Sudan University of Science & Technology

College of Graduate Studies

Studyeffects of Thyroid HormonesDisturbance on Thyroid Size and Echogenicity using Ultrasonography

دراسة تأثير تغيرات هرمونات الغدة الدرقية على حجم وسطوع الغدة الدرقية بإستخدام الموجات فوق الصوتية

A Thesis Submitted for Fulfillment of Requirements of M.Sc. Degree in Medical Diagnostic Ultrasound.

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Dedication

To the sole of my

Father.

Mother

My sons...

My daughters

My friends.

Acknowledgement

I want to express my sincere thanks and deep gratitude to my faithful supervisor **Dr**. **Mona Ahmed Mohammed** for her guidance throughout this thesis and sharing her knowledge through the entire studies.

My thanks extent to **Dr. AwadiaGreeballah**who made great effort in writing and statistic analysis of this study.

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I want to thank the staff of El amal tower for their co-operation.

My prayers to all of them.

Abstract

Thyroid function is the production of thyroid hormones which are created from thyroglobulin protein.The disturbance of thyroid most of it without signs and symptoms so we use U/S to detect it. The aim of this study was to study the size and texture of thyroid gland with disturbance of T3, T4, TSH using ultrasonography. The study was a descriptive which included 309 patients who were referred to the ultrasonography clinic and suffered from a disturbance of T3 ,T4 and TSH during the period from April/2015 up to February 2017. The machines used in the study were Aloka 200 CD and Sonoscape with high frequency 7 – 10 MHZ.Left and right lobes were measured and echogenicity and size were detected. Ultrasonography findings of this study revealed that the most age group affected by thyroid hormones disturbance was (25 – 50years) 76.2%. The incidence of thyroid diseases is more common in females (94.8%).The study, as well, revealed that the most endemic areas for thyroid diseases in Sudan was the west (40). The study revealed that most of thyroid gland changes was increased in size and complex echogenicity in 0<05 decrease TSH hormones no significant correlation between size and abnormal.

ملخص البحث

إستخدام الموجات فوق الصوتية لمعرفة تأثير هرمونات الغدة الدرقية، إن وظيفة الغدة الدرقية هي إنتاج الهرمونات التي تنتج في بروتين القلوبيولين الدرقي.

الهدف من هذا البحث هو دراسة حجم وشكل الغدة الدرقية من خلال التغيرات في هرمونات ت3، ت4، تي أس أتش والهرمون المحفز للغدة الدرقية بإستخدام التصوير بالموجات فوق الصوتية.

هذه الدراسة دراسة وصفية أشتملت على عدد 309 مريض تم تحويلهم إلى قسم التصوير بالموجات فوق الصوتية وكانوا يعانون من إضطرابات في إفراز هرمونات ت3، ت4، تي أس أتش، أثناء الفترة من شهر أبريل 2015م إلى شهر فبراير 2017م تم إستخدام جهازي تصوير الموجات فوق الصوتية ألوكا 200 سي وسونوسكوب بتردد من 7 – 10 ميغا هيرتز تم قياس الفص الأيمن والفص الأيسر للغدة الدرقية وتم الكشف على شكل وحجم الغدة ، وقد كشفت نتائج التصوير للموجات فوق الصوتية أن المجموعة العمرية الأكثر تأثراً هي من 25 – 50سنة ، كما أظهرت النتائج أيضاً أن أمراض الغدة الدرقية تنتشر بين الإناث بنسبة 94.8% مقارنة مع الذكور بنسبة 5.2% بالإضافة إلى ذلك نجد أن الدراسة قد كشفت أن أكثر المناطق تأثراً بأمراض الغدة الدرقية في السودان هي غرب السودان بنسبة40% وقد إرتبطت معظم التغيرات في الغدة الدرقية بزيادة إفراز هرمونات الغدة الدرقية في شكل نسيج معقد أو قلة في إنتاج الصدأ.

List of abbreviations

T3	Thriiodothyronine.
T4	Tetraiodothyronine.
TSH	Thyroid – stimulating hormone.
TRH:	Thyrotropin-releasing hormone.
MNG	Multi-nodular goiter.
RAIU	Radioactiveiodine-123 uptake.
TGB	Thyroiglobulin.
PTH	parathyroid hormone.
FT4	Free thyroxin.
THBR	Thyroid hormone bending ratio.
FT4I	Free thyroxin index.
FT3	Free thiirodothyronine.
TBG	Thyroxin bending globulin.
TAGB	Thyroglobulin antibody titer.

Thyroid Function Tests

Function	Abbreviation	Normal
Serum thyrotropin/ thyroid stimulating hormone.	TSH	0.3 – 3.0 µU/ml
Free thyroxin	FT4	7 -18 ng/1=0.7 – 1.8ng/d1
Serum triiodothyrnine	T3	0.8 – 1.8µg/1=80-180 ng/d1
Radioactive iodine -123 uptake	RAIU	10 -30%
Radioiodine scan (gamma camera)	N/A	N/A – thyroid contrasted images
Free thyroxin fraction	FT4F	0.03 – 0.005%
Serum thyroxin	T4	46 – 120 µg/1=4.6 – 12.0 µg/d1
Thyroid hormone binding ratio	THBR	0.9 – 1.1
Free thyroxin index	FT4I	4 - 11
Free triiodothyronine 1	FT_3	230 – 619 pg/d
Free T3 index	FT31	80 – 180
Thyroxin – binding globulin	TBG	12 – 20 ug/d1 T4 + 1.8 µg
TRH stimulation test	Peak TSH	9 – 30 µIU/ml at 20 – 30 min
Serum thyroglobulin 1	Tg	0 – 30 ng/m
Thyroid microsomal antibody titer	TMAb	Varies with method.
Thyroglobulin antibody titer	TgAb	Varies with method

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Chapter One

Introduction

Chapter One

1-1 Introduction:

The thyroid gland plays a critical role in a person’s overall health. Yet many people suffering from thyroid conditions remain undiagnosed, and do not understand the serious health repercussions of untreated thyroid disorders. Diagnosis and treatment are key steps to managing a thyroid problem, and will help to control the related symptoms. The thyroid is an endocrine gland that is responsible for controlling metabolism (the energy produced and used by the body) and regulating the body’s sensitivity to hormones. Diseases of the thyroid cause either underactivity or overactivity of this gland. Underactivity of the thyroid results in hypothyroidism (also known as Hashimoto’s thyroiditis) and goiter. Hypothyroidism can produce symptoms of weight gain, sensitivity to cold and brittle nails and hair. In Western countries, hypothyroidism is largely due to an autoimmune response, although iodine deficiency can also cause underactivity – which is largely in other parts of the world that lack iodized salt. Hypothyroidism is associated with several other diseases, including heart disease, type 1 diabetes, celiac disease and metabolic syndrome. Overactivity of the thyroid is seen in Grave’s disease, which results in bulging eyeballs, anxiety and sensitivity to heat among other symptoms. Enlargement of the thyroid can be the result of noncancerous goiter, which may or may not result in hypothyroidism or hyperthyroidism, or cancer. Radiation exposure, such as x-rays—especially in children—can affect thyroid status. Lab tests of TSH (thyroid stimulating hormone), T3 and T4 help in the diagnosis of thyroid conditions. Recent changes in screening guidelines that have a lower threshold limit of TSH hormone affects the thyroid status of millions of adults in the U.S. This has resulted in the diagnosis of many more patients with hypothyroidism. Lab results, symptoms and physical exam help direct physicians to the proper diagnosis and treatment of the thyroid.(**Cleveland Clinic, MD Mary&etal, April 1, 2013**)

1-2 Problem of the study:

The disturbance of thyroid most of it without signs and symptoms so we use U/S to detect it.There was changing in thyroid size and texture in relation to hormone defect.Examination of thyroid disturbance using CT had high radiation dose for the patient. MRI is expensive so ultrasound is safe method and highly accurate and cheap.

1-3 General Objectives:

To study thyroid gland in patients with disturbance of thyroid hormones using ultrasonography.

1-4 Specific Objectives:

- To measure the size of thyroid.
- To assess the echogenicity.
- To compare the size and texture of thyroid when increase of hormones.
- To compare the size and texture of thyroid when decrease of hormones.
- To compare age and gender with thyroid disturbance.

1-5 Overview of the study:

This study consists of five chapters, chapter one is an introduction which includes (problem and objectives of the study), chapter two is literature review which includes (anatomy, physiology and pathology), chapter three about research methodology, chapter four deals with results and chapter five includes discussion, conclusion, recommendation and references and appendices.

1-6 Instrumentation:

High frequency transducers , 7.5 to 17 MHZ currently provide both deep U/S presentation up to 5cm and high detention images with a resolution of o5 to 1mm No other imaging method can achieve this degree of spatial resolution .

Linear array transducers with wither rectangular or trapezoidal scan format are preferred to sector transducers because of the wider near field of view and capability to combine high frequency gray – scale and color Doppler images . the thyroid gland is one of the most vascular organs of the body . As a result Doppler examination may provide use full diagnostic information in sum thyroid diseases . The newer techniques used for the serigraphic study of the thyroid gland are contrast enhanced sonography second generation contrast agents using mechanical index can provide useful information disease and for ultrasound select case of noduler guided therapeutic procedure sonoelastography is based on the principle that when body tissues are compressed the softer part deform more easily harder parts .

The amount of displacement at various depths is determined by the U/S signal reflected by tissues before and after they are compressed and the corresponding strains are calculated from the displacements and displayed visually already proved useful diagnosis of breast lesions is being applied to thyroid nodules

From diagnostic U/S 4th edition chapter 18 page 708 Carol M Rumack .

1-7 Basic ultrasound physics:

Ultra sound physics is made up mechanical waves can transmit through different materials like fluids, soft tissues and solids. It has a frequency higher than auditory limit of 20 KHz, Ultrasound frequency is defined as the number of waves per second, the velocity of ultra sound in a specific medium equals the frequency of ultrasound multiplied by its waves lengths, there are different method that control the way ultrasound waves are emitted from the ultrasound transducers they can be either interrupted or continuous, interrupted emission generates brightness (B) mode while continuous emission generates Doppler mode. Imaging one line over time is called the moving mode (M mode). Changing the frequency of ultrasound waves will control the penetration and resolution of the images.(Fikri et al,2011).

Chapter Two

Theoretical Background

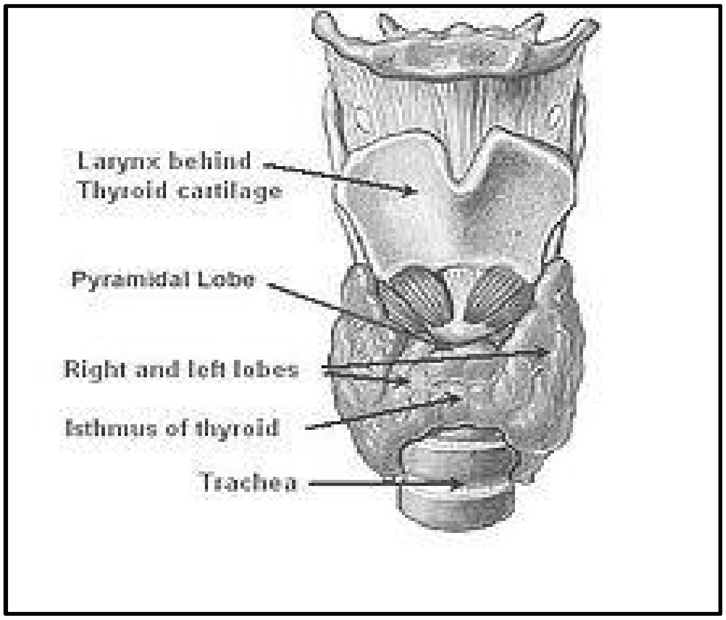
Chapter Two

Literature Review

2-1Theoretical Background

2-1-1Anatomy:

