DIAGNOSIS OF THYROID DISEASE

An Assay

Submitted For Partial Fulfilment

of M.Sc. (General Surgery)

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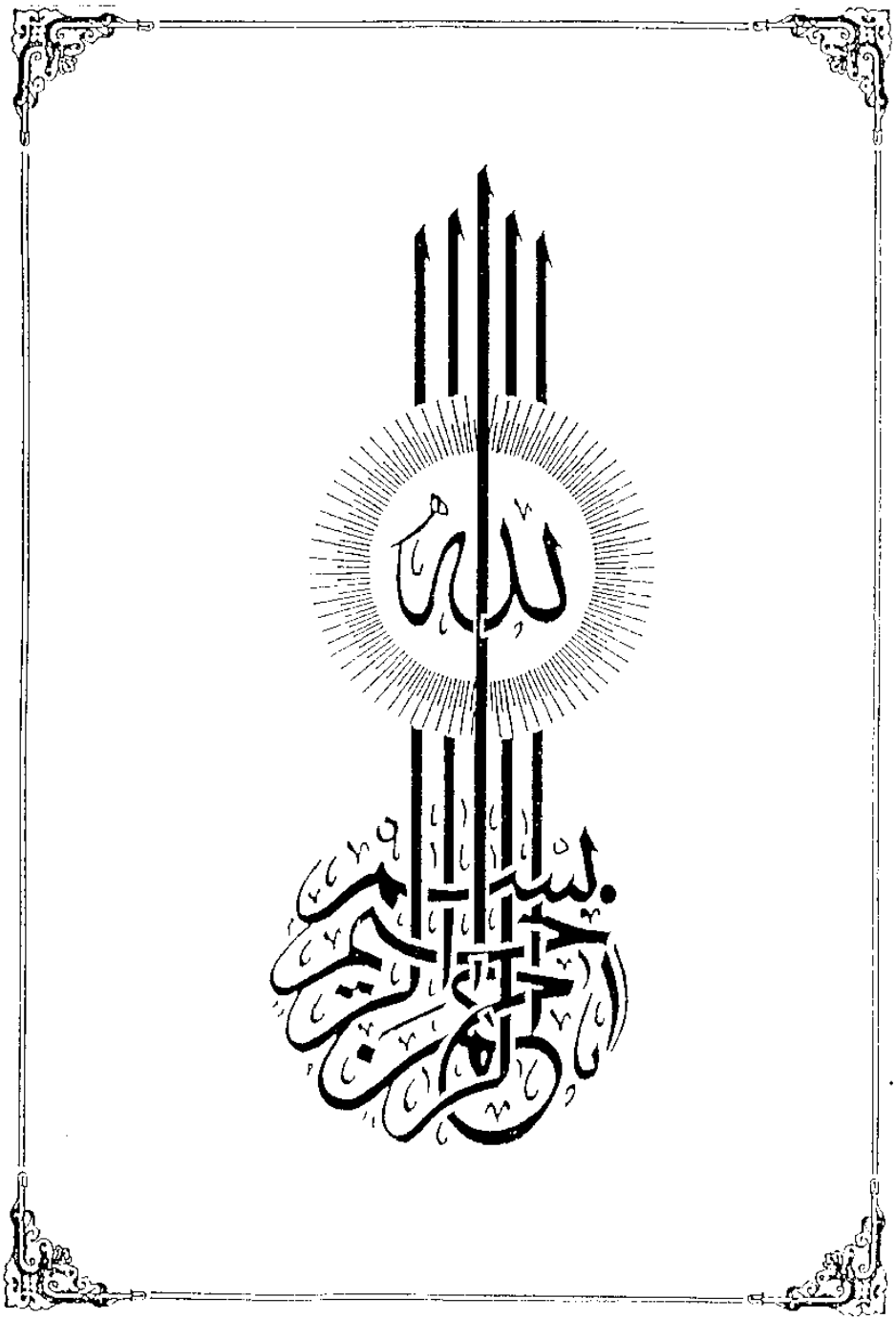
ACKNOWLEDGEMENT

I want to thank the Melitary Medical Acadamy and Ein-Shams University for giving me the opportunity to go forward in my post graduate researches. Special thanks to my supervisors and their precious advise and helping hand in accomplishing this assay, which I hope that it would be of value in the hands of students and colligues in their work.



