CHAPTER 9
THE ENDOCRINE SYSTEM

A. INTRODUCTION

The endocrine and nervous system work together to coordinate activities of the body. Some courses treat the two system together as a neuroendocrine system. Both have their specific effects on **target organs.** The nervous system carries **neural impulses** to its specific target organs. Its effect is localized because the neurons go to specific muscles or glands. The endocrine system releases **hormones from ductless glands** directly into the bloodstream so that every cell in the body potentially can be affected by the hormone. However, only certain organs will be affected because only those that are the specific **target organ** have the necessary **receptor sites** on their cells to allow them to react to the hormone. **Generally the endocrine effect is produced slowly and is long lasting whereas the nervous effect is produced quickly and lasts for a brief instant.**

Endocrine organs are located throughout the body in specific places. Many of these have hormones that are important in speech or hearing mechanisms and will be dealt with here. We will also look at others that have general importance to bodily functions.

1. Pituitary gland: The pituitary gland has an anterior and a posterior lobe. The anterior portion is called the **adenohypophysis** and is a major endocrine organ. The posterior lobe, called the **neurohypophysis,** does not produce any hormones but stores hormones produced by the **hypothalamus.** This shows an interesting relationship between the nervous and endocrine systems!

a. Anterior lobe (adenohypophysis): This portion of the pituitary is often called the master gland. It produces several hormones.

1). **Tropic hormones.** These stimulate other endocrine glands to produce their characteristic hormone. **Thyrotropic hormone** stimulates the thyroid. **Adrenocorticotropic hormone (ACTH)** stimulates the adrenal cortex.

Gonadotropic hormones stimulate the ovary and testis to produce their hormones. **FSH or follicle stimulating hormone** stimulates follicular growth and maturation of the ova in females. In the male it is responsible for stimulation of the seminiferous tubules. **LH, or luteinizing hormone,** converts the follicle to a corpus luteum in females. In the male it causes testosterone development in the testes.

Somatotropic hormone targets all body cells. It causes stimulation of growth. **Hypopituitarism** or lack of somatotropic hormone produces **dwarfism.** This may result in infantile development of speech structures. The voice will often be weak and infantile.

Hyperpituitarism or overproduction of Somatotropic hormone produces giantism if it occurs early. If the onset is later, **acromegaly** ensues. Acromegalic individuals have mandible and skull bones enlarged, the tongue, hyoid bone, larynx, vocal folds, and laryngeal cartilages enlarge. This sometimes occurs to the point of obstruction of the laryngeal vestibule. **Stridor** (harsh, high-pitched respiratory sound) will be heard. Voice deepening especially in females will occur because arytenoids and epiglottic cartilages as well as the vocal folds enlarge. The mandible length may increase thus affecting speech.

b. Posterior lobe of the pituitary: This part of the pituitary does not produce hormones. It stores those produced in the **hypothalamus**.

Oxytocin is responsible for stimulating the uterine muscles to contract prior to birth.

Antidiuretic hormone (ADH) regulates water balance by causing more resorption of water from the kidney filtrate. (Beer and coffee counteract the effects of ADH causing copious urine production and water loss from the body. Add to this the dehydrating effects of salt on potato chips and pretzels and it's no wonder that bars sell lots of alcohol.)

2. Thyroid gland: This gland is located on the anterior tracheal surface just below the thyroid cartilage.

a. The thyroid gland is regulated by **thyrotropic hormone** produced from the **anterior pituitary gland.**

b. The thyroid gland is interrelated with gonadal cycles. It enlarges at puberty, during menstruation, and pregnancy. It is depressed by castration or menopause.

c. **Thyroid hormones.** three active hormones of this gland are triiodothyronine (T3), thyroxin (T4), and calcitonin. T3 and T4 need **iodine** for their production. Lack of iodine in the diet causes hypothyroidism (see below). Calcitonin promotes calcium storage in bone.

d. The action ofT3/T4 is to **increase the basal metabolic rate.** It also **increases mental activity, heart rate, blood circulation, heat production, and sweat gland function.**

e**. Hypothyroidism:** A **lack of iodine in the diet produces simple goiter.** Inactivity of the thyroid due to other causes produces **cretinism** if this inactivity occurs early (in children). Cretinism manifests itself in slowed growth and sluggish mentality. If the inactivity occurs in adults the condition is **myxedema.**

Cretin children have notable **speech disorders.** These are brought on by the fact that the skeletal muscles become torpid and relaxed. The speech often is slurred because the tongue and lips are swollen. The voice range is restricted due to **hypoplasia** (lack of development) of laryngeal structures.

Myxedemic adults may display incomplete glottal closure, frequent hoarseness, and atrophy of certain vocal muscles.