The thyroid gland, or simply the thyroid is an endocrine gland in the neck, consisting of two lobes connected by an isthmus. It is found at the front of the neck, below the Adam's apple. The thyroid gland secretes thyroid hormones, which primarily influence the metabolic rate and protein synthesis. The hormones also have many other effects including those on development. The thyroid hormones triiodothyronine (T3) and thyroxine (T4) are created from iodine and tyrosine. The thyroid also produces the hormonecalcitonin, which plays a role in calcium homeostasis. Hormonal output from the thyroid is regulated by thyroid-stimulating hormone (TSH) secreted from the anterior pituitary gland, which itself is regulated by thyrotropin-releasing hormone (TRH) produced by the hypothalamus. The thyroid may be affected by several diseases. Hyperthyroidism occurs when the gland produces excessive amounts of thyroid hormones, the most common cause being Graves' disease an autoimmune disorder. In contrast, hypothyroidism is a state of insufficient thyroid hormone production. Worldwide, the most common cause is iodine deficiency. Thyroid hormones are important for development, and hypothyroidism secondary to iodine deficiency remains the leading cause of preventable intellectual disability. In iodine-sufficient regions, the most common cause of hypothyroidism is Hashimoto's thyroiditisalso an autoimmune disease. In addition, the thyroid gland may also develop several types of nodules and cancer.(Guyton & Hall 2011,*et al*)



Human thyroid (2-1)

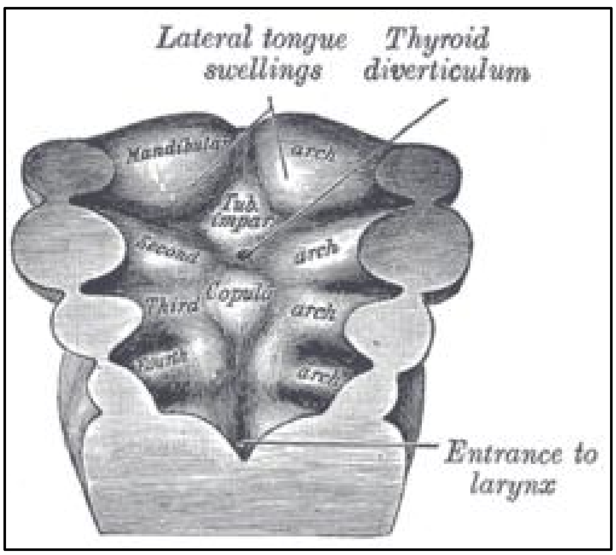
The thyroid gland surrounds the cricoid and tracheal cartilages, and consists of two lobes. This image shows a variant thyroid with a pyramidal lobe emerging from the middle of the thyroid.

(Matthew Hoffman, MD. 2009 webMD LLC).

2-1-2Etiology:

In the development of the embryo, at 3–4 weeks gestational age, the thyroid gland appears as an epithelial proliferation in the floor of the pharynx at the base of the tongue between the tuberculumimpar and the copula linguae. The copula soon becomes covered over by the hypopharyngeal eminence at a point later indicated by the foramen cecum. The thyroid then descends in front of the pharyngeal gut as a bilobeddiverticulum through the thyroglossal duct. Over the next few weeks, it migrates to the base of the neck, passing in front of the hyoid bone. During migration, the thyroid remains connected to the tongue by a narrow canal, the thyroglossal duct. At the end of the fifth week the thyroglossal duct degenerates and the detached thyroid continues on to its final position over the following two weeks.Thefetalhypothalamus and pituitary start to secrete thyrotropin-releasing hormone (TRH) and thyroid-stimulating hormone

(TSH). TSH is first measurable at 11 weeks. By 18–20 weeks, the production of thyroxine (T_4) reaches a clinically significant and self-sufficient level. Fetal triiodothyronine (T_3) remains low, less than 15 ng/dL until 30 weeks, and increases to 50 ng/dL at full-term The fetus needs to be self-sufficient in thyroid hormones in order to guard against neurodevelopmental disorders that would arise from maternal hypothyroidism. The presence of sufficient iodine is essential for healthy neurodevelopment.Theneuroendocrineparafollicular cells, also known as C cells, responsible for the production of calcitonin, are derived from neural crest cells, which migrate to the pharyngeal arches. This part of the thyroid then first forms as the ultimopharyngeal body, which begins in the ventral fourth pharyngeal pouch and joins the primordial thyroid gland during its descent to its final location.Aberrations in prenatal development can result in various forms of thyroid dysgenesis which can cause congenital hypothyroidism, and if untreated this can lead to cretinism.*(Larsen, William J.,et al(2001).)*

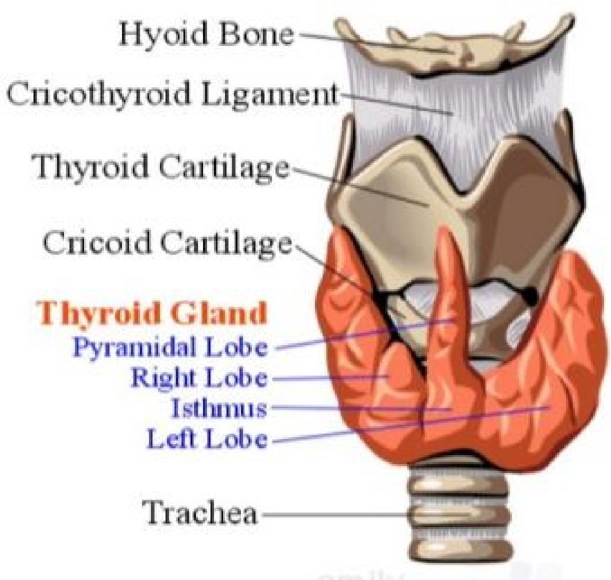


Development (2-2)

Larsen, William J. (2001). Human embryology (3. ed.). Philadelphia, Pa.: Churchill Livingstone. pp. 372–374. ISBN 0-443-06583-7.

2-1-3Location:

- Anteriorly: Pretracheal fascia, sternohyoid muscle and the superior belly of omohyoid muscle. Overlapped inferiorly by the anterior border of the sternocleidomastoid muscle.
- Medially: Recurrent laryngeal nerve, trachea, larynx and oesophagus. The superior pole of the gland contacts the inferior pharyngeal constrictor and superior part of cricothyroid. The external laryngeal nerve runs medial to the superior pole to supply the cricothyroidmuscle.Posteriorly: Prevertebral fascia, carotid sheath, parathyroid glands and trachea. (Richard S. Snell,2004)



Thyroid gland surrounds (2-3)

Larsen, William J. (2001). Human embryology (3. ed.). Philadelphia, Pa.: Churchill Livingstone. pp. 372–374. ISBN 0-443-06583-7.

2-1-4Structure:

The thyroid gland surrounds the cricoid and tracheal cartilages, and consists of two lobes. This image shows a variant thyroid with a pyramidal lobe emerging from the middle of the thyroid.The thyroid gland is a butterfly-shaped organ that sits at the front of the neck. It is composed of two lobes, left and right, connected by a narrow isthmus. The thyroid weighs 25 grams in adults, with each lobe being about 5 cm long, 3 cm wide and 2 cm thick, and the isthmus about 1.25 cm in height and width. The gland is usually larger in women, and increases in size in pregnancy. The thyroid sits near the front of the neck, lying against and around the front of the larynx and trachea. The thyroid cartilage and cricoid cartilage lie just above the gland, below the Adam's apple. The isthmus extends from the second to third rings of the trachea, with the uppermost part of the lobes extending to the thyroid cartilage, and the lowermost around the fourth to sixth tracheal rings. The thyroid gland is covered by a thin fibrous capsule, which has an inner and an outer layer. The outer layer is continuous with the pretracheal fascia, attaching the gland to the cricoid and thyroid cartilages, via a thickening of the fascia to form the posterior suspensory ligament of thyroid gland also known as Berry's ligament. This causes the thyroid to move up and down with swallowing. The inner layer extrudes into the gland and forms the septae that divides the thyroid tissue into microscopic lobules. Typically four parathyroid glands, two on each side, lie on each side between the two layers of the capsule, at the back of the thyroid lobes. The infrahyoid muscles lie in front of the gland and the sternocleidomastoid muscle to the side. Behind the outer wings of the thyroid lie the two carotid arteries. The trachea, laryngx, lower pharynx and esophagus all lie behind the thyroid. In this region, the recurrent laryngeal nerve and the inferior thyroid artery pass next to or in the ligament. (Elsevier's 2007,.*et al*)

2-1-5Blood vesselsof the thyroid:

The thyroid is supplied with arterial blood from the superior thyroid artery, a branch of the external carotid artery, and the inferior thyroid artery, a branch of the thyrocervical trunk, and sometimes by an anatomical variant the thyroid ima artery, which has a variable origin. The superior thyroid artery splits into anterior and posterior branches supplying the thyroid, and the inferior thyroid artery splits into superior and inferior branches. The superior and inferior thyroid arteries join together behind the outer part of the thyroid lobes. The venous blood is drained via superior and middle thyroid veins, which drain to the internal jugular vein, and via the inferior thyroid veins. The inferior thyroid veins originate in a network of veins and drain into the left and right brachiocephalic veins. Both arteries and veins form a plexus between the two layers of the capsule of the thyroid gland. Lymphatic drainage frequently passes the prelaryngeal lymph nodes (located just above the isthmus), and the pretracheal and paratracheal lymph nodes. The gland receives sympathetic nerve supply from the superior, middle and inferior cervical ganglion of the sympathetic trunk. The gland receives parasympathetic nerve supply from the superior laryngeal nerve and the recurrent laryngeal nerve. (Elsevier's 2007,*et al*)

2-1-6 Isthmus:

Connects the lower parts of the two lobes. It measures about 1.25 transversely and the same vertically and usually extend interiorly to the second and third rings of the trachea through it is often placed at a higher or occasionally lower level. Its situation and size present however many variations. It is separated by sternohyoid. The anterior runs along its upper border. At its lower border the inferior thyroid and anterior jugular veins. The fascia and the skin.An anastomic branch uniting the two superior thyroid ateriesruns along its upper border. At its lower border the inferior thyroid veins leave the gland occasionally the isthmus is absent.

A fibrous or fibro – muscular band sometimes descends from the body of the hyoid bone to the Isthmus of the glands. Restages of the thyroglossalduct may persist between the Isthmus and the foramen caecum of the tongue and may give rise to accessory nodules or cysts of thyroid tissue.(Las's, 2007).

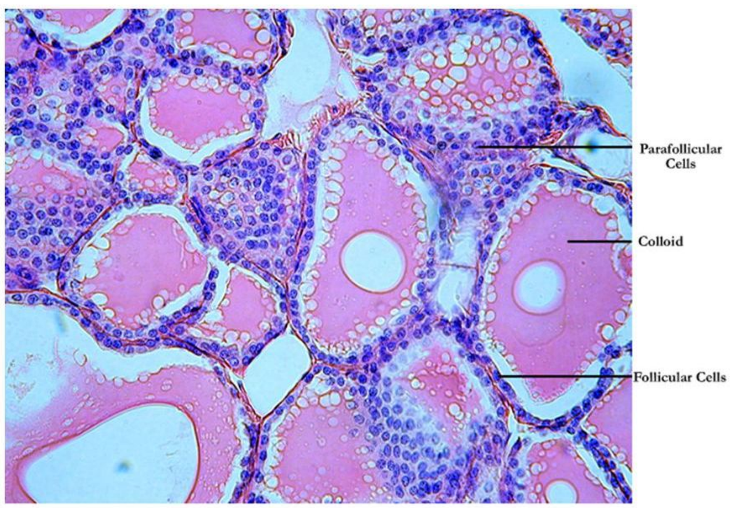
2-1-7Variation:

There are many variants in the size and shape of the thyroid gland, and in the position of the embedded parathyroid glands. Sometimes there is a third lobe present called the *pyramidal lobe*. When present, this lobe often stretches up the hyoid bone from the thyroid isthmus and may be one to several divided lobes. The presence of this lobe ranges in reported studies from 18.3% to 44.6%. It was shown to more often arise from the left side and occasionally separated. The pyramidal lobe is also known as Lalouette's pyramid. The pyramidal lobe is a remnant of the thyroglossal duct which usually wastes away during the thyroid gland's descent. Small accessory thyroid glands may in fact occur anywhere along the thyroglossal duct, from the foramen cecum of the tongue to the position of the thyroid in the adult. A small horn at the back of the thyroid lobes, usually close to the recurrent laryngeal nerve and the inferior thyroid artery, is called Zuckerkandl's tubercle.

