

*Sudan University for Science and Technology*  
*College of Graduate Studies*

**Study of Thyroid Pathologies using Ultrasonography**

**دراسة أمراض الغدة الدرقية باستخدام الموجات فوق الصوتية**

A Thesis submitted for partial fulfillment of the requirement for the  
Degree of master (M.Sc) in medical Diagnostic ultrasound

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# الآية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ  
أَقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ ① خَلَقَ الْإِنْسَانَ مِنْ عَلَقٍ ②  
أَقْرَأْ وَرَبُّكَ الْأَكْرَمُ ③ الَّذِي عَلَّمَ بِالْقَلَمِ ④ عَلَّمَ الْإِنْسَانَ مَا  
لَمْ يَعْلَمْ ⑤

صدق الله العظيم

(سورة العلق)

## *Dedication*

*To my mother and father who encouraged me to join in M.sc of ultrasound*

*To my sisters and brothers who helped me a lot.*

*To my teachers who taught me how to catch science.*

*To my friend who supported and helped me all time.*

## *Acknowledgement*

*First I thank Allah for helped me and gave me health and patience to gain knowledge to complete this thesis.*

*Secondly my thanks to my supervisor Dr. Ikhlas Abd El aziz who helped me, and gave me her knowledge and experience.*

*My thanks extend to Antalya medical center, and Ibrahim Malik hospital which the places where I took my samples.*

*At last I thank all the people who helped me to complete this thesis.*

## **Abstract**

The aim of this study is to evaluate the accuracy of high frequency ultrasound in detection of thyroid pathologies. It is descriptive analytic study. This study was conducted in Antalya medical center and Ibrahim Malik hospital during period from October 2016 to February 2017.

The thyroid ultrasonography was done by using direct adhesion technology with linear array transducer with range of frequency from 7.5 -10 MHZ. Data was analyzed using Excel program. The sample were randomly selected (50) patients, the female patients 90% and male patients 10%. The age groups of patients range between (12-70) years old. The result of this study showed that 26% of patients had simple goiter, 46% of patients had multi nodular goiter, 20%had diffuse goiter and 8% of patients had toxic goiter. The results showed that the most affected patients with thyroid pathologies (48%) came from middle of Sudan, followed by the west of Sudan (26%).

## المستخلص

الهدف من هذه الدراسة تقييم دقة الموجات فوق الصوتيه في الكشف عن امراض الغده الدرقيه، وهي دراسه وصفيه تحليليه .

أجريت هذه الدراسة فى مركز انطاليا الطبي ومستشفى ابراهيم مالك في الفتره من اكتوبر 2016 الى فبراير 2017 . تم اجراء فحص الموجات فوق الصوتيه للغده الدرقيه بتقنيه الالتصاق المباشر باستخدام مسبار خطي الحزمه تردده الصوتى يتراوح ما بين 7.5-10 ميغا هيرتز .

تم اختيار عينه عشوائيه عباره عن 50 مريض ،نسبه النساء 90% ونسبه الرجال 10% ، وقد كانت الاعمار ما بين 12-70 سنه .

اظهرت النتائج ان 26% من المرضى يعانون من تضخم الغده البسيط ،46%يعانون من تضخم الغده متعدد العقيدات ، 20% يعانون من تضخم الغده المنتشر، و 8% يعانون من تضخم الغده السام . واطهرت النتائج ايضا ان معظم المرضى المصابين بامراض الغده الدرقيه (48%) هم من وسط السودان تليهم منطقه غرب السودان.

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## List of abbreviations

<b>U/S</b>	Ultrasound
<b>MHZ</b>	Mega hertz
<b>TSH</b>	Thyroid stimulating hormone
<b>T3</b>	Triiodo thyronine
<b>T4</b>	Thyroxine
<b>TRH</b>	Thyrotropin releasing hormone
<b>TGC</b>	Time gain compensator
<b>PD</b>	Power Doppler

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# **Chapter One**

## **Introduction**



## **1.1 Introduction**

The thyroid is one of nine endocrine glands located throughout the body that make and send hormones into the bloodstream, which helps to regulate a variety of body functions including how fast the heart beats. It is located in front of the neck just above the collar bones and is shaped like a butterfly, with one lobe on either side of the neck connected by a narrow band of tissue (thyroid isthmus).

A thyroid disease is a medical condition impairing the function of the thyroid. Different thyroid diseases include functional disorders, nodular abnormalities (Goiter), iodine deficiency, and tumors can affect wide spectrum of population. These diseases have a large range of symptoms and affect all ages. About five to 10 percent of adults will have lumps in their thyroid that a doctor can identify on an exam, these are called palpable nodules. Many imaging modalities, ultrasonography, X-ray, nuclear medicine computerized tomography, and magnetic resonance imaging have been used in diagnosis of thyroid diseases. (www.wikipedia.com)

An ultrasound of the thyroid produces pictures of the thyroid gland and the adjacent structures in the neck. We use high frequency transducer above 5 megahertz (MHZ) because it lies superficial. Ultrasound is very sensitive and shows many nodules that cannot be felt.

Ultrasonography (US) is the most common and most useful way to image the thyroid gland and its pathology, because it is safe, painless, and produces pictures of the inside of the body using sound waves. Ultrasound imaging, also called ultrasound scanning or sonography, involves the use of a small transducer (probe) and ultrasound gel placed directly on the skin. High-frequency sound waves are transmitted from the probe through the gel into the body. The transducer collects the sounds that bounce back and a computer then uses those sound waves to create an image. Ultrasound examinations do not use ionizing radiation (as used in x-rays), thus there is no radiation exposure to the patient. Because ultrasound images are captured in real-time, they can show the structure and movement of the body's internal organs, as well as blood flowing through blood vessels. Ultrasound imaging is a noninvasive medical test that helps physicians diagnose and treat medical conditions. (www.wikipedia.com)

## **1.2 Objectives:**

### **1.2.1 General Objective:**

To study thyroid pathologies using ultrasonography.

### **1.2.2 Specific Objectives:**

- To determine the value of ultrasound imaging modality in detection of thyroid diseases.
- To recognize the geographical sources of patients with thyroid pathologies.

## **1.3 Problem of the study:**

According to current statistics, it has been proved that thyroid diseases increased in incidence during the last years in Sudan. The lack of accuracy in detecting thyroid diseases has contributed in the increased prevalence.

## **1.4 overview of the study:**

This study consist 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 ) and pervious study, chapter three about materials and methods, chapter four deals with results and chapter five includes discussion, conclusion and recommendations, references and appendices.



# **Chapter Tow**

**Literature review**

## **Chapter Two**

### **Literature review**

#### **2.1 Anatomy of thyroid gland:**

The thyroid lies in the anterior neck between the level of the fifth cervical and the first thoracic vertebrae, with two lateral lobes, joined by a thin band of connective tissue called the isthmus, bridging the underlying trachea. Each lobe measures approximately 5 cm in length, 3 cm in width, and 2 cm in depth. (Carol, 1993)

The thyroid is one of the larger endocrine glands, weighing 2-3 grams in neonates and 18-60 grams in adults, and is increased in pregnancy.