INTRODUCTION

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The thyroid gland was first described in the second century A.D. by Galen, who thought its function was to moisten and lubricate the pharynx. In 1656 Wharton named it after the underlying thyroid cartilage. The name "thyroid" derives from the Greek tiros, meaning shield shaped. Wharton assigned four functions for the thyroid gland: (1) to take up certain superfluous fluids emanating from the recurrent nerve, (2) to warm the cartilage of the trachea, (3) to lubricate the larynx and so to render the voice smoother, more melodious and sweeter, and (4) to contribute to the contour and beauty of the neck; especially in the female sex to whom on this account a larger gland has been assigned. Other function were also ascribed to the thyroid, particularly in reference to its inordinately rich supply of blood. It was thought to divert the flow of blood from the brain during periods of quiescence or to buffer the large changes in blood flow to the brain that might occur in sudden periods of excitement.

As in many other areas of endocrinology, clues to the role of the thyroid and its physiology were derived from clinical observations (Vernon B. Mountcastle et al., 1980).

The possibility of throid disease arises when signs or symptoms suggest hyper- or hypo-thyroidism, or some physical abnormality of the gland (Degroot, L.J. and Stanbury, J.B., 1975).

In considering the patient with known or suspected thyroid disease, the physician should seek to arrive at two types of diagnosis, an atiologic or anatomic diagnosis and a functional diagnosis. The one encompasses an appreciation of the underlying cause or nature of the disorder, as well as the assotiated pathologic changes in the gland. The other encompasses a decision whether the physiologic and metabolic state of the patient is being conditioned by an excess, normal, or insufficient supply of thyroid hormone. In many instances, obviously, the one diagnosis facilitates or influences the other (William, R.,1981).

Disorders of the thyroid gland comprise a group of commonly encountered endocrinologic diseases. It has been estimated that there are 200 million people world-wide with goiter. Many of these abnormalities reflect genetic, dietary, and environmental factors (Virginia A. Livolsi and Marta J. Merino, 1981).

Goiter, defined as any thyroid enlargement, can spring from a variety of cases.

Thyroid Enlargement

Diffuse:

Diffuse toxic goiter (Graves' disease).

Thyroiditis (especially chronic forms).

Nodular:

Non toxic nodular goiter (adenomatous goiter; colloid goiter).

Toxic nodular goiter.

Thyroiditis (some times).

Adenoma.

Carcinoma.

Other malignant tumors.

EMBERIOLOGY AND ANATOMY

During emberyonic development the thyroid gland is derived from the ventral wall of the primitive pharynx. This median outgrowth migrates downward, and at its lower end it bifurcates to form the isthmus and lateral lobes of the thyroid (Szewezyk, T., 1978).

Initially, it is connected to the pharynx by the thyroglossal duct, which attenuates and eventually is obliterated. In most species the thyroglossal duct atrophies early, but occasionally isolated portions persist and give rise to ectopic bits of thyroid tissue, particularly in the lingual and sublingual regions. In man a recognizable thyroid organized in follicles appears by the first trimester. Even at this early date, iodine accumulation and colloid formation indicate that the gland is functional. Early stages of thyroid development appear to be independent of the pituitary and its TSH (Vernon B. Mountcastle et al. 1980).

GROSS ANATOMY:

The thyroid gland is a brownish-red, highly vascular organ, situated anteriorly in the lower part of the neck, at the level of the fifth, sixth, and seventh

cervical; and the first thoracic vertebrae, it is ensheathed by the pretracheal layer of the deep cervical fascia and consists of a right and left lobes connected across the median plane by a narrow region, termed the isthmus.