Other variants include a levator muscle of thyroid gland, connecting the isthmus to the body of the hyoid bone, and the presence of the small thyroid ima artery.(*Buyukmumcu, M; et al (2007).*)

2-1-8Microanatomy:

Section of a thyroid gland under the microscope. 1 follicles, 2 follicular cells, 3 endothelial cells. At the microscopic level, there are three primary features of the thyroid—follicles, follicular cells, and parafollicular cells, first discovered by GeofferyWebsterson in 1664. (Fawcett, et al, 2002)



Microanatomy (2-4)
Section of a thyroid gland under the microscope

2-1-9Follicles:

Thyroid follicles are small spherical groupings of cells 0.02–0.9mm in diameter that play the main role in thyroid function. They consist of a rim that has a rich blood supply, nerve and lymphatic presence, that surrounds a core of colloid that consists mostly of thyroid hormone precursor proteins called thyroglobulin, an iodinatedglycoprotein.(Young Barbara; et al; 2006)

2-1-10Follicular cells:

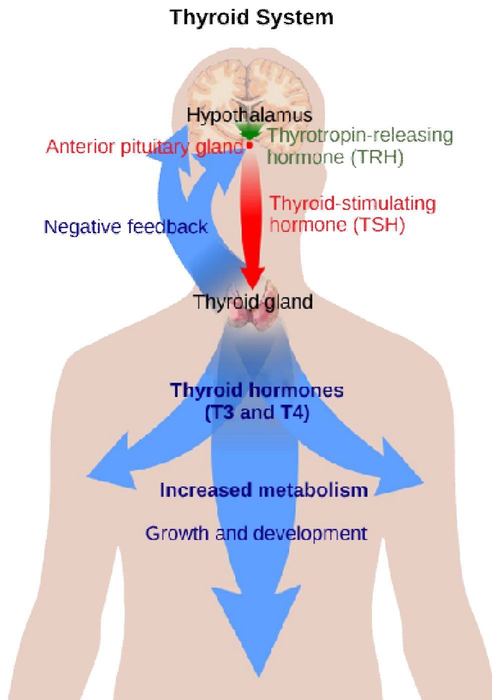
The core of a follicle is surrounded by a single layer of follicular cells. When stimulated by thyroid stimulating hormone (TSH), these secrete the thyroid hormones T3 and T4. They do this by transporting and metabolising the thyroglobulin contained in the colloid. Follicular cells vary in shape from flat to cuboid to columnar, depending on how active they are.(Gray's Anatomy; 2008)

2-1-11Parafollicular cells:

Scattered among follicular cells and in spaces between the spherical follicles are another type of thyroid cell, parafollicular cells. These cells secrete calcitonin and so are also called C cells.(Hazzard.JB; 1977).

2-2 Function:

The thyroid hormonesT_3 and T_4 have a number of metabolic, cardiovascular and developmental effects on the body. The production is stimulated by release of thyroid stimulating hormone (TSH), which in turn depends on release of thyrotropin releasing hormone (TRH). Every downstream hormone has negative feedback and decreases the level of the hormone that stimulates its release.



Function (2-5)

2-2-1Thyroid hormones:

The primary function of the thyroid is the production of the iodine-containing thyroid hormones, triiodothyronine (T_3) and thyroxine (T_4) and the peptide hormonecalcitonin. T_3 is so named because it contains three atoms of iodine per molecule and T_4 contains four atoms of iodine per molecule. The thyroid hormones have a wide range of effects on the human body. These include:

2-2-2Metabolic. The thyroid hormones increase the basal metabolic rate and have effects on almost all body tissues. Appetite, the absorption of substances, and gut motility are all influenced by thyroid hormones. They increase the absorption in the gut, generation, uptake by cells, and breakdown of glucose. They stimulate the breakdown of fats, and increase the number of free fatty acids. Despite increasing free fatty acids, thyroid hormones decrease cholesterol levels, perhaps by increasing the rate of secretion of cholesterol in bile.The hormones increase the rate and strength of the heartbeat. They increase the rate of breathing, intake and consumption of oxygen, and increase the activity of mitochondria. Combined, these factors increase blood flow and the body's temperature. Thyroid hormones are important for normal development. They increase the growth rate of young people, and cells of the developing brain are a major target for the thyroid hormones T_3 and T_4. Thyroid hormones play a particularly crucial role in brain maturation during fetal development.The thyroid hormones also play a role in maintaining normal sexual function, sleep, and thought patterns. Increased levels are associated with increased speed of thought generation but decreased focus. Sexual function, including libido and the maintenance of a normal menstrual cycle, are influenced by thyroid hormones.After secretion, only a very small proportion of the thyroid hormones travel freely in the blood. Most are bound to thyroxine-binding globulin (about 70%), transthyretin (10%), and albumin (15%). Only the 0.03% of T_4 and 0.3% of T_3 traveling freely has hormonal activity. In addition, up to 85% of the T_3 in blood is produced following conversion from T_4 by iodothyroninedeiodinases in organs around the body.Thyroid hormones act by crossing the cell membrane and binding to intracellularnuclearthyroid hormone receptorsTR-α1,TR-α2,TR-β1 and TR-β2, which bind with hormone response elements and transcription factors to modulate DNA transcription.[30][31] In addition to these actions on DNA, the thyroid hormones also act within the cell membrane or within cytoplasm via reactions with enzymes, including calcium ATPase, adenylyl cyclase, and glucose transporters.(Davidson's; et al 2010)

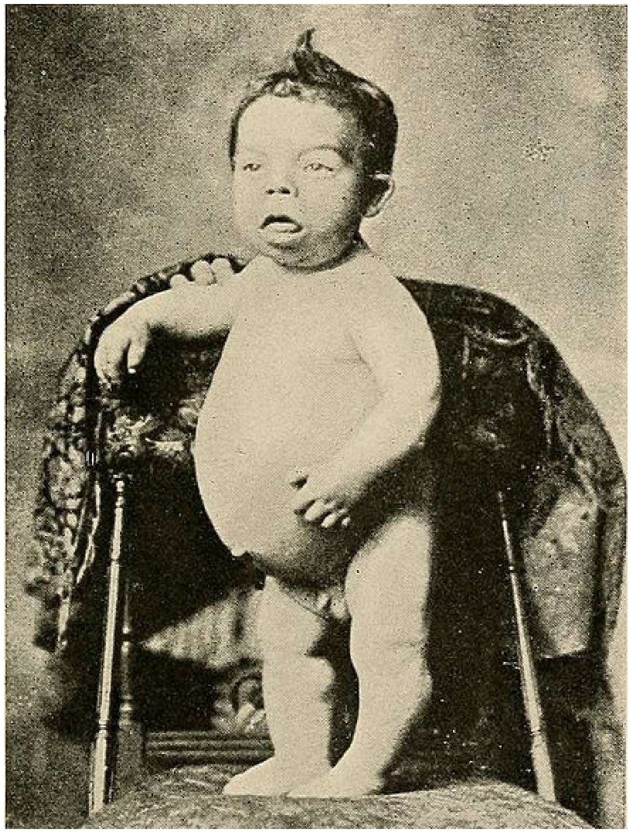
2-2-3Regulation:

The production of thyroxine and triiodothyronine is primarily regulated by thyroid-stimulating hormone (TSH), released by the anterior pituitary gland. TSH release in turn is stimulated by thyrotropin releasing hormone (TRH), released in a pulsatile manner from the hypothalamus. The thyroid hormones provide negative feedback to the thyrotropes TSH and TRH: when the thyroid hormones are high, TSH production is suppressed. This negative feedback also occurs when levels of TSH are high, causing TRH production to be suppressed.(Greenspan's 2011.)

TRH is secreted at an increased rate in situations such as cold exposure in order to stimulate thermogenesis. In addition to being suppressed by the presence of thyroid hormones, TSH production is blunted by dopamine, somatostatin, and glucocorticoids.(Harrison's 2011)

2-2-4 Calcitonin:

The thyroid gland also produces the hormone calcitonin, which helps regulate blood calcium levels. Parafollicular cells produce calcitonin in response to high blood calcium. Calcitonin decreases the release of calcium from bone, by decreasing the activity of osteoclasts, cells which break bone down. Bone is constantly reabsorbed by osteoclasts and created by osteoblasts, so calcitonin effectively stimulates movement of calcium into bone. The effects of calcitonin are opposite those of the parathyroid hormone, produced in the parathyroid glands. However, calcitonin seems far less essential than PTH, as calcium metabolism remains clinically normal after removal of the thyroid (thyroidectomy), but not the parathyroid glands.(Guyton & Hall 2011.)



Child affected by cretinism (2-6)

Child affected by cretinism, associated with a lack of iodine

2-3 Pathology:

2-3-1 Hyperthyroidism:

Excessive production of the thyroid hormones is called hyperthyroidism, which is most commonly a result of Graves' disease, a toxic multinodulargoitre, a solitary thyroid adenoma, or inflammation. Other causes include drug-induced excess of iodine, particularly from amiodarone, an antiarrhythmic medication; an excess caused by the preferential uptake of iodine by the thyroid following iodinated contrastimaging; or from pituitary adenomas which may cause an overproduction of thyroid stimulating hormone. Hyperthyroidism often causes a variety of non-specific symptoms including weight loss, increased appetite, insomnia, decreased tolerance of heat, tremor, palpitations, anxiety and nervousness. In some cases it can cause chest pain, diarrhoea, hair loss and muscle weakness. Such symptoms may be managed temporarily with drugs such as beta blockers.Long-term management of hyperthyroidism may include drugs that suppress thyroid function such as propylthiouracil, carbimazole and methimazole. Radioactiveiodine-131 can be used to destroy thyroid tissue. Radioactive iodine is selectively taken up by the thyroid, which over time destroys the cells involved in its uptake. The chosen first-line treatment will depend on the individual and on the country where being treated. Surgery to remove the thyroid can sometimes be performed as a transoral thyroidectomy, a minimally-invasive procedure. Surgery does however carry a risk of damage to the parathyroid glands and the nerves controlling the vocal cords. If the entire thyroid gland is removed, hypothyroidism will naturally result, and thyroid hormone substitutes will be needed. (Davidson's 2010,.et al).

2-3-2 Hypothyroidism:

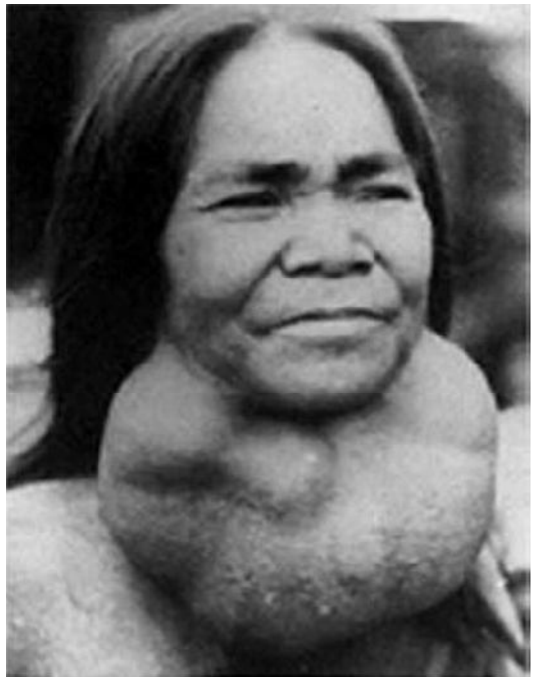
An underactive thyroid gland results in hypothyroidism. Typical symptoms are abnormal weight gain, tiredness, constipation, heavy menstrual bleeding, hair loss, cold intolerance, and a slow heart rate. Iodine deficiency is the most common cause of hypothyroidism worldwide, and the autoimmune disease Hashimoto's thyroiditis is the most common cause in the developed world. Other causes include congenital abnormalities, diseases causing transient inflammation, surgical removal or radioablation of the thyroid, the drugs amiodarone and lithium, amyloidosis, and sarcoidosis. Some forms of hypothyroidism can result in myxedema and severe cases can result in myxedema coma.Hypothyroidism is managed with replacement of the hormone thyroxine. This is usually given daily as an oral supplement, and may take a few weeks to become effective. Some causes of hypothyroidism, such as Postpartum thyroiditis and Subacute thyroiditis may be transient and pass over time, and other causes such as iodine deficiency may be able to be rectified with dietary supplementation.(Davidson's 2010, et al).