The size and shape of the thyroid varies, often being thinner and more elongated in slim subjects. The normal, healthy, thyroid adult gland volume is approximately 10–12 ml.

The thyroid gland is covered by a thin fibrous sheath, the capsule of the thyroid. The external layer is anteriorly continuous with the pre tracheal fascia and posterolaterally continuous with the carotid sheath. The capsule extrudes into the gland itself and forms the septae that divides the thyroid tissue into microscopic lobules.

The gland is covered anteriorly with infra hyoid muscles and laterally with the sternocleidomastoid muscle. Behind, the gland is fixed to the cricoid and tracheal cartilages and cricopharyngeus muscle by a thickening of the fascia to form the posterior suspensory ligament of thyroid gland also known as Berry's ligament. (Michael, 2006)

##### **2.1.1 Blood supply:**

It is one of the largest classical endocrine glands in the body and receives a high blood flow from the superior thyroid arteries (arising from the external carotid artery) and the inferior thyroid arteries (arising from the subclavian arteries). Superior thyroid artery and vein are at the upper pole, inferior thyroid vein at the lower pole. Inferior thyroid artery is posterior to the lower third of each pole.

### **2.1.2 Lymphatic drainage:**

Lymphatic drainage frequently passes the prelaryngeal lymph nodes (located just above the isthmus), and the pretracheal and paratracheal lymph nodes.

### **2.1.3 Nerve Supply:**

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. The esophagus laryngeal nerve can often be appreciated lying deep to the thyroid; the former more often on the left side, the latter in the trachea-esophageal groove.

The internal jugular veins show significant asymmetry in approximately two-thirds of people, with the right jugular vein larger in two-thirds of these.  
(Michael, 2006)

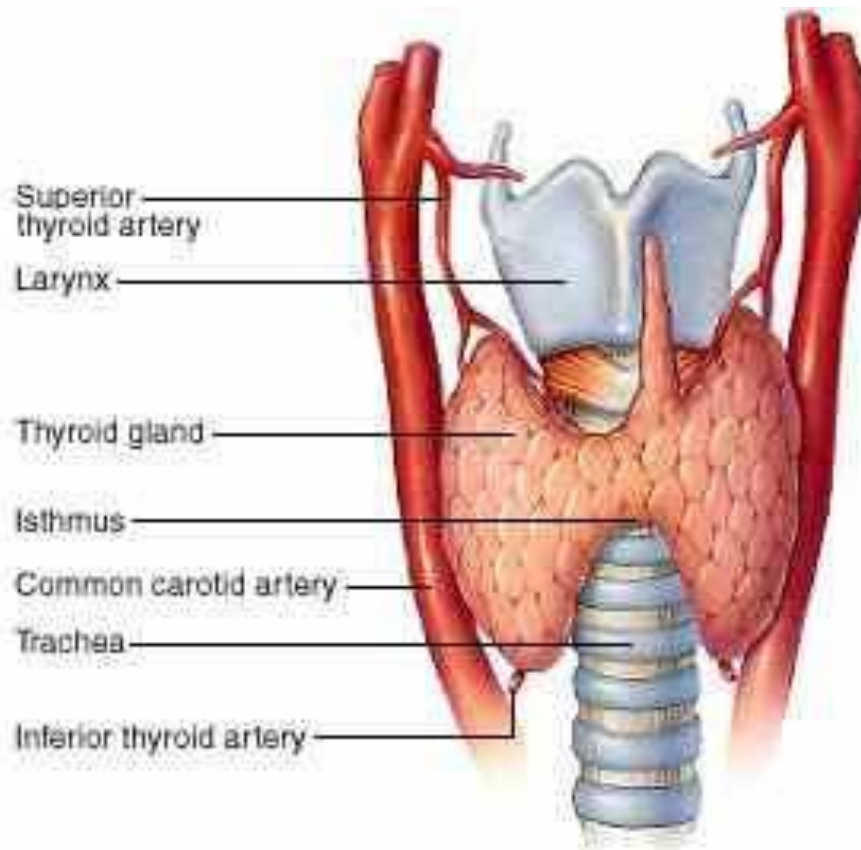
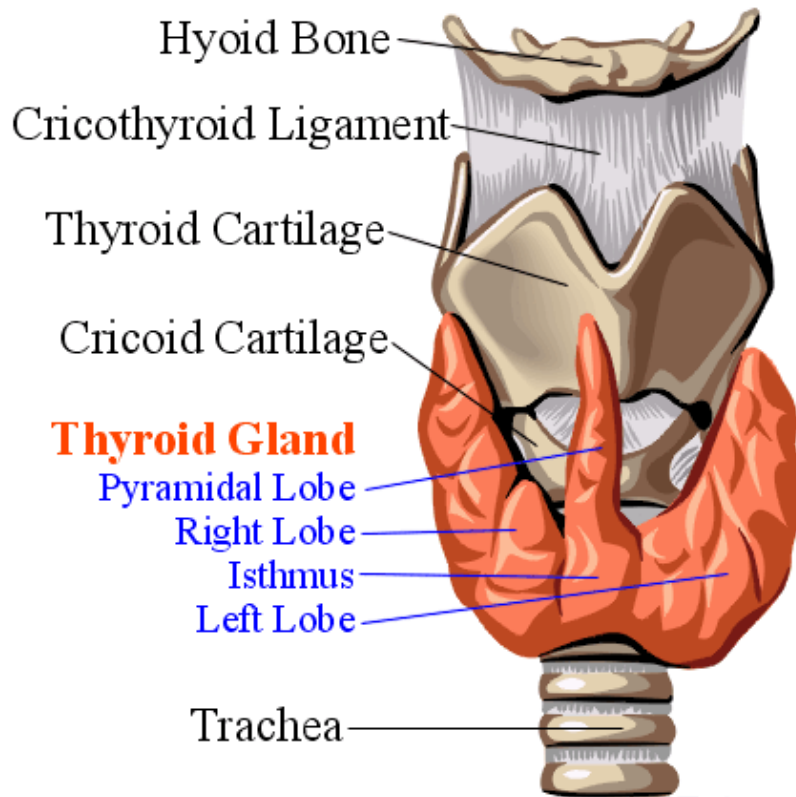


Fig (2.1) shows anterior view of thyroid gland  
([www.wikipedia.com](http://www.wikipedia.com))



family  
**FP** practice  
 notebook.com  
 a Resource for Physicians

Adapted from Corel Draw 9

Fig (2.2) shows Anatomy of thyroid gland.

([www.wikipedia.com](http://www.wikipedia.com))

## 2.2 Embryology of thyroid gland:

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 tuberculum impar 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 bilobed diverticulum 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. [www.wikipedia.com](http://www.wikipedia.com), 31Oct 2016)

## **2.3 Histology:**

At the microscopic level, there are three primary features of the thyroid—follicles, follicular cells, and parafollicular cells, first discovered by Geoffery Websterson in 1664.