The lobes are approximately conical in shape, the apex of each ascending and diverging laterally on the level of the oblique line of the thyroid cartilage; the base is on a level with the fourth or fifth tracheal ring. Each lobe is about 5 cm long; its greatest transverse and antero posterior dimensions being about 3 cm and 2 cm. The posteromedial aspect of each lobe is attached to the side of the cricoid cartilage by a ligamentous band called the lateral ligament of the thyroid gland. The lateral or superficial surface is convex. External to the sheath of pretracheal fascia, this aspect of the gland is closely covered with the sternothyroid and it is the insertion of this muscle into the oblique line on the lamina of the thyroid cartilage which prevents the upper part of the lobe from extending on to the thyrohyoid muscle. More anteriorly still are the sternohyoid and the superior belly of the omohyoid, overlapped below by the anterior border of the sternocleidomastoid. The medial surface is adapted to the larynx and trachea. At its superior pole,

it is in contact with the inferior pharyngeal constrictor and the posterior part of the cricothyroid, which intervene between the gland and the posterior part of the lamina of the thyroid and the side of the cricoid cartilages. The external laryngeal nerve is medial to this part of the gland on its way to the cricothyroid Below, it is related to the side of the trachea in front and to the reccurent laryngeal nerve and (especially on the left side) to the oesophagus posteriorly. The postero-lateral surface is related to the carotid sheath and overlaps the common carotid artery. The anterior border, closely related to the anterior branch of the superior thyroid artery, is thin and descends obliquely and medially. The posterior border, blunt and rounded, is between the posterior and the medial surfaces and is closely related below to the inferior thyroid artery and an anastomosing branch which connects it to the posterior branch of the superior thyroid artery. In addition, the parathyroid glands are usually related to the posterior border. The lower end of the posterior border of the left lobe is closely related to the thoracic duct.

The isthmus connects the lower parts of the two lobes, it measures about 1.25 cm transversely, and the

same vertically, and usually extends anterior to the second and third rings of the thrachea, though it is often placed at a higher, or occasionally lower, level. Its situation and size present, however, many variations. Anteriorly, it is separated by the pretracheal fascia from the sternothyroids. More superficially it is covered by the sternohyoids, the anterior Juglar veins, the fascia and the skin. An anastomotic branch uniting the two superior thyroid arteries runs along its upper border, at its lower border the inferior thyroid veins leave the gland. Occasionally the isthmus is absent.

A third, conical pyramidal lobe is often present, it ascends towards the hyoid bone from the upper part of the isthmus, or from adjacent part of either lobe (more commonly the left). It is occasionally quite detached, or may occur as two or more separate parts.

A fibrous or fibromuscular band sometimes descends from the body of the hyoid bone to the isthmus of the gland, or its pyramidal lobe, when muscular, it is termed the levator of the thyroid gland, (William & Worwick, 1980).

The thyroid gland is among the most richly vascalarized tissues of the body; only the lungs and