2-3-3 Nodules:

Thyroid nodules are often found on the gland, with a prevalence of 4–7%. The majority of nodules do not cause any symptoms and are non-cancerous. Non-cancerous cases include simple cysts, colloid nodules, and thyroid adenomas. Malignant nodules, which only occur in about 5% of nodules, include follicular, papillary, medullary carcinomas and metastases from other sites Nodules are more likely in females, those who are exposed to radiation, and in those who are iodine deficient.When a nodule is present, thyroid function tests are performed and reveal whether a person has a normal amount of thyroid hormones ("euthyroid") or an excess of hormones, usually secreted by the nodule, causing hyperthyroidism. When the thyroid function tests are normal, an ultrasound is often used to investigate the nodule, and provide information such as whether the nodule is fluid-filled or a solid mass, and whether the appearance is suggestive of a benign or malignant cancer. A needle aspiration biopsy may then be performed, and the sample undergoes cytology, in which the appearance of cells is viewed to determine whether they resemble normal or cancerous cells.There can be many nodules, which is termed a multinodulargoitre, and this can sometimes be a toxic multinodulargoitre. (*Dean, et al; 2008*)

2-3-4 Swelling:

An enlarged thyroid gland is called a goitre. Goitres are present in some form in about 5% of people, and are the result of a large number of causes, including iodine deficiency, autoimmune disease (both Grave's disease and Hashimoto's thyroiditis), infection, inflammation, and infltrative disease such as sarcoidosis and amyloidosis. Sometimes no cause can be found, a state called "simple goitre".Some forms of goitre are associated with pain, whereas many do not cause any symptoms. Enlarged goitres may extend beyond the normal position of the thyroid gland to below the sternum, around the airway or esophagus. Goitres may be associated with hyperthyoidism or hypothyroidism, relating to the underlying cause of the goitre. Thyroid function tests may be done to investigate the cause and effects of the goitre. The underlying cause of the goitre may be treated, however many goitres with no associated symptoms are simply monitored.(Davidson's 2010,.et al)



Figure(2-7)

. Large goiters are prevalent in areas of iodine deficiency. Many decades later, large goiters still occur in many parts of the world, as demonstrated in this woman from a mountainous region of Vietnam, 1970.

Figure. Large goiters are prevalent in areas of iodine deficiency. A woman from Switzerland operated uponby Dr. Theodor Kocher (From Kocher (3)).

2-3-5Other pathology:

Disorders of the thyroid are functional–caused by dysfunction in the production of hormones, and nodes and tumors either benign or malignant. Functional disorders can cause inflammation as can some other forms of thyroiditis. Functional disorders can result in the overproduction or underproduction of hormones. Any of the functional thyroid disorders can result in the gland's enlargement and cause a swollen neck termed a goitre.

2-3-6Inflammation:

Inflammation of the thyroid is called thyroiditis. Inflammed thyroids may cause symptoms of hyperthyroidism or hypothyroidism. Two types thyroiditis initially present with hyperthyroidism and are sometimes followed by a period of hypothyroidism – Hashimoto's thyroiditis and postpartum thyroiditis. There are other disorders that cause inflammation of the thyroid, and these include subacute thyroiditis, acute thyroiditis, silent thyroiditis, Riedel's thyroiditis and traumatic injury, including palpation thyroiditis.

Hashimoto's thyroiditis is an autoimmune disorder in which the thyroid gland is infltrated by the lymphocytesB-cell and T-cells. These progressively destroy the thyroid gland. In this way, Hasimoto's thyroiditis may have occurred insidiously, and only be noticed when thyroid hormone production decreases, causing symptoms of hypothyroidism. Hashimoto's is more common in females than males, much more common after the age of 60, and has known genetic risk factors. Also more common in individuals with Hashimoto's thyroiditis are type 1 diabetes, pernicious anaemia, Addison's diseasevitiligo.Postpartum thyroiditis occurs in some females following childbirth. After delivery, the gland becomes inflamed and the condition initially presents with a period of hyperthyroidism followed by hypothyroidism and, usually, a return to normal function. The course of the illness takes place over several months, and is characterised by a painless goitre. Antibodies against thyroid peroxidase can be found on testing. The inflammation usually resolves without treatment, although thyroid hormone replacement may be needed during the period of hypothyroidism.(Harrison's 2011)

2-3-7Cancer:

The most common neoplasm affecting the thyroid gland is a benign adenoma, usually presenting as a painless mass in the neck. Malignant thyroid cancers are most often carcinomas, although cancer can occur in any tissue that the thyroid consists of, including cancer of C-cells and lymphomas. Cancers from other sites also rarely lodge in the thyroid. Radiation of the head and neck presents a risk factor for thyroid cancer, and cancer is more common in women than men, occurring at a rate of about 2:1.In most cases, thyroid cancer presents as a painless mass in the neck. It is very unusual for thyroid cancers to present with other symptoms, although in some cases cancer may cause hyperthyroidism. Most malignant thyroid cancers are papillary, followed by follicular, medullary, and thyroid lymphoma. Because of the prominence of the thyroid gland, cancer is often detected earlier in the course of disease as the cause of a nodule, which may undergo fine needle aspiration. Thyroid function tests will help reveal whether the nodule produces excess thyroid hormones. A radioactive iodine uptake test can help reveal the activity and location of the cancer and metastases.Thyroid cancers are treated by removing the whole or part of thyroid gland. Radioactive Iodine 131 may be given to radioablate the thyroid. Thyroxine is given to replace the hormones lost and to suppress TSH production, as TSH may stimulate recurrence. With the exception of the rare anaplastic thyroid cancer, which carries a very poor prognosis, most thyroid cancers carry an excellent prognosis and can even be considered curable.(Harrison's 2011,)

2-3-8Congenital:

A persistent thyroglossal duct is the most common clinically significant congenital disorder of the thyroid gland. A persistent sinus tract may remain as a vestigial remnant of the tubular development of the thyroid gland. Parts of this tube may be obliterated, leaving small segments to form thyroglossal cysts. Preterm neonates are at risk of hypothyroidism as their thyroid glands are insufficiently developed to meet their postnatal needs. In order to detect hypothyroidism in newborn babies, to prevent growth and development abnormalities in later life, many countries have newborn screening programs at birth.Infants with thyroid hormone deficiency (congenital hypothyroidism) can manifest problems of physical growth and development as well as brain development, termed cretinism. Children with congenital hypothyroidism are treated supplementally with levothyroxine, which facilitates normal growth and development.Mucinous, clear secretions may collect within these cysts to form either spherical masses or fusiform swellings, rarely larger than 2 to 3 cm in diameter. These are present in the midline of the neck anterior to the trachea. Segments of the duct and cysts that occur high in the neck are lined by stratified squamous epithelium, which is essentially identical to that covering the posterior portion of the tongue in the region of the foramen cecum. The disorders that occur in the lower neck more proximal to the thyroid gland are lined by epithelium resembling the thyroidal acinar epithelium. Characteristically, next to the lining epithelium, there is an intense lymphocytic infiltrate. Superimposed infection may convert these lesions into abscess cavities, and rarely, give rise to cancers.Another disorder is that of thyroid dysgenesis which can result in various presentations of one or more misplaced accessory thyroid glands. These can be asymptomatic.*(Rose, et al; 2006)*

2-3-9Iodine:

Iodine deficiency, most common in inland and mountainous areas, can predispose to goitre – if widespread, known as endemic goitre. Pregnant women deficient of iodine can give birth to infants with thyroid hormone deficiency. The use of iodised salt used to add iodine to the diet has eliminated endemic cretinism in most developed countries, and over 120 countries have made the iodination of saltmandatory.Because the thyroid concentrates iodine, it also concentrates the various radioactive isotopes of iodine produced by nuclear fission. In the event of large accidental releases of such material into the environment, the uptake of radioactive iodine isotopes by the thyroid can, in theory, be blocked by saturating the uptake mechanism with a large surplus of non-radioactive iodine, taken in the form of potassium iodide tablets. One consequence of the Chernobyl disaster was an increase in thyroid cancers in children in the years following the accident.As with most substances, either too much or too little can cause problems. Recent studies on some populations are showing that excess iodine intake could cause an increased prevalence of autoimmune thyroid disease, resulting in permanent hypothyroidism. (*Harris,.et al; 2015)*

2-3-10Graves' disease:

Graves' disease is an autoimmune disorder that is the most common cause of hyperthyroidism. In Graves' disease, for an unknown reason autoantibodies develop against the thyroid stimulating hormone receptor. These antibodies activate the receptor, leading to development of a goitre and symptoms of hyperthyroidism, such as heat intolerance, weight loss, diarrhoea and palpitations. Occasionally such antibodies block but do not activate the receptor, leading to symptoms associated with hypothyroidism. In addition, gradual protrusion of the eyes may occur, called Graves' ophthalmopathy, as may swelling of the front of the shins. Graves' disease can be diagnosed by the presence of pathomnomonic features such as involvement of the eyes and shins, or isolation of autoantibodies, or by results of a radiolabelled uptake scan. Graves' disease is treated with anti-thyroid drugs such as propylthiouracil, which decrease the production of thyroid hormones, but hold a high rate of relapse. If there is no involvement of the eyes, then use of radioactive isotopes to ablate the gland may be considered. Surgical removal of the gland with subsequent thyroid hormone replacement may be considered, however this will not control symptoms associated with the eye or skin. (*Smith; et al; 2016*)

2-4Lab investigation

A number of tests that can be used to test the function of the thyroid, for the presence of diseases, and for the success or failure of treatment. Blood tests in general aim to measure thyroid function or determine the cause of thyroid dysfunction. Thyroid function tests include a battery of blood tests including the measurement of the thyroid hormones T3 and T4, as well as the measurement of TSH. They may reveal hyperthyroidism (high T3 and T4), hypothyroidism (low T3, T4), or subclinical hyperthyroidism (normal T3 and T4 with a low TSH).TSH levels are considered the most sensitive marker of thyroid dysfunction. They are however not always accurate, particularly if the cause of hypothyroidism is thought to be related to insufficient TRH secretion, in which case it may be low or falsely normal. In such a case a TRH stimulation test, in which TRH is given and TSH levels are measured at 30 and 60-minutes after, may be conducted.T3 and T4 can be measured directly. However, as the two thyroid hormones travel bound to other molecules, and it is the "free" component that is biologically active, free T3 and free T4 levels can be measured. T4 is preferred, because in hypothyroidism T3 levels may be normal. The ratio of bound to unbound thyroid hormones is known as the thyroid hormone binding ratio (THBR). It is also possible to measure directly the main carriers of the thyroid hormones, thryoglobulin and throxine-binding globulin. Thyroglobulin will also be measurable in a healthy thyroid, and will increase with inflammation, and may also be used to measure the success of thyroid removal or ablation. If successful, thyroglobulin should be undetectable. Lastly, antibodies against components of the thyroid, particularly anti-TPO and anti-thyroglobulin, can be measured. These may be present in normal individuals but are highly sensitive for autoimmune-related disease.(Harrison’s; 2011)

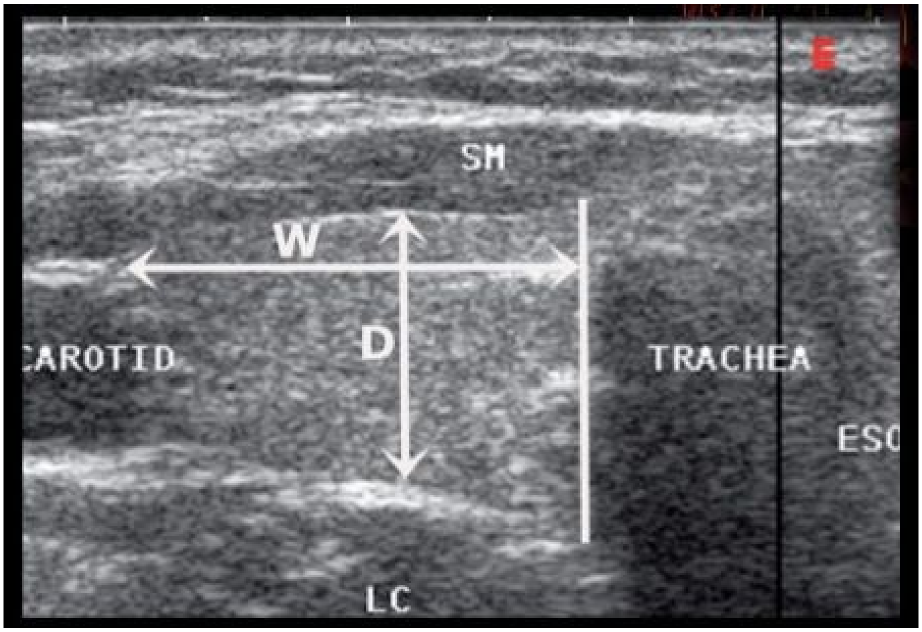
2-4-1 Ultra Sound Test:

Ultrasound of the thyroid may be used to reveal whether structures are solid or filled with fluid, helping to differentiate between nodules and goitres and cysts. It may also help differentiate between malignant and benign lesions. A fine needle aspiration biopsy may be taken concurrently of thyroid tissue to determine the nature of a lesion. These biopsies are then sent for histopathology and cytology. When further imaging is required, a radiolabelled iodine-123 or technetium-99 uptake scan may take place. This can the size and shape of lesions, reveal whether nodules or goitres are metabolically active, and reveal and monitor sites of thyroid disease or cancer deposits outside the thyroid.(Greenspan's 2011,)

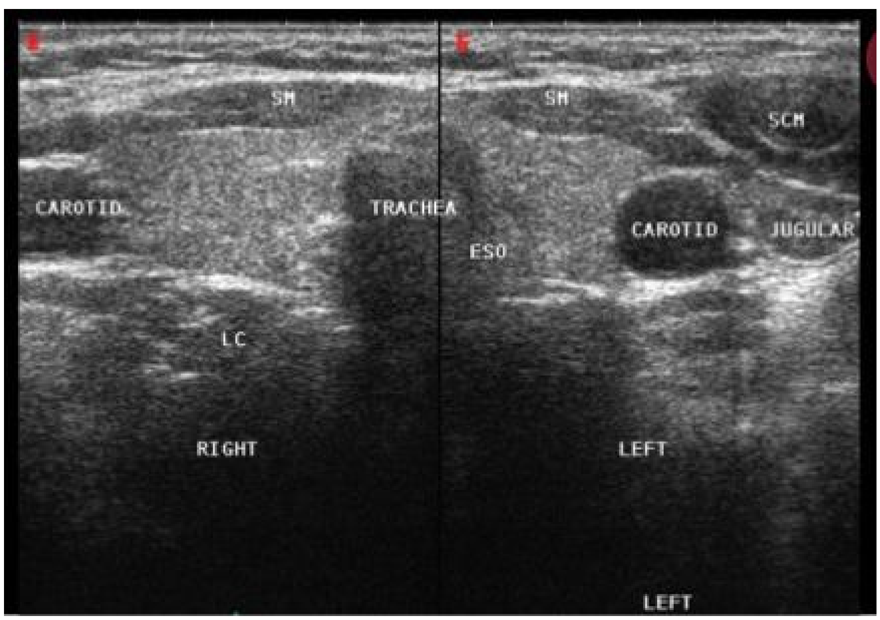
2-4-2 Ultra Sound appearance:

The normal thyroid gland is homogeneous in texture with an echo-pattern is similar to that found within the liver the vascular structure may be seen as tubular anechoic structure within the gland Color Doppler with a low pulse repetition frequency will distinguish the structure as blood filled. The muscles surrounding the gland infrahyoid, sternocleidomastoid, longuscholi are hypoechoic compared with thyroid tissue, the esophagus may be seen to the left of the midline next to the trachea with hyperechoic rim surrounding an echogenic center. (Sandro, L., Hagen; textbook).

Normal Sonography:



The normal thyroid gland is 2cm or less in both the transverse dimension and depth, and is 4.5 – 5.5 cm in length and 0.5 mm ithmus.



Normal appearing in thyroid In transverse view. Thyroid is homogenous and slightly hyperechoic. The lobes are bordered anteriorly by the strap muscles (SM). Posteriorly by the lunguscolli muscles (LC) medially by the trachea, and laterally by the stermocleidomastoid muscle (SCM). Carotid artery and jugular vein. Apportion of the esophagus (ESO) protrudes behind the tracheal shadow against the medial border of the left lobe

2-5 Scanning technique:

The patient is typically examined in the supine position with neck extended. A small pad may be placed under the shoulders to provide better exposure of the neck particularly in patients with a short sticky habitus. The thyroid gland must be examined in transverse and longitudinal planes. Imaging of the lower poles can be enhanced by asking patient to swallow which momentarily raises the thyroid gland in the neck.

2-6 Previous studies:

Supported by the previous studyof Ahmed Ali Elhaj (2012) most of the patients are in the age group between 25 -55yrs , 76 % of patients , 14% less the 25 yrs, 10% more than 55 yrs nearly the same as my result .

The thyroid disease may be affected by geographic areas and these areas defined as endemic area for thyroid disease and this may occur due to presence or deficiency of some diet factors including the iodine in the case of thyroid gland.

The study revealed that the most endemic area of thyroid disease in Sudan is the West (40%) and the less endemic area is Eastern Sudan (3.6 %).

Chapter Three

Chapter Three

Methodology

3-1 type of study:

This is descriptive study deal with patientsrefered for U/S clinics for thyroid examination.

3-2 materials and Methods:

Patients: referred for U/S clinics for thyroid examination Elamal tower in Khartoum

Habiballa medical center in AlkalaklaAlwihda.

Eleiskan medical center Dar Elsalam from April 2015 to February 2017.

3-3 Study Sample:

The sample size consists of 309 cases to Sudanese patient who have U/S and lab investigations results.

3-4 Inclusion Criteria:

Patientsrefered for U/S clinics for thyroid examination using high frequency probe for abnormal thyroid function test.

3-5 Exclusion Criteria:

Normal patientsrefered for U/S clinics whom have normal thyroid U/S.

3-6 Equipment:

Real time ultrasound machine with 7.5 – 10 MHZ.

Data was arranged in master table and analyzed by SPSS to give results in form of table and figures.

3-7 Data Collection:

The data was collected by data sheets specially designed for this study.

3-8 Data analysis:

Data analyzed using SPSS program version 16 and the results were presented in form of graphs and tables.

3-9 Data Storage:

Data was stored on:

- Personal computer.
- Data collection sheet.

3-10 Ethical Consideration:

- No identification or individual details were published.
- No information or patient details will be disclosed or used for other reason than study.

Chapter Four

Results and Analysis

Chapter four
Results and Analysis

(4-1) Results &Analysis:

This study was carried out on 309 patients referred for U/S clinics for thyroid gland examined with the following results

Table (4.1) Frequency distribution of age group

Age group	Frequency	Percent	Valid Percent	Cumulative Percent
9-19 years	11	3.6	3.6	3.6
20-30 years	62	20.1	20.1	23.6
31-40 years	82	26.5	26.5	50.2
41- 50 years	87	28.2	28.2	78.3
51-60 years	46	14.9	14.9	93.2
61-70 years	17	5.5	5.5	98.7
71-80 years	2	.6	.6	99.4
more than 80 years	2	.6	.6	100.0
Total	309	100.0	100.0	
Minimum= 9, maximum=84, mean = 41.5534,std= 13.43725				

0-25	25-55	More than 55
32	235	42
10.3%	76.2%	13.5%

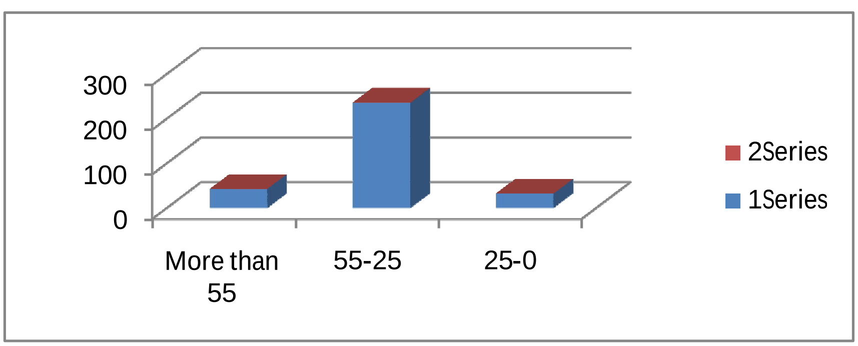


Table (4.2) Frequency distribution of gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	16	5.2	5.2	5.2
Female	293	94.8	94.8	100.0
Total	309	100.0	100.0	

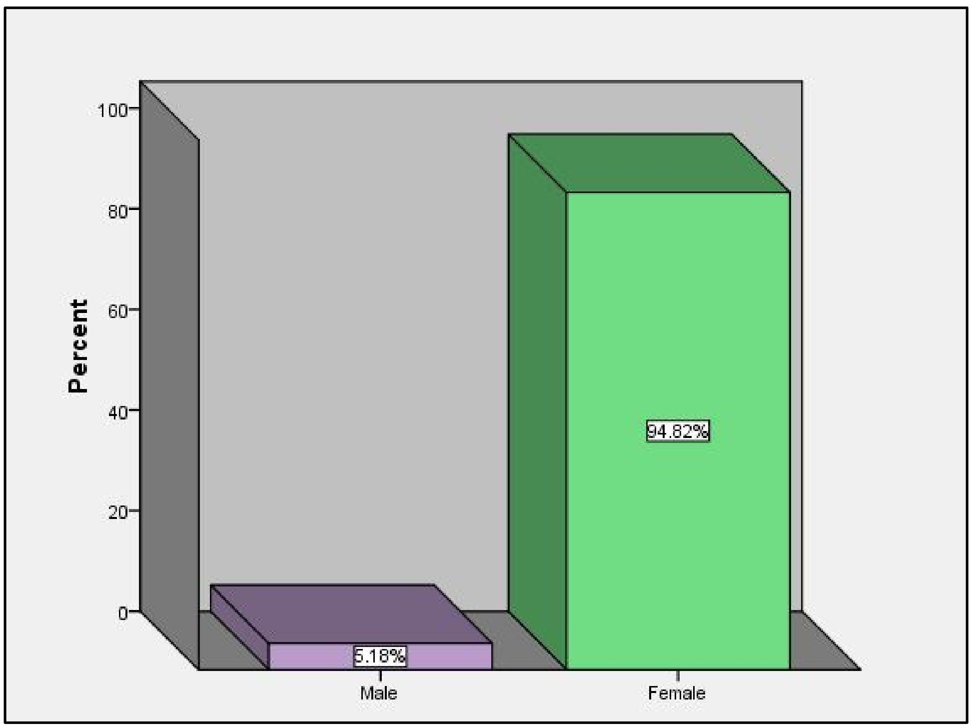


Figure (4.2) Frequency distribution of gender

Table (4.3) (4.4) (4.5) Frequency distribution of values:

	T3	T4	TSH	Percent	Valid Percent
	Frequency				
Decreased	43	58	152	11.0	11.0
Increased	126	86	102	40.8	40.8
Normal	149	165	55	48.2	48.2
Total	309	309	309	100.0	100.0