### **2.3.1 Follicles:**

The 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 flow, nerve and lymphatic supply, that surrounds a core of colloid that consists mostly of thyroid hormone precursor proteins called thyroglobulin, an iodinated glycoprotein.

### **2.3.2 Follicular cells:**

The core of follicles 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 metabolizing the thyroglobulin contained in the colloid. Follicular cells vary in shape from flat to cuboid to columnar, depending on how active they are.

### **2.3.3 Parafollicular cells:**

The cytoplasm of these cells is clear, they are also called "C cells" Scattered among follicular cells and in spaces between the spherical follicles are another type of thyroid cell, parafollicular cells. These cells secrete calcitonin. ([www.wikipedia.com](http://www.wikipedia.com), 31Oct 2016)

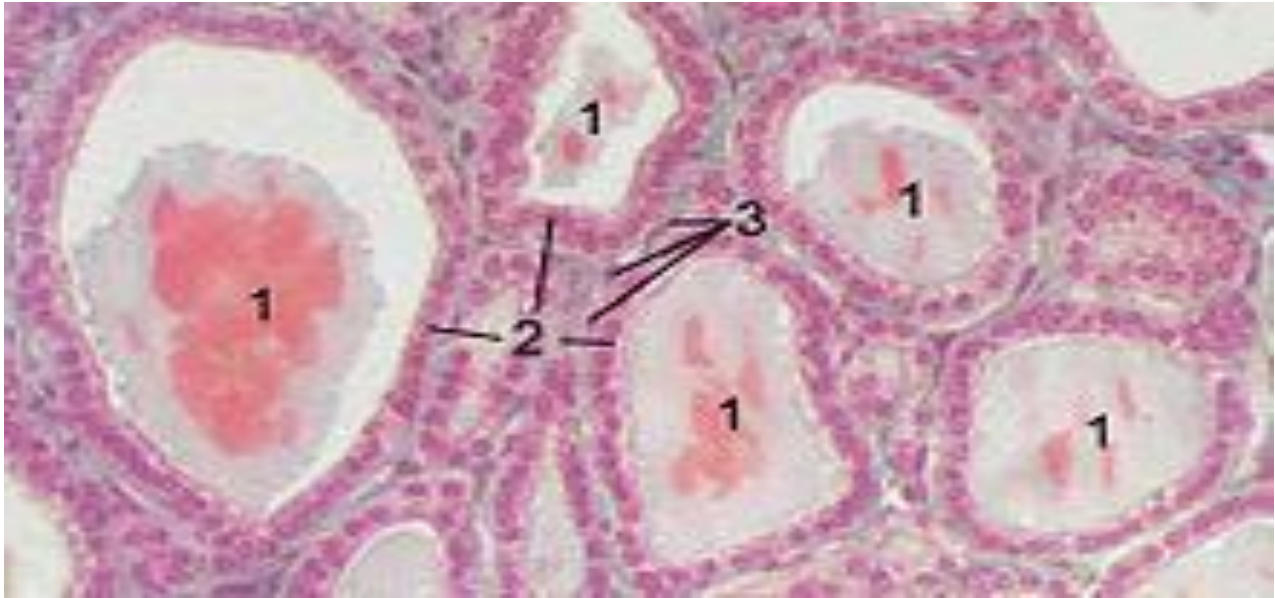


Fig (2.3) shows histological section through the thyroid of a horse. (1) Follicles, (2) Follicular epithelial cells, (3) Endothelial cells. ([www.wikipedia.com](http://www.wikipedia.com))

## 2.4 Physiology:

The gland consists of varying sized follicles, which are bounded by a single layer of cuboidal epithelial cells (follicular cells} and a basement membrane, surrounding a central lumen filled with a homogenous protein rich colloid (thyroglobulin). The apical surface of the cell membranes is covered with numerous microvilli to increase surface area. The follicular cells are connected by tight junctions, and have a dense capillary network. The colloid is a store of thyroid hormones prior to secretion. The thyroid gland is the only endocrine gland to store its hormone in large quantities. In the active gland colloid is diminished and epithelial cells are tall and columnar. ([www.wikipedia.com](http://www.wikipedia.com), 31Oct 2016)

### 2.4.1 Thyroid hormones action:

The thyroid hormones T3 and T4 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.

The primary function of the thyroid is the production of iodine-containing hormones, triiodothyronine (T3) and thyroxine (T4) and peptide hormone calcitonin. The thyroid hormones have a wide range of effects on the human body. These include:

Metabolic; 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, creation, uptake by cells and breakdown of glucose. They stimulate the breakdown of fats, and increase free fatty acids. Despite increasing free fatty acids, thyroid hormones decrease cholesterol levels, perhaps by increasing the rate of secretion of cholesterol in bile.

Cardiovascular; 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.

Developmental; 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 T3 and T4. 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. (www.wikipedia.com, 31Oct 2016)