In both cretinism and myxedema there may be **deafness** associated with **inner ear damage**.

f. **Hyperthyroidism (Grave's Disease)**. When the thyroid overproduces thyroxin, nervousness may develop. The metabolic rate will raise and **tachycardia** (rapid pulse rate) often ensues. **Exopthalmia** caused by swelling of the tissues under the eyes often occurs. The voice may be breathy and irregular due to this condition.

g. As with many disorders, an individual may have the disorder but no manifestation of the disorder occurs.

3. Parathyroid

a. There are **4 parathyroids** (two superior and two inferior) embedded in the thyroid tissue.

b. **Parathyroid hormone** (PTH) produced from the parathyroids draws calcium into the blood serum from storage places in bone, etc.

c. Calcium levels are critical to normal muscle and nerve functioning. **Too little calcium** causes an increase in nerve and muscle irritability. Rapid and overly nervous speech may develop. **Too much calcium** causes a decrease in irritability.

4. Thymus

a. The thymus is located in the **mediastinum** anterior and lateral to the trachea. It reaches its maximum size in 11-12 years. Thereafter it begins to regress until it nearly disappears by the early 20's.

b. It is responsible for **development of immunologic capability** regarding tissue rejection.

c. In speech pathology its importance is in its failure to regress upon reaching puberty. Speech would be affected due to pressure exerted by this gland on the trachea and general mediastinal area.

5. Adrenal Glands: Medulla

a. The **medulla** is the center part of the adrenal gland which is located on top of the kidney.

b. Hormones produced by the medulla have the same effect as the **sympathetic nervous system** in that it adjusts the body to specific stresses. It produces **epinephrine (adrenaline) and norepinephrine (noradrenalin).**

Epinephrine acts fast but generally has a short-lived action. It is a heart stimulant. Norepinephrine has a much longer action time. It acts strong on constriction of blood vessels in skeletal muscle. It increases the metabolic rate. It also relaxes smooth muscles.

c. **Stage fright speech** is caused by over stimulation of the adrenal medulla and the sympathetic nervous system. The **sympathetic nervous system** stimulation is rapid and short-lived, however the **adrenal medulla** stimulation is slower to start but lasts longer.

6. Adrenal Glands: Cortex

a. The adrenal cortex is **vital** to life. If it is removed death ensues.

b. There are actually over 30 hormones produced by this gland. These are the **steroid hormones.**

1). **Mineralocorticoids:** hormones that preserve the ionic balance of the blood.

2). **Glucocorticoids:** This is a group of hormones concerned with normal metabolism and resistance to stress. Some of these, such as **cortisone,** are anti inflammatory compounds. Corticoids often are used to suppress various ailments. Unfortunately, they also depress immune responses and are dangerous to take over extended periods. They should only be used under doctors advice and then only with great caution.

3). **Androgens, estrogens, progesterones.** This group of sex hormones is responsible for production of **secondary sexual development.** These are produced along with those from the ovary and testis.

They stimulate normal development of secondary sexual characteristics, including **voice changes associated with puberty.**

Tumors may cause an increase in androgens but rarely estrogens. The **bearded lady** of the circus has an overproduction of androgens.

7. Gonads: These are responsible for production of hormones that control secondary sexual characteristics in males and females.

a. Testes produce **testosterone** which stimulates **spermatogenesis** as well as development of **secondary sexual characteristics.** Among these secondary sexual characteristics are voice changes and skeletal structure development.

Hypogonadism may be caused by castration or due to insufficiency on the part of the anterior pituitary.

Eunuchism (castration) or **eunuchoidism (testicular insufficiency)** both cause decrease in vocal fold length, regression of the thyroid cartilage, and assumption of falsetto voice. Eunuchoidism before sexual maturity causes a delay in maturation of the larynx. The voice of the adult is that of a young boy.

b. Ovaries produce **estrogens** which develop secondary sexual characteristics.

Overectomy before puberty causes cessation in development of secondary sexual characteristics, sexual cycles, genital tract atrophy, sterility, obesity and emotional disturbance. The voice may not be affected. In many cases the vocal range changes in the prepubescent female castrate. The vocal range and speaking level may be lower, vocal timbre may be harsh.

c. Vocal changes in males and females due to physiological process are noted below.

1). Mutation is a general voice change through puberty. The voice range drops 1 octave in males and 1/3 octave in females.

2). Menstrual flow phase produces **edema** (tissue swelling) and **reduced mucus secretion** in the region of the vocal folds causing flatness in the singing voice of females.

3). Voice changes due to age are generally endocrine based. **Menopause** produces gradual changes including a reduction in brilliance and range of voice in females. In **older males** the voice loses volume and strength, the range becomes narrower. **Calcification or ossification** of the hyaline cartilages of the larynx and trachea cause a decrease in elasticity of these structures and thus restrict vocal range and quality.