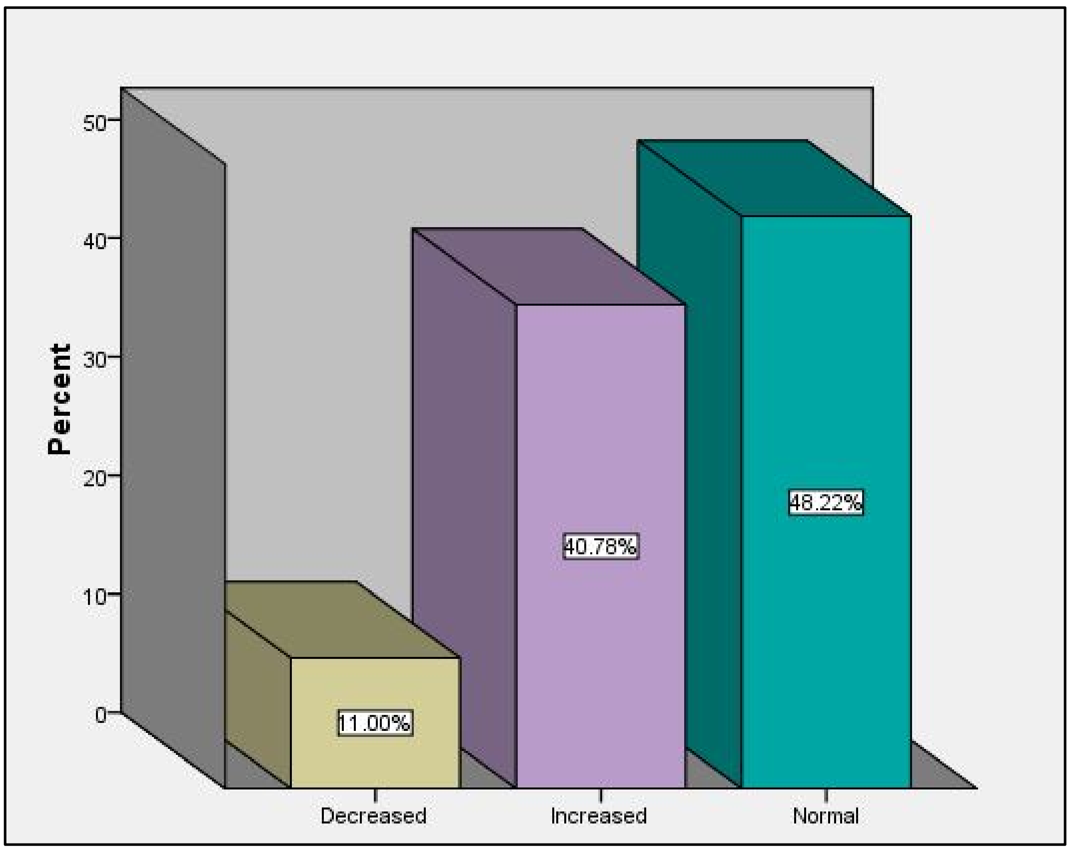


Figure (4.3)Frequency distribution of T3 values

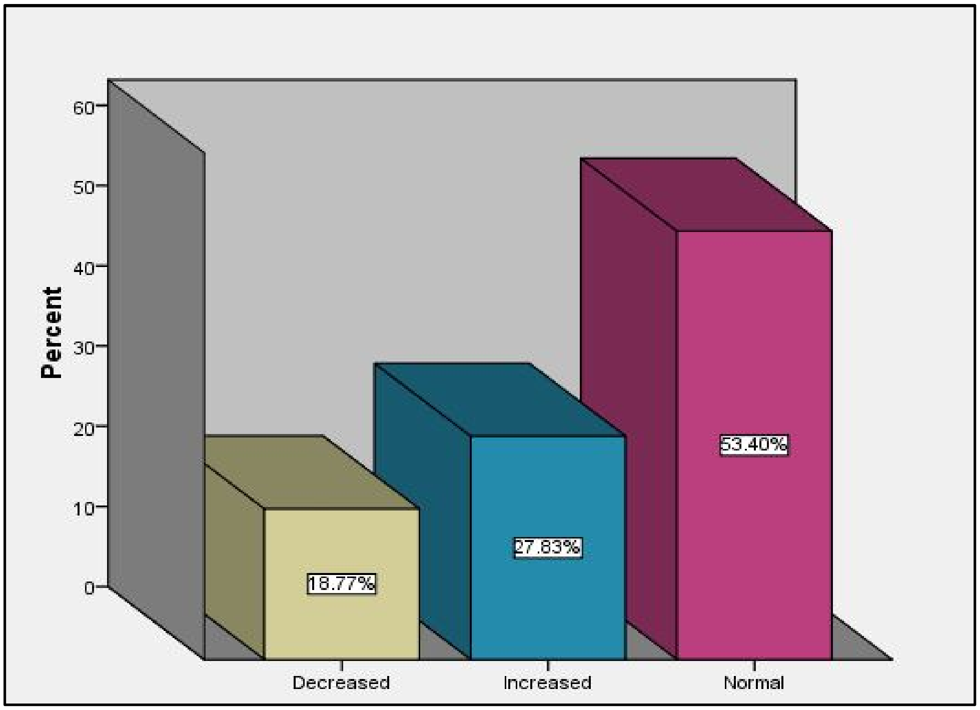


Figure (4.3)Frequency distribution of T4 results

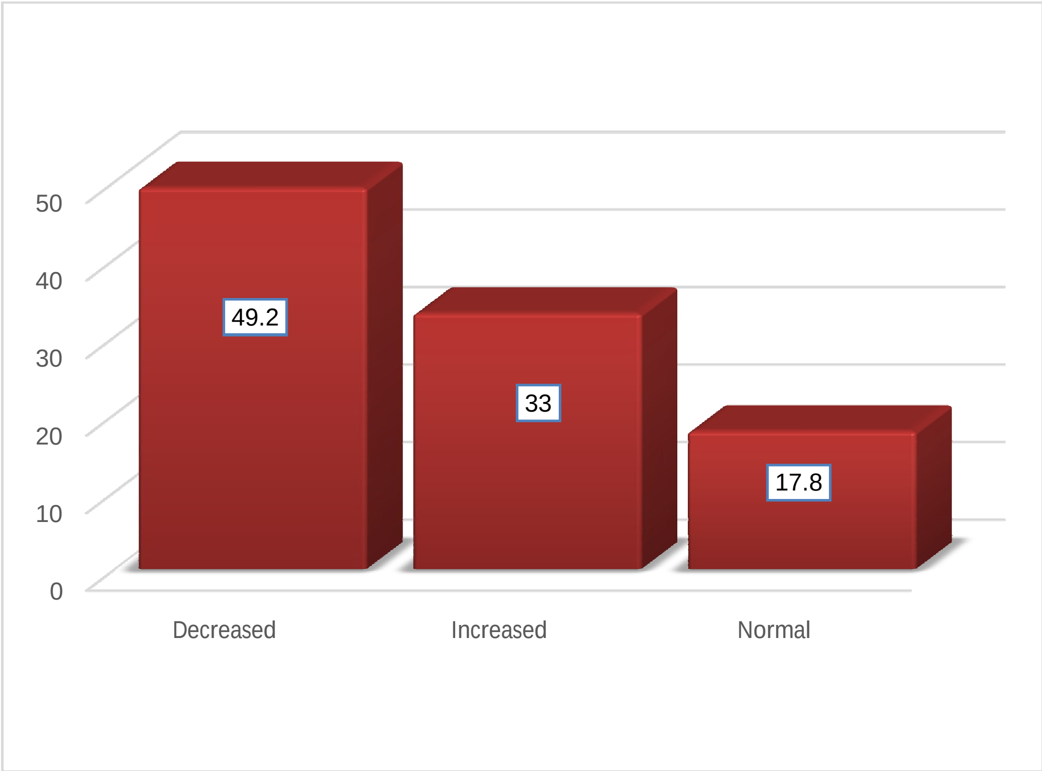


Figure (4.3)Frequency distribution of TSH results

Table (4.6) frequency distribution of presence of residence of the patients.

Residence	Frequency	Percent	Valid Percent
Khartoum	96	31.06	31.06
West of Sudan	125	38.18	38.18
East of Sudan	11	3.6	3.6
White Nile	16	5.2	5.2
Algazera	22	7.1	7.1
Shamalia	26	8.4	8.4
Middle of sudan	12	3.9	3.9
Blue Nile	1	0.3	0.3
Total	309	100	100

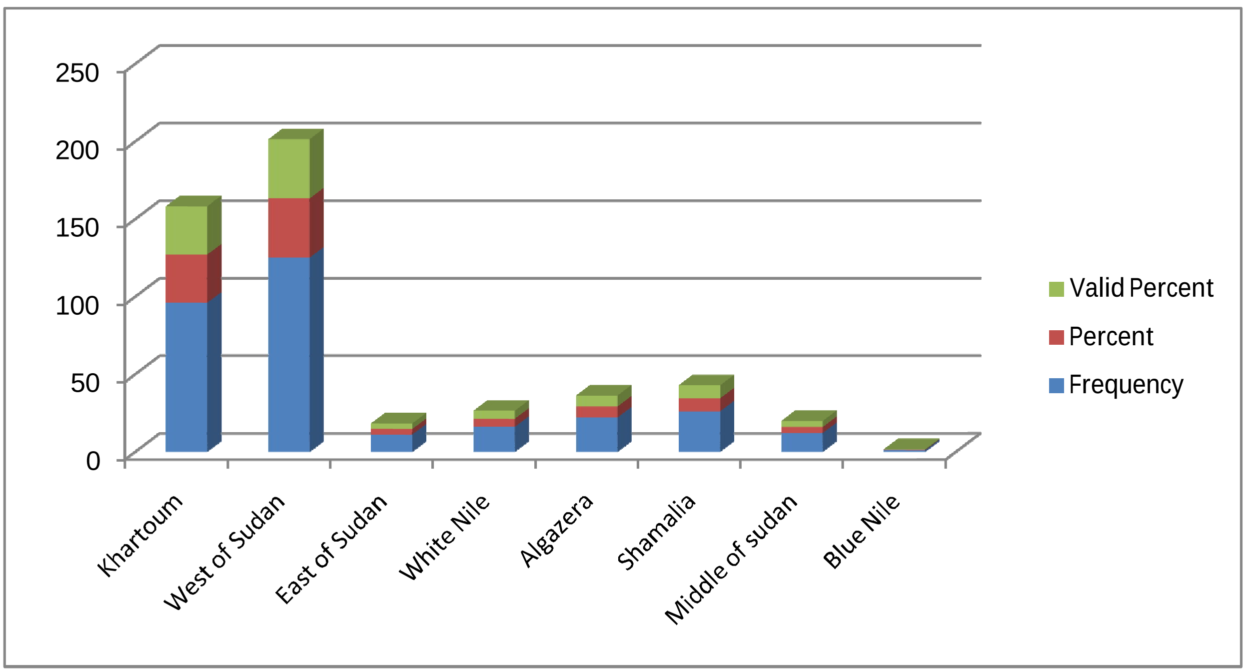


Figure (4.6) Frequency distribution of presence of residence of the patients.

Table (4.7) (4.8) (4.9) T3, T4, TSHcross tab echogenicity

	Complex			Isoechoic			Hyperechoic			Hypoechoic			Total		
	T3	T4	TSH	T3	T4	TSH	T3	T4	TSH	T3	T4	TSH	T3	T4	TSH
Decrease	30	49	139	0	1	1	0	1	0	11	4	12	34	58	152
Increase	110	76	86	1	0	1	0	0	0	15	9	15	126	86	102
Normal	129	144	44	1	0	0	1	0	1	18	20	10	149	165	55
Total	269	269	269	2	1	2	1	1	1	37	37	37	309	309	309