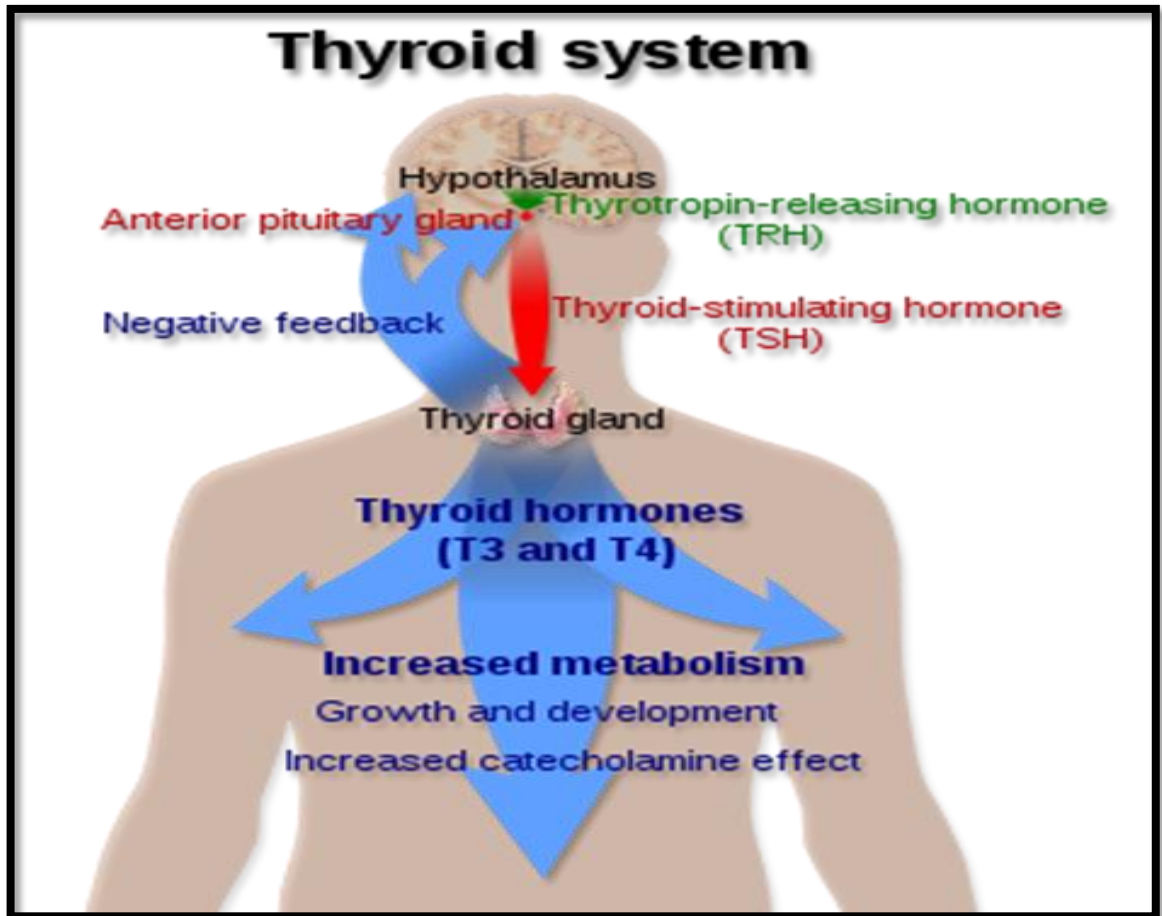


Fig (2.4) shows the system of the thyroid hormones T3 and T4.  
(www.wikipedia.com)

### 2.4.2 Regulation:

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.

TRH is secreted at an increased rate in situations such as cold exposure (to stimulate thermogenesis) which is prominent in case of infants. TSH production is blunted by dopamine and somatostatin which act as local regulators at the level of the pituitary, in response to rising levels of glucocorticoids and sex hormones (estrogen and testosterone), and excessively high blood iodide concentration. ([www.wikipedia.com](http://www.wikipedia.com), 31 Oct 2016)

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. ([www.wikipedia.com](http://www.wikipedia.com), 31 Oct 2016)

### 2.4.3 Thyroid function tests:

There are a number of blood tests that can be used to test the function of the thyroid. 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. TSH levels are considered the most sensitive marker of thyroid dysfunction.

Table (2.1) Thyroid function testes. ([www.wikipedia.com](http://www.wikipedia.com))

Test	Abbreviation	Normal ranges
Free thyroxine fraction	FT4F	0.03–0.005%
Serum thyroxine	T4	46–120 µg/l = 4.6–12.0 µg/dl
Thyroid hormone binding	THBR	0.9–1.1

ratio		
free thyroxine index	FT4I	4–11
Free triiodothyronine	FT3	230–619 pg/d
Free T3 index	FT3I	80–180
Thyroxine binding globuline	TBG	12–20 ug/dl T4 +1.8 µg
TRH stimulating test	Peak TSH	9–30 µIU/ml at 20–30 min.
Serum thyroglobulin I	Tg	0-30 ng/m
Thyroid microsomal antibody titer	TMAb	Varies with method
Thyroglobulin antibody titer	TgAb	Varies with method

## 2.5 Significance of iodine:

In areas of the world where iodine is lacking in the diet, the thyroid gland can become considerably enlarged, a condition called endemic goiter. Pregnant women on a diet that is severely deficient of iodine can give birth to infants with thyroid hormone deficiency (congenital hypothyroidism), manifesting in problems of physical growth and development as well as brain development (a condition referred to as endemic cretinism). In many developed countries, newborns are routinely tested for congenital hypothyroidism as part of newborn screening. Children with congenital hypothyroidism are treated supplemental with levothyroxine, which facilitates normal growth and development.

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.

The use of iodized salt is an efficient way to add iodine to the diet. It has eliminated endemic cretinism in most developed countries, and some governments have made the iodination of flour, cooking oil, and salt mandatory. Potassium iodide and sodium iodide are typically used forms of supplemental iodine. 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. ([www.wikipedia.com](http://www.wikipedia.com), 31Oct 2016)

## 2.6 Sonographic characteristics of normal thyroid gland:

- It is a homogeneous structure of medium-level echogenicity situated on either side of the trachea with an isthmus joining the right and left lobes .the common carotid arteries and jugular veins are circular sonolucent vessels that lie lateral to the thyroid in transverse plane.
- The sternocleidomastoid, longus colli, and strap muscles are hypoechoic compared to thyroid tissue. (Carol, 1993)



Fig (2.5) Normal thyroid ultrasound. The thyroid is homogeneous and uniformly hyperechoic relative to the overlying strap muscle (S). The contour is smooth and size is normal. Note esophagus (E) posterior to the left lobe. SCM,

sternocleidomastoid muscle; J, internal jugular vein; C, common carotid artery; LC, longus colli muscle; TR, trachea. (Steven, 2011)

### **2.6.1 Thyroid Volume:**

The volume of the thyroid gland is calculated in milliliters as the sum of the volume of the both the lobes, isthmus is neglected.

$$V (\text{ml}) = \text{width} \times \text{depth} \times \text{length} \times 0.479 (\text{cm})$$

Normal thyroid volume in females is less than 10-15 ml and in males less than 12-18ml.calculated for each lobe and added. (Jananai, 2015)

## **2.7 Disorders of thyroid:**

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 hormone. These diseases have a large range of symptoms and affect all ages. ([www.wikipedia.com](http://www.wikipedia.com), 31Oct 2016)

### **2.7.1 Hyperthyroidism:**

Excessive production of the thyroid hormone due to an overactive thyroid is called hyperthyroidism, which is most commonly a result of Graves' disease, a toxic multinodular goitre, a solitary thyroid adenoma, and inflammation. 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, diarrhea, hair loss, and muscle weakness. ([www.wikipedia.com](http://www.wikipedia.com), 31Oct 2016)

### **2.7.2 Hypothyroidism:**

An underactive thyroid gland results in hypothyroidism. Typical symptoms are abnormal weight gain, tiredness, constipation, heavy menstrual bleeding, baldness, cold intolerance, and a slow heart rate. Hypothyroid disorders may occur as a result of autoimmune disease such as Hashimoto's thyroiditis; iodine deficiency; as a

result of medical treatments such as surgical removal or radio ablation of the thyroid, amiodarone and lithium; as a result of congenital thyroid abnormalities; or as a result of diseases such as amyloidosis or sarcoidosis or because of transient inflammation of the thyroid. Some forms of hypothyroidism can result in myxedema and severe cases can result in myxedema coma. Some causes of hypothyroidism, such as Postpartum thyroiditis and Sub acute thyroiditis may be transient and pass over time, and other causes such as iodine deficiency may be able to be rectified with dietary supplementation. ([www.wikipedia.com](http://www.wikipedia.com),31Oct 2016)

### **Sonographic characteristic of Graves' disease:**

- Enlarged gland.
- Heterogeneous or diffusely hypoechoic echotexture. (Steven, 2011)

