figure 1.5). Such teens also have higher rates of disordered eating and drug abuse and generally have poorer attitudes towards health. Severe side effects can occur if a teenager uses anabolic steroids. For example, the steroids may prematurely stop the lengthening of bones, resulting in stunted growth. Other effects include, but are not limited to, accelerated bone maturation, increased acne outbreaks, and premature sexual development.

In addition to dangerous side effects of the steroids themselves, dangerous drug-taking habits have been reported by abusers. These include unsafe injection practices such as reusing needles, sharing needles, and sharing multidose vials. A common practice among anabolic steroid abusers is self-medicating with other hormones such as growth hormone and insulin, which in itself can lead to serious health consequences. Testosterone and other anabolic steroids are classified as controlled substances in the United States (US), Canada, the United Kingdom (UK), Australia, Argentina, and Brazil.

Summary

• Type 1 diabetes is caused by hyposecretion of insulin.
• Hypersecretion of growth hormones causes gigantism.
• Hormone-replacement therapy can be very beneficial to diabetics (insulin), those with severe allergies (epinephrine), and AIDS patients (steroids), among others.
• Abuse of hormones, such as anabolic steroids, can be incredibly dangerous.

Review

1. What is hypothyroidism?
2. How does type 2 diabetes occur?
3. How does epinephrine help those with significant allergies?

References