P value =0.969 (T3) , P value = 0.488 (T4) &(TSH) P value = 0.109

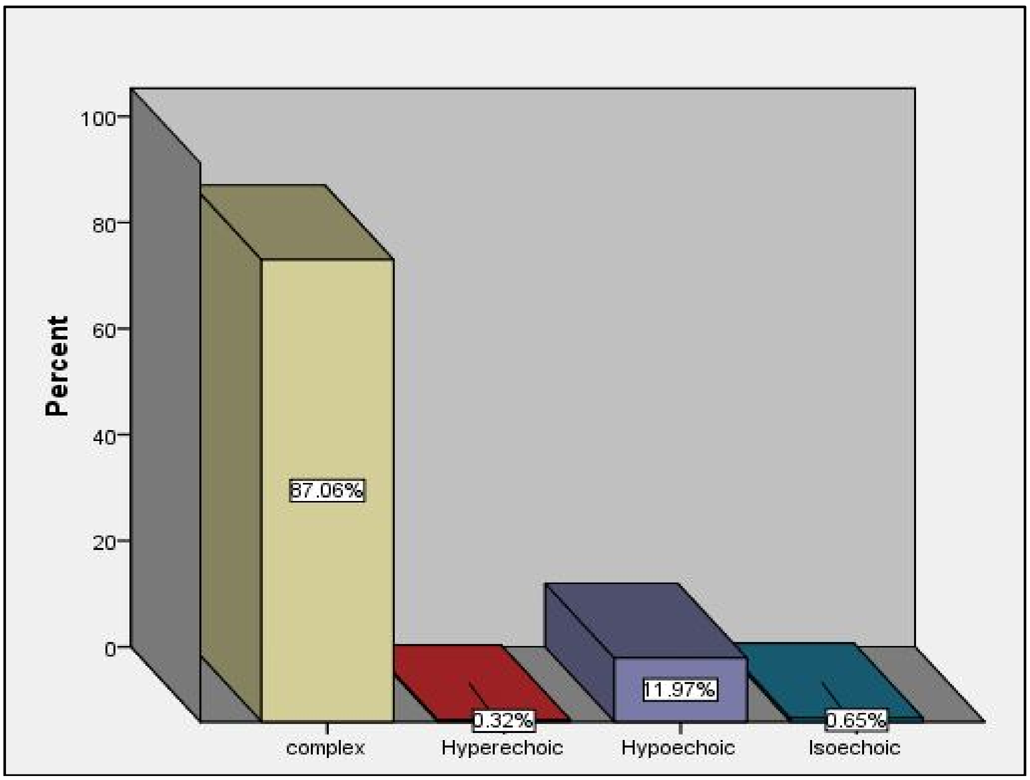


Figure (4.7) frequency distribution of echogenicity of thyroid gland

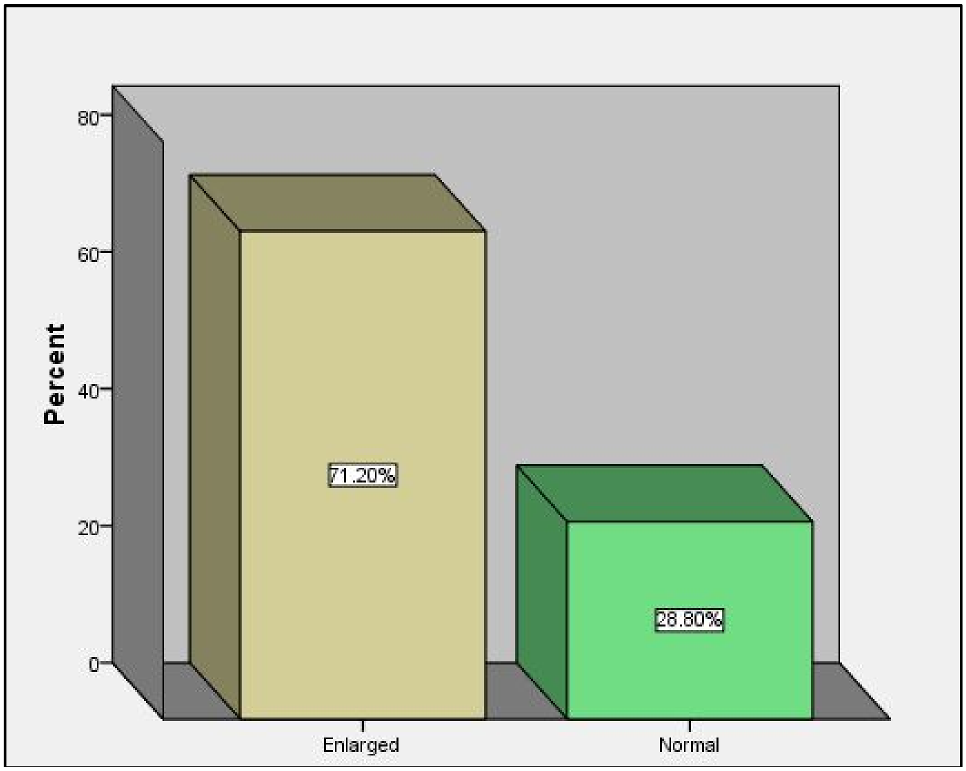


Figure (4.8) frequency distribution of size of thyroid gland

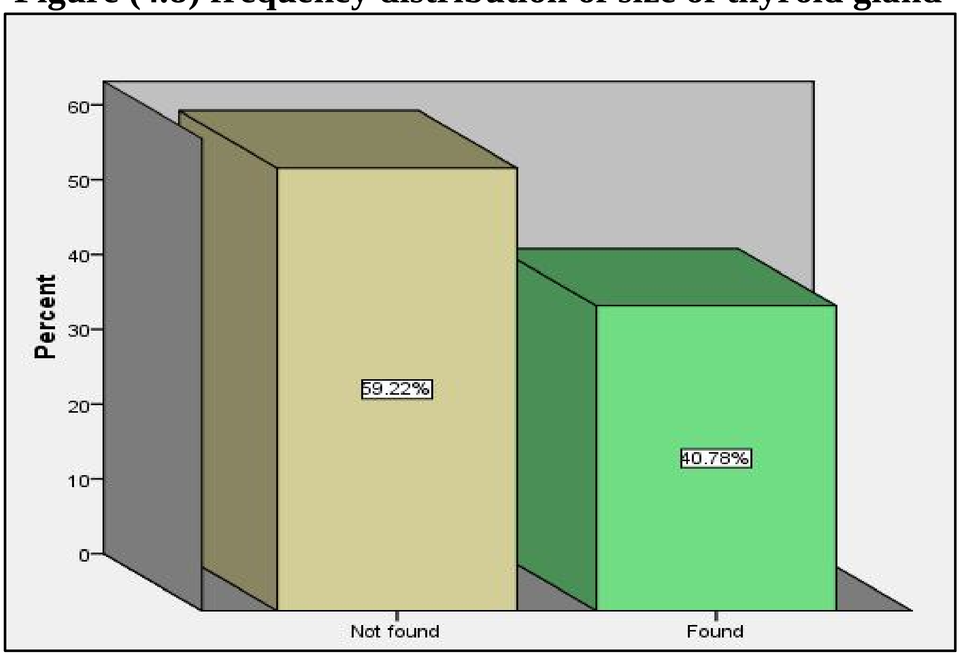


Figure (4.9) frequency distribution of presence of thyroid gland

Table (4.10) (4.11) (4.12) cross tab & size

Size

	Enlarged			Normal			Total		
	T3	T4	TSH	T3	T4	TSH	T3	T4	TSH
Decrease	25	41	110	9	17	42	34	58	152
Increase	98	61	71	28	25	31	126	86	102
Normal	97	118	39	52	47	16	149	165	55
Total	220	220	220	89	89	89	309	309	309
P value = 0.065	**P value = 0.991**			**P value = 0.892**					

Chapter Five

Discussion, Conclusion and Recommendations

Chapter Five

5-1 Discussion:

Thyroid gland is one of the most important gland in the body in which responsible for many metabolic and functional operation in various part of the body. This study intended to study the morphological disturbance of the gland using thyroid ultrasound in which the hormones were measured and the scan parameter and appearance were evaluated relative to the patient demographic data.

Age is the target also the age were grouped into 8 major classes from 9-more than 80years to find the most affected age groups of this disturbance, where the most affect age range between 40-50yrs (87), accounted for 28.2%, followed by 30-40yrs (82) 26.5%. this indicate that the middle age of the patient life at higher risk of morphological change especially those with disturbed thyroid function. As in table (1) figure (1).

Female here is mostly affected by the morphological disturbance of thyroid texture and function in which accounted for 94.8% of study data were the male minimally incorporated into this effect. As in figure (2).

Female to male ratio 18-3.1this result consider with result of most common pathology of thyroid occur in female agree with ratio who state 4-1 this result agree with **Ahmed Alhaj (2012)** the study be done for smaller sample where in our study which correlate with this study.

Thyroid hormone measured to ensure the presence of abnormal function relative to the normal one where TFT were done for 309 patients as in figure 3. There was increasing in level of T3, T4 and TSH for 126, 86, and 102 patients while decreased for 43, 58, and 152 patients where the rest of the patient was normal. Here a majority of people with disturbed TFT having hyperthyroidism in which the level of TFT as general increased especially the level of T3, and T4. From this point we need to correlate these finding with abnormality that could be detected using ultrasound.

According to this study people from Khartoum state and west of Sudan was the major group accounting for 31.06% and 38.18% respectively. Regionally according the food habits this may explain the possibility of thyroid disturbance among these groups.

A correlation intended to test the possibility of thyroid morphological changes was carried out, so the texture was complex, isoechoic, hyperechoic and hypoechoic echo pattern in which the most of the patient came with either complex echotexture or hypoechoicechotexture, but related to the thyroid hormone status this texture is related to the increased T3 level in 110 patients and decreased of TSH level in 139 patients, where the T4 has no strong impact in this echo pattern. Hypoechogenicity as well related to the same hormones as 15 patients for T3 and 59 for TSH respectively.

But the volume of thyroid gland is mostly related to increment of T3 and T4 and decreased TSF for 98, 61 and 110 patients respectively as p= 0.991.As in table (5)

Chapter Five

5-2 Conclusion:

Thyroid function is the production of thyroid hormones which are created from thymoglobulin protein. The aim of this study to study the size and texture of thyroid gland with disturbance of T3, T4, TSH using ultrasonography. A descriptive study 309 patient were enrolled in the study with disturbance of T3, T4, TSH, in period from April/2015 up to February/2015 for patient referred for ultrasonic clinic to examine thyroid gland. The machine used in the study areAloka 200 CD and Sonoscape with high frequency 7 – 10 MHZ left and right lobes were measured and detect echogenicity and size. Ultrasound findings of this study revealed that most age group affected due to this disturbance (25 – 50) 76.2%. The incidence of thyroid disease is more common in females 94.8% to 5.2% in males. The study revealed that the most endemic areas for thyroid diseases in Sudan are the west 40%. Most cases of thyroid changes were associated with increased thyroid hormone level with either complex or hypoechogenic texture.

The most affected age due to hormones disturbance age group (25-55) (76%).Female (94%) more affected than (16%) male ratio (18-3.1).According to echogenicity when T3 decreased it was complex and on increased and normal values. TSH when increased the thyroid echogenicity complex and normal level on iso and hyper.The size of thyroid enlarged when TSH decreased and normal size on decreaseT3 increased and normal sizecause enlargement of thyroid.T3 enlarge on size when the level is normal.T4 normal level in thyroid size was enlarged.

The size of thyroid enlarged when TSH decreased and normal on decreased T3 when also there increase T3 and T4 in most cases the thyroid gland enlarged, no significant correlation between thyroid gland function and size of thyroid.

No significant correlation between thyroid gland echogenicity and thyroid function test(normal, elevated, or abnormal).

5-3 Recommendations:

1. Thyroid scanning should be planned as one of the basic necessary exam to aid in diagnosis management and follow up.
2. More training program should planned for sonologist in the field of ultrasound specially in thyroid scanning to give accurate results.
3. Use modern equipment with new software program as segmentation of ultra sound thyroid image.
4. Future research study should be done include more sample data for more precise and accurate results including Doppler.

Further studies should be done to correlate abnormal thyroid function test with thyroid morphology and compare with nuclear medicine and Doppler.