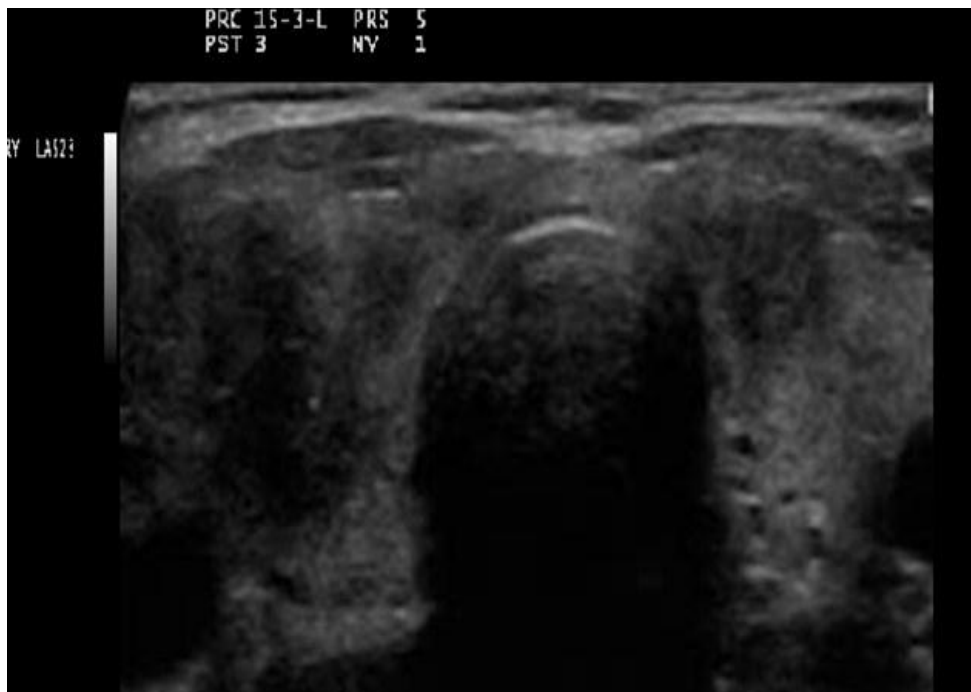


Fig (2.6) Right lobe 2.7\*2.5 diffusely enlarged and hypoechoic. Note heterogeneity of the nodule. (Jananai, 2015)

### **2.7.3 Thyroiditis:**

It is an inflammatory process ongoing within the thyroid gland. Thyroiditis can present with a number of symptoms such as fever and pain, but it can also present as subtle findings of hypo or hyper-thyroidism. There are a number of causes, some more common than others. Thyroiditis can be divided into the following:

- Hashimoto's thyroiditis or Hashimoto's disease is an autoimmune disorder whereby the body's own immune system reacts with the thyroid tissues in an attempt to destroy it.
- Sub acute (De Querverian's) Thyroiditis occur secondary to viral infections, especially of respiratory tract.
- Postpartum thyroiditis occurs in some females following childbirth due to the development of immune tolerance in pregnancy. (Carol, 1993)

#### **Sonographic characteristics of Hashimoto's disease:**

- Mild enlargement of the thyroid gland.
- Heterogeneous echotexture.
- Hypervascular gland.

(Carol, 1993)

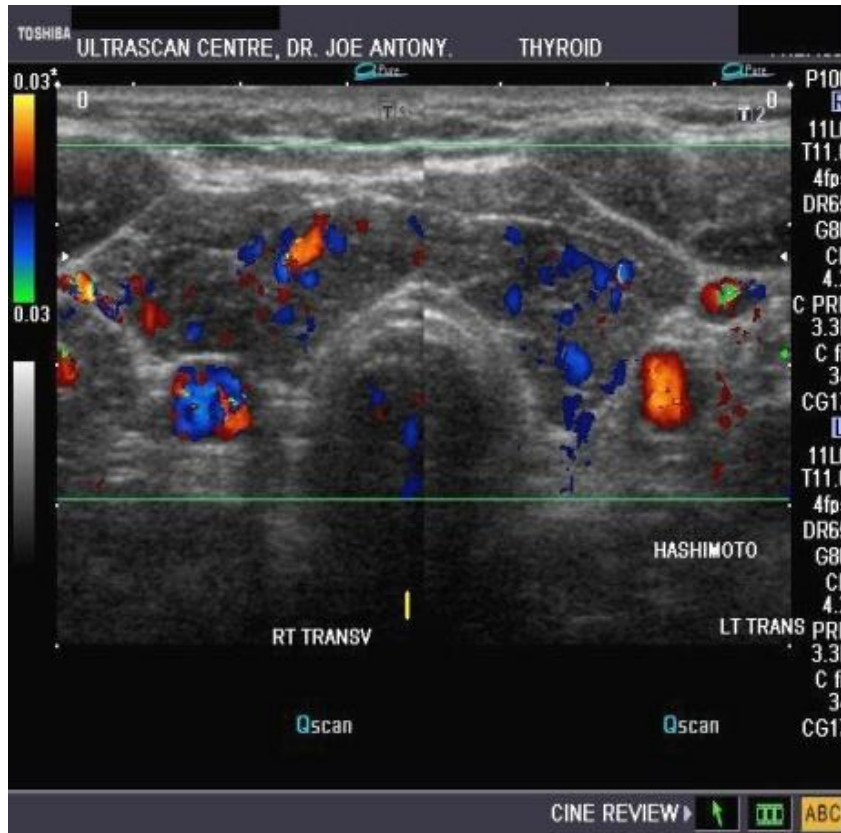


Fig (2.7) color Doppler demonstrates marked hyper vascularity.  
(www.wikipedia.com)

### 2.7.4 Cyst:

Simple cysts are relatively uncommon. These lesions are usually solitary and considered benign. A cyst may cause thyroid enlargement and displace adjacent structures. Hemorrhage into the cyst occasionally occurs. The vast majority of thyroid cysts result from hemorrhage or cystic degenerative changes in an adenoma. (Carol, 1993)

#### **Sonographic characteristics of cyst:**

- Most commonly an anechoic mass with sharply defined walls and enhanced posterior borders.
- Hemorrhage may produce low level echoes and septations. (Carol, 1993)





Fig (2.8) ultrasound image shows hemorrhagic colloid cyst of thyroid.

(www.wikipedia.com)

### 2.7.5 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.

There can be many nodules, which is termed a multinodular goiter, and this can sometimes be a toxic multinodular goiter. (www.wikipedia.com)

#### 2.7.5.1 Goiter:

An enlarged thyroid gland is called a goiter. Goiters 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, infiltrative disease such as sarcoidosis and amyloidosis. Sometimes no cause can be found, a state called "simple goiter". Various histological patterns are:

- Simple Nontoxic goiter; diffuse enlargement of the thyroid that is not associated with hyperthyroidism.
- Nodular or Multinodular Goiter; enlarged thyroid with multiple nodules, usually asymmetrical and complex due to adenomatous changes and degeneration.
- Diffuse Toxic Goiter; diffuse enlargement associated with hyperthyroidism (Graves' disease).
- Colloid Goiter; thyroid enlargement with the gland appearing soft due to the follicles distended with colloid.
- Endemic Goiter; diffuse enlargement of thyroid that develops in certain geographic locations due to low iodine content in the normal diet.