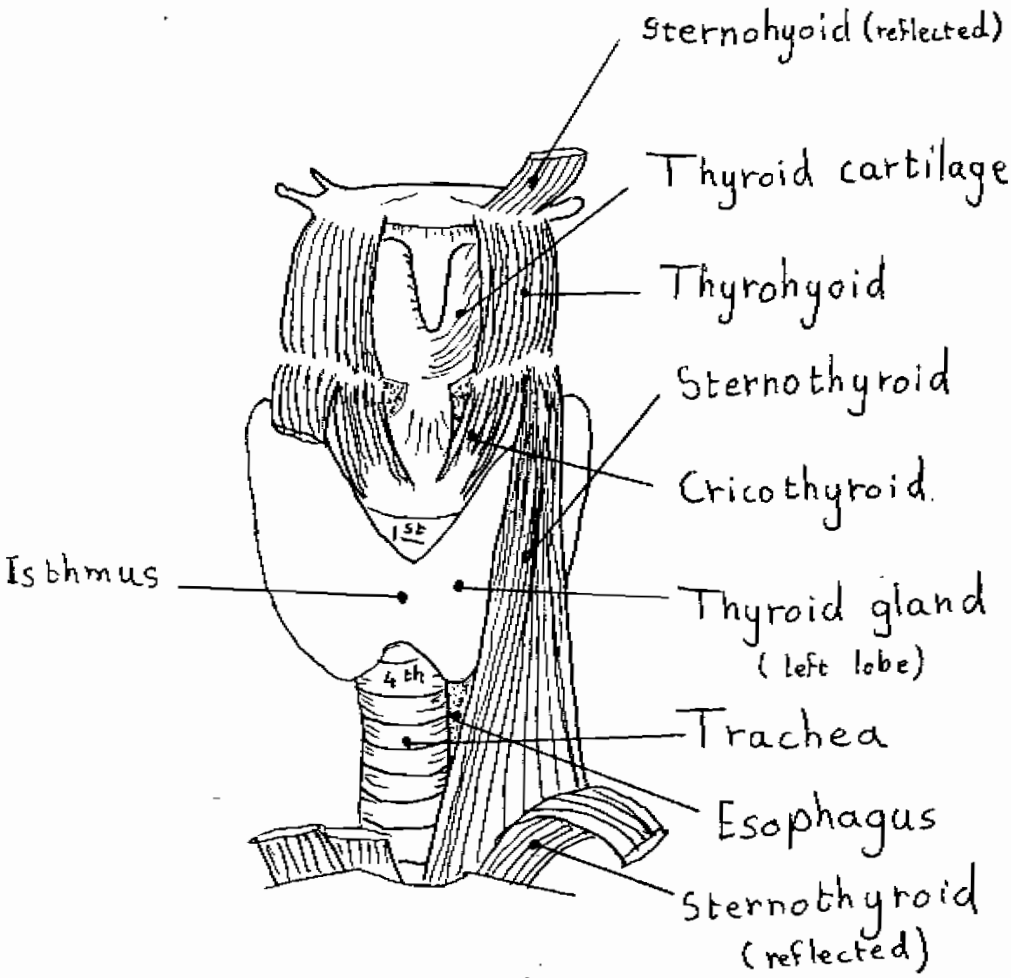
carotid body receives a greater blood supply. Normal blood flow to the thyroid is approximately 5 ml/min/gm, as compared, for example, to roughly 3 ml/min/gm, for the kidney. Blood flow may become as high as 1 L/min/gm after extreme stimulation. The thyroid receives its blood supply from the superior and inferior thyroid arteries that arise from the external carotids and subclavian arteries. Venous drainage is by way of the superior and middle thyroid veins into the internal juglar veins and by way of the inferior thyroid vein into the innominate veins. The thyroid also is endowed with a rich lymphatic system that may play an important role in the delivery of hormone to the general circulation. The thyroid gland is innervated by both sympathetic and parasympathetic fibers that arise from the cervical sympathetic ganglia and the vagus nerves, respectively (Vernon B. Mountcastle et al. 1980).

MICROSCOPIC ANATOMY:

The thyroid gland is invested by a thin capsule of connective tissue and it is divided into masses of irrigular form and size by extension of this connective tissue (William & Worwick, 1980).

The functional unit of the thyroid gland is the follicle, which is composed of closely packed vesicles of various shapes and sizes (from 0.02 to 0.3 mm in diameter) and filled with a proteinaceous colloid, thyroglobulin. The epithelial cells lining the follicles vary in configuration from low caboidal to columnar, depending on their functional state; the height of the epithelium is greatest when the gland is most active. Each follicle is invested with a dense capillary network separated from the epithelial cells by a well-defined basement membrane. The capillary endothelium is fenestrated and contains pores that range from 400 to 600 A in diameter, (Vernon B. Mountcastle et al. 1980).

In addition to the follicular cells proper, the thyroid parenchyma contains a second cell type, the para follicular, light, clear or C cells, which produce the peptide horomone thyrocalcitonin (William & Worwick, 1980).



Thyroid Gland

(diagramatic, in situ)

PHYSIOLOGY OF THE THYROID GLAND

The mammalian thyroid gland produces three recognized hormones: Thyroxine, Triiodothyronine and Thyrocalcitonin.

Thyroxine and triiodothyronine are classically regarded as the thyroid hormones. Thyrocalcitonin, which arises from the parafollicalar cells rather than the follicles, may serve in the regulation of calcium metabolism (Vernon B. Mountcastle et al. 1980).

Both thyroxine and triiodothyronine are iodine containing amino acids (William F. Ganong 1981).

The naturally occuring forms of thyroxine and its congeners with an asymmetric carbon atom are the L-isomers (William F. Ganong 1981).

Biosynthesis, Storage and Secretion of Thyroid Hormones:

Biosynthesis of thyroxine and triiodothyronine requires synthesis of thyroglobulin and accumulation and oxidation of iodine. Thyroxine and triiodothyronine are