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Appendices

بسم الله الرحمن الرحيم

Sudan University of Science & Technology

College of Graduate Studies

Study effects of Thyroid Hormones Disturbance on Thyroid Size and Echogenicity using Ultrasonography

Age ☐ Gender M ☐ F ☐

Lab findings

T3 ☐ T4 ☐ TSH ☐

U/S Findings Echogenicity:

complex ☐ hypo ☐ hyper ☐ Iso ☐

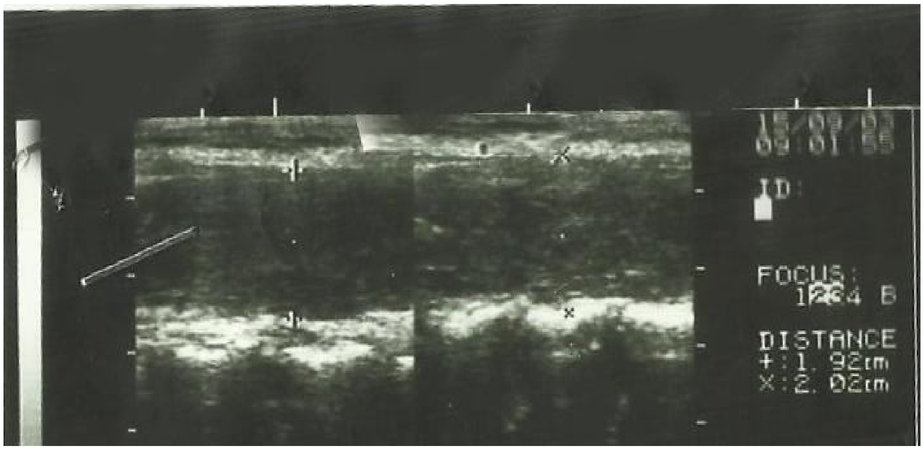
U/S findings size :

Enlarged ☐ Normal ☐ Small ☐

	Normal	Increase	Decrease
T3			
T4			
TSH			

Appendix (1) Ultrasound images

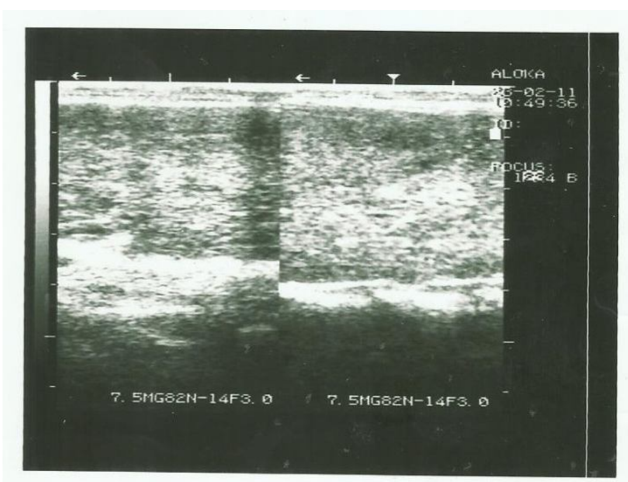
Image (1)

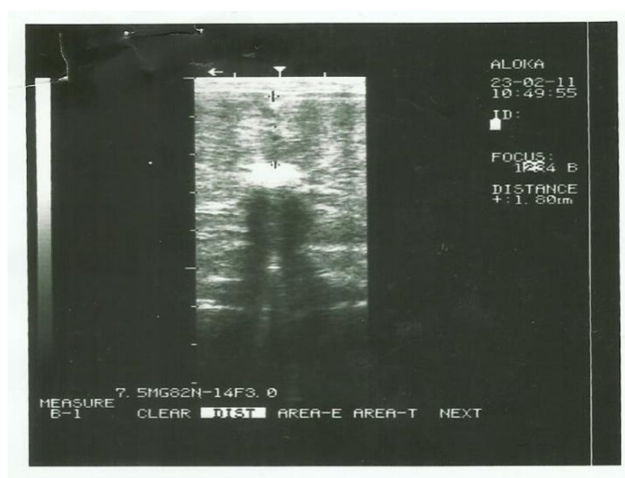


thyroid gland hypoechoic texture: long

itudinal section, female patient 32 yrs old, enlarged in size ,length: right lobe length 2.02 , left lobe 2.02cm, T3 2.5, T4 125, TSH .002.

Image (2)



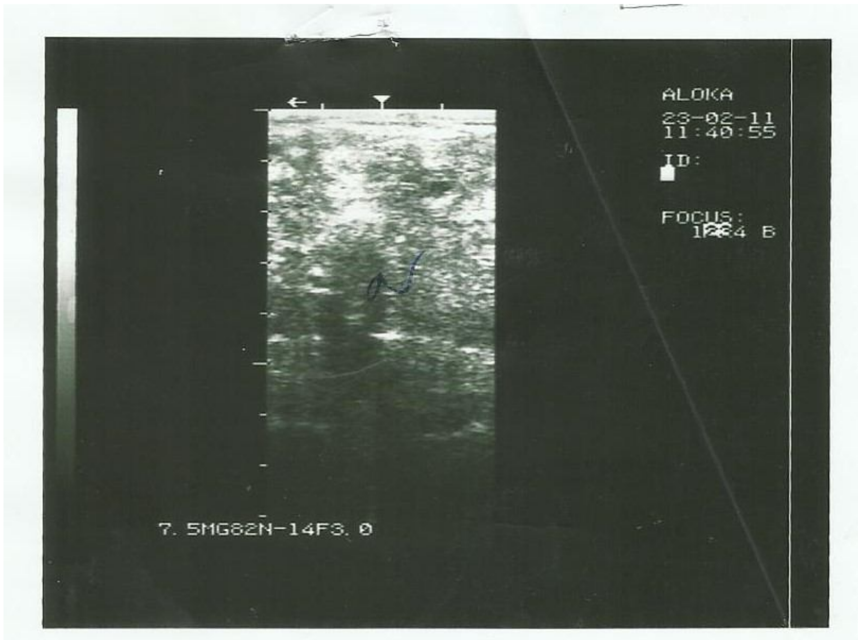


Transverse view

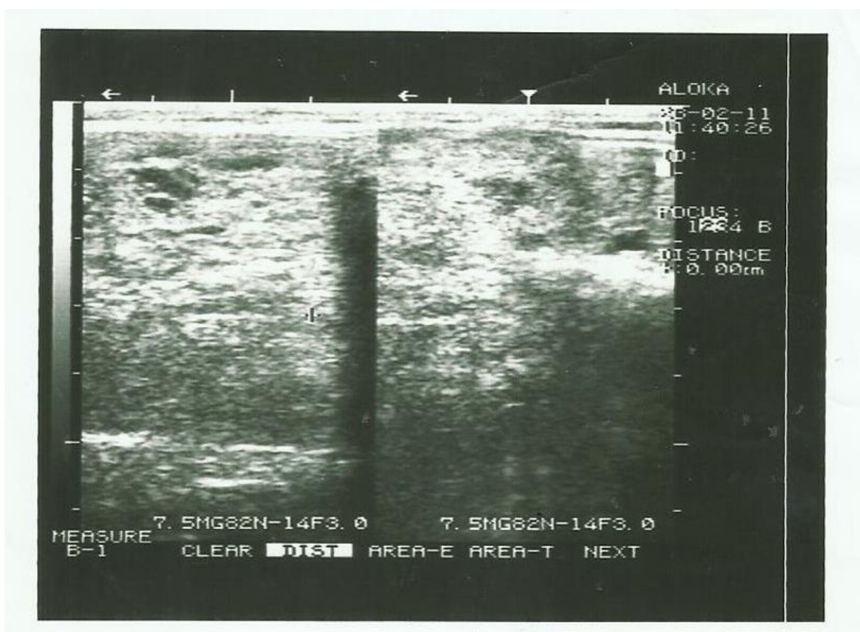
Longitudinal view

Female 15 years old, enlarged lobes: 2.4 cm , Isthmus: 1.2 cm, complex texture T3: 26 , T4 :49, TSH: 0.17

Image (3)



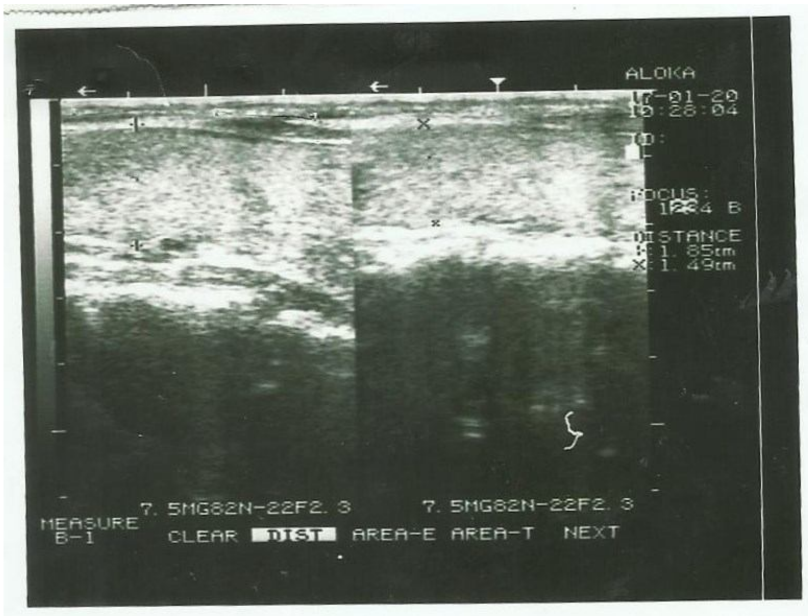
Transverse view



Longitudinal view

Female 51 years old, enlarged lobes: 2.5 cm, Isthmus: 1.3 cm, Complex texture: noduler formation, T3: 2.19, T4: 5.9, TSH 0.01.

Image (4)

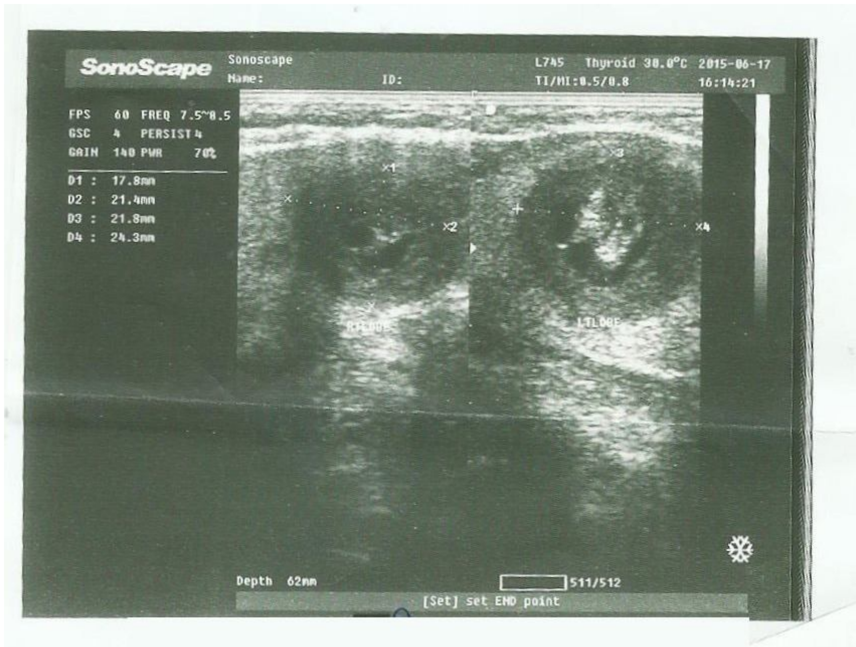


Female 56 years old, Normal size: Hyperechoic texture, T3: Normal, T4: 12.3 , TSH: 4.83.Longitudinal view.

Image (5)

Female 27 years old, enlarged lobes: 2.7, Isthmus:1.4 , Isoechoic texture: T3: 5.23, T4: 19.5 , TSH: 0.10 , noduler formation. Transverse view.

Image (6)



Female 35 years old, enlarged in size: Right lobe 2.6 cm, Left lobe 2.8, complex texture: T3: 1.24, T4: 175, TSH: 0.117, noduler formation. Longitudinal view.

Thyroid Function Tests

Function	Abbreviation	Normal
Serum thyrotropin/ thyroid stimulating hormone.	TSH	0.3 – 3.0 µU/ml
Free thyroxin	FT4	7 -18 ng/1=0.7 – 1.8ng/d1
Serum triiodothyrnine	T3	0.8 – 1.8µg/1=80-180 ng/d1
Radioactive iodine -123 uptake	RAIU	10 -30%
Radioiodine scan (gamma camera)	N/A	N/A – thyroid contrasted images
Free thyroxin fraction	FT4F	0.03 – 0.005%
Serum thyroxin	T4	46 – 120 µg/1=4.6 – 12.0 µg/d1
Thyroid hormone binding ratio	THBR	0.9 – 1.1
Free thyroxin index	FT4I	4 - 11
Free triiodothyronine 1	FT_3	230 – 619 pg/d
Free T3 index	FT31	80 – 180
Thyroxin – binding globulin	TBG	12 – 20 ug/d1 T4 + 1.8 µg
TRH stimulation test	Peak TSH	9 – 30 µIU/ml at 20 – 30 min
Serum thyroglobulin 1	Tg	0 – 30 ng/m
Thyroid microsomal antibody titer	TMAb	Varies with method.
Thyroglobulin antibody titer	TgAb	Varies with method