Some forms of goiter are associated with pain, whereas many do not cause any symptoms.

Enlarged goiters may extend beyond the normal position of the thyroid gland to below the sternum, around the airway or esophagus. (Carol, 1993)

### **Sonographic characteristics of goiter:**

- depending on the type of goiter, the lesion may have highly variable appearance ranging from diffuse homogenous enlargement to a complex mass.
- may contain rounded cystic components or multiple nodular components.
- hemorrhage, calcification, necrosis, or cystic degeneration may occur. (Carol, 1993)



Fig (2.9) shows ultrasound imaging of multinodular goiter. ([www.wikipedia.com](http://www.wikipedia.com))



Fig (2.10) ultrasound imaging shows multinodular goiter. ([www.wikipedia.com](http://www.wikipedia.com))

### 2.7.5.2 Benign Thyroid Nodules:

Benign thyroid nodules are the most common masses identified within the thyroid gland with sonography.

They can be considered either follicular adenomas or hyperplastic nodules. Follicular adenomas are the most common benign thyroid neoplasm. Follicular adenomas have a wide range of sonographic appearances. Hyperplastic nodules, also referred to as adenomatous nodules, are almost always multiple and also have varying sonographic appearances.

#### Sonographic characteristics of benign thyroid nodules:

- Extensive cystic components
- Cysts <5 mm
- Hyperechoic mass
- Eggshell calcifications. (Steven, 2011)

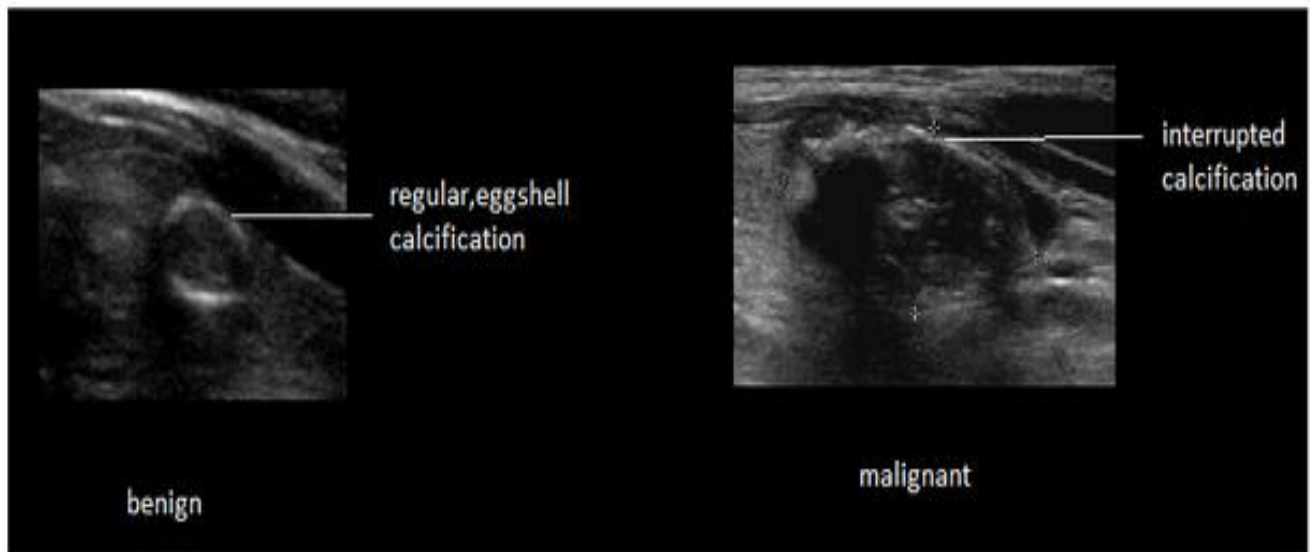


Fig (2.11) Differences between benign and malignant thyroid nodule calcification. (Jananai, 2015)

### 2.7.5.3 Malignant Thyroid Nodules:

Papillary carcinoma is the most common form of thyroid cancer. Other forms of thyroid malignancies include follicular carcinoma, medullary carcinoma, anaplastic carcinoma, lymphoma, and metastases to the thyroid. It is difficult to diagnose malignant thyroid nodules with sonography; however, there are some distinct features that increase the likelihood of the nodule being malignant. (Steven, 2011)

#### 2.7.5.3.1 Papillary carcinoma:

Papillary carcinoma accounts for 60%–70% of all thyroid malignancies, with a peak incidence in the third and fourth decades. Females are more commonly affected than males. The tumor may be small or up to 10 cm in diameter. The tumor is complex and contains cystic areas, papillary projections, degeneration, fibrosis, and calcification. Commonly spreads along the rich lymphatic system within and adjacent to the thyroid gland accounting for the multifocal nature of the tumor within the thyroid gland and its spread to regional lymph nodes. (Carol, 1993)

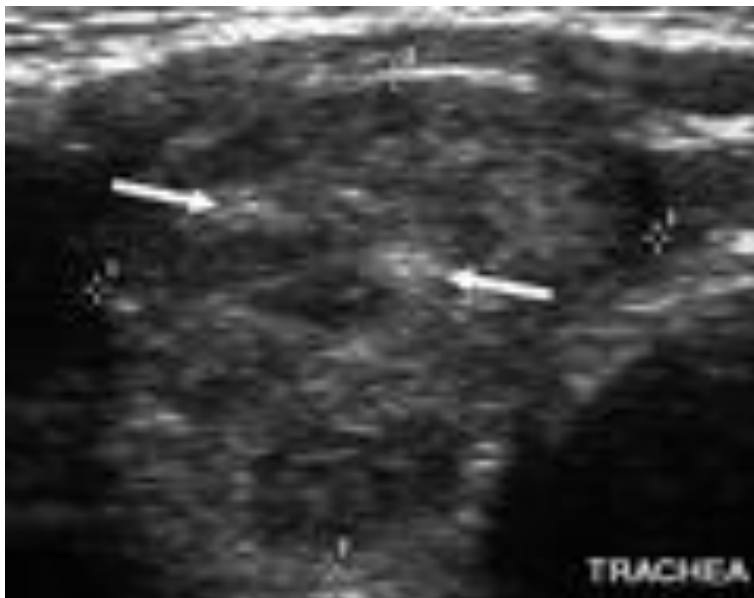


Fig (2.12) Transverse grey scale sonogram shows papillary carcinoma. (www.wikipedia.com)

### **2.7.5.3.2 Anaplastic carcinoma:**

Anaplastic carcinoma is one of the most aggressive head and neck cancers and has a grave prognosis. It accounts for 15%–20% of all thyroid cancers. It is usually occurs after age 60. This tumor is commonly associated with nodular goiters. (Carol, 1993)

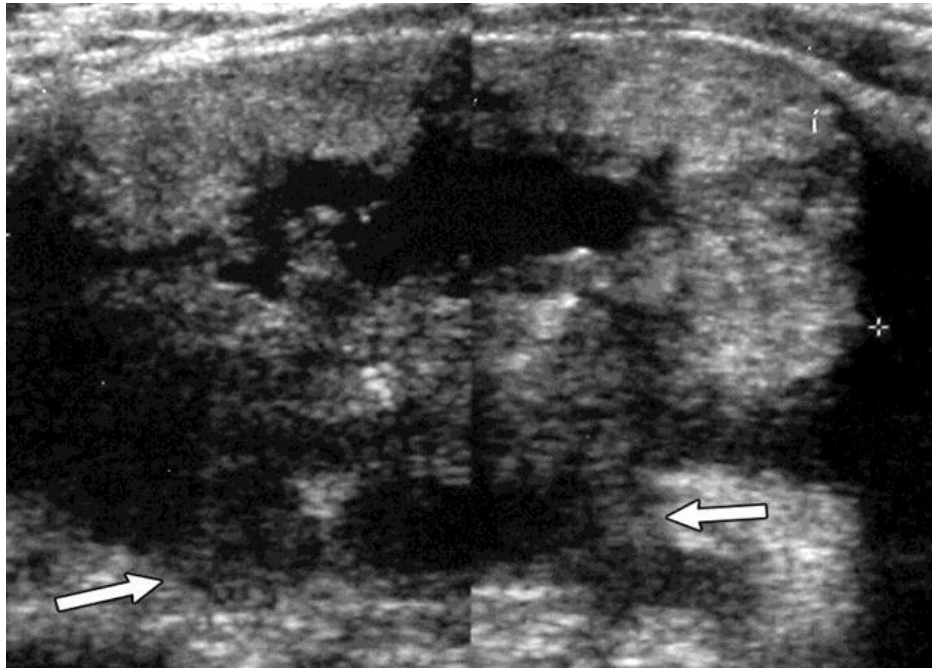


Fig (2.13) Transverse grey scale sonogram shows a large, solid, hypoechoic mass (arrows) occupying the right lobe of thyroid gland. Note the presence of extra-thyroid spread posteriorly (arrowheads). Histology: anaplastic carcinoma. (www.wikipedia.com)

### **2.7.5.3.3 Medullary carcinoma:**

It represents 5%-10% of all thyroid cancers. It is usually a well-circumscribed mass that contains granular micro-calcifications in half the cases. Cervical lymph node metastases frequently occur. (Carol, 1993)

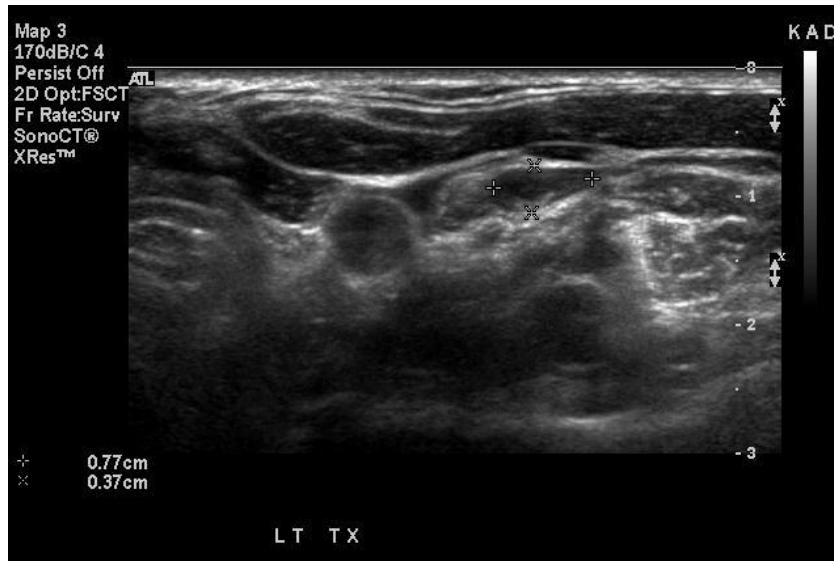


Fig (2.14) sonogram shows medullary carcinomas are typically solid, hypoechoic, and often have coarse central calcifications. ([www.wikipedia.com](http://www.wikipedia.com))

#### 2.7.5.3.4 Follicular carcinoma:

It is the most common malignant thyroid neoplasm in the older age group. The tumor may be solitary or multiple and tends to involve the stromal tissue, blood vessels, and adjacent structures. . (Carol, 1993)

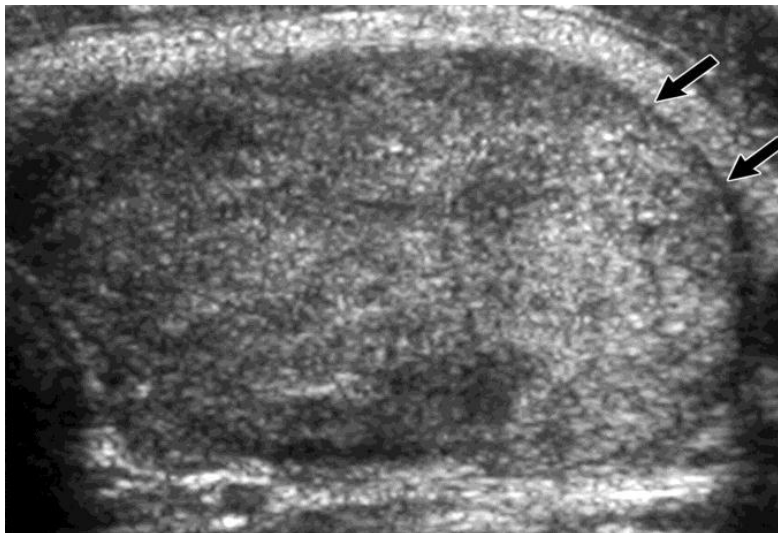


Fig (2.15) longitudinal grey scale sonogram shows a well-defined hyper echoic nodule (arrows) in the left lobe of thyroid gland suggestive of a follicular lesion. ([www.wikipedia.com](http://www.wikipedia.com))

### **Sonographic characteristics of malignant nodules:**

- Most commonly a solid complex mass with heterogeneous echo pattern and irregular margins.
- Carcinomas usually are more hypoechoic than normal thyroid tissue.
- Hemorrhage, necrosis, and calcification may be present.
- A halo is present in a small percentage of cases. . (Carol A. Krebs, 1993)

### **2.7.5.3.5 Lymphoma:**

Lymphoma accounts for 1%–3% of all thyroid malignancies. An antecedent history of Hashimoto's thyroiditis is commonly present. Thyroid involvement is more commonly seen in non-Hodgkin's lymphoma than in Hodgkin's disease. The typical clinical presentation is an elderly female with a rapidly enlarging neck mass. (Carol, 1993)

### **Sonographic characteristics of lymphoma:**

- Most commonly a well-defined hypoechoic mass.
- Decreased echogenicity of entire gland occurs because of frequently associated with Hashimoto's thyroiditis.
- There may be associated nodal involvement. (Carol, 1993)





Fig (2.16) longitudinal grey scale sonogram shows an ill-defined, solid, and hypoechoic nodule in the thyroid gland (lymphoma). (www.wikipedia.com)

#### **2.7.5.4 Thyroid metastases:**

The metastases to the thyroid gland are infrequent. Metastases to the thyroid are due to haematogenous spread, most commonly from primary melanoma, breast carcinoma, renal cell carcinoma, lung carcinoma and colonic carcinoma. (Carol, 1993)

#### **Sonographic characteristics of metastases:**

Most commonly an irregular mass with mixed echo pattern and irregular walls.

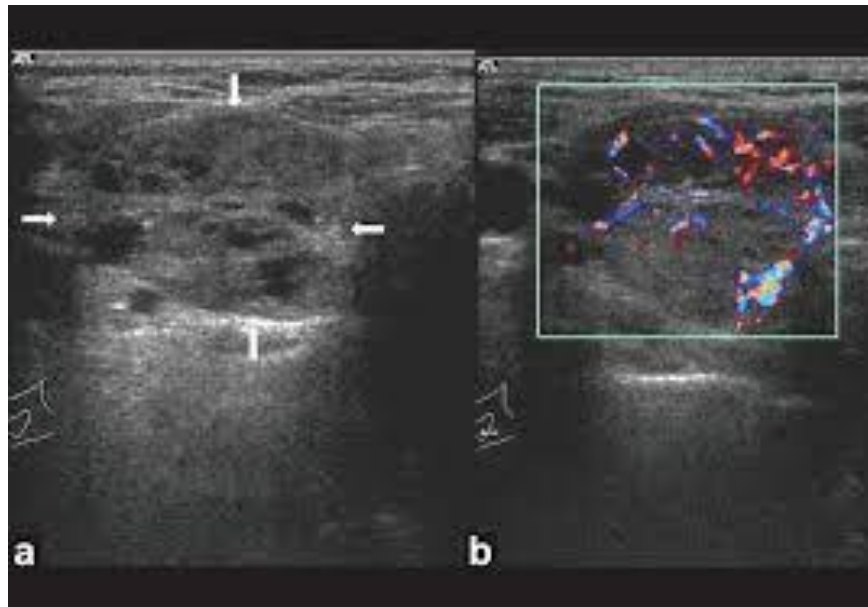


Fig (2.17) Transverse grey scale sonogram in a patient with known breast carcinoma shows a well-defined solid, homogeneous hypoechoic mass occupying the right lobe of thyroid. FNAC confirmed a metastatic carcinoma. (www.wikipedia.com)

## **2.7.6 Congenital conditions:**

### **2.7.6.1 Ectopic Thyroid:**

Thyroid tissue located other than the normal position anterior to laryngeal cartilages. During embryological development, the thyroid gland migrates down from the foramen caecum at the posterior aspect of the tongue, to its permanent location. This normal migration can be halted at any point, or it can go 'off-target' with thyroid tissue coming to rest in unusual location within the neck. (Jananai, 2015)

### **2.7.6.2 Thyroglossal Cyst:**

Is the most common clinically significant congenital anomaly of the neck, is the neck mass or lump that develops from the cells and tissue remaining after formation of thyroid gland during embryonic development it is most commonly diagnosed in preschool age children or during mid- adolescence, and often appears after an upper respiratory infection when it enlarges and become painful. (Jananai, 2015)



Fig (2.18) ultrasound image shows Thyroglossal duct cyst. (www.wikipedia.com)

## 2.8 Previous studies

Khalf Allah (2006) studied the Gray scale ultrasound assessment of thyroid swelling in Kadogli city, from report that the incidence of thyroid diseases is more frequent in females (80%) and only (20%) were males, the most common age group affected by thyroid diseases was in range of (10-40) years. The diffuse and multi nodular goiter were the more common types of goiter representing (40%) for each type.

Ahmed (2011) studied Ultrasound of patients with abnormal thyroid scintigraphy, 50 patients who have abnormal thyroid scintigraphy findings, then ultrasound was done, in that study female to male ratio is (4:1), and the majority patients either from western Sudan 40% or from north 38%, the age group of most patients (76%) falls in range between (25-55) years. Ultrasound revealed (62%) of patents have multi nodular goiter, (26%) diffuse enlarge goiter, (10%) solitary nodule, and (2%) thyroid cyst.

Saied (2014) studied the Characterization of thyroid nodules using ultrasound in Sudanese, in that study the sample was randomly selected (50) patients. The female patients were more than male in the sample (84%). The age group of patients rang between (16-65) years old. The result of this study showed that 48% of patients had normal thyroid volume 50% of patients had increase in volume, while 2% of patients had decrease in volume. Ultrasonography showed 86% of patients had homogeneous echotexture, while 14% of patients had heterogeneous echotexture. The study also showed 60% of patients had multiple nodules, while 40% of patients had solitary nodules.

Caren (2014) studied the Role of Ultrasonography in thyroid swellings; Ultrasound is one of the most valuable tools available. It can effectively differentiate between different types of thyroid masses and intrathyroidal pathologies. Inflammatory and neoplastic changes can be appreciated well. It can be used as a screening tool to detect thyroid neoplasia. In that study 200 cases of thyroid swellings were enrolled. Out of those 180 (90%) were females and 20(10%) were males, sex ratio being 9:1. Age distribution ranged from 11-76 years. Most of the patients presented with complain of neck swellings (84%), followed by swallowing difficulty, pain, fever. On USG examination nodular thyroid disease was the most common presentation.

Abdel Haleem (2005) studied the Role of high frequency ultrasound in diagnosis of thyroid pathologies. Revealed that using ultrasound the image of foci of disease within the gland are easily identified, especially using high frequency probes which enable solid nodules up to approximately 3mm to be revealed. In non-nodular thyroid disease the ultrasonic structure guides the diagnosis (Thyroiditis, Graves' disease).

# **Chapter Three**

## **Materials and Method**

## **Chapter three**

### **Materials and Method**

This study is descriptive, analytical study deal with ultrasound findings in patients with thyroid pathology which was conducted in Khartoum state, Antalya medical center and Ibrahim Malik hospital between the periods of October 2016-February 2017.

#### **3.1 Materials:**

##### **3.1.1 Patients:**

All patients who presented with thyroid problems were investigated by U/S, 50 patients of them were selected randomly to this study.

##### **3.1.2 Equipment used:**

The researcher used sonoscape ultrasound machine model SSI 8000. The features of the machine are superior contrast, high resolution, 2D and 4D imaging, with multi-frequency linear array transducer (7.5 to 10 MHz) which has variable focal zone and frequency capability. Proper setting of the overall gain (system) gain and time gain or depth gain compensation (TGC/ DGC) was adjusted to optimally visualize each organ.

A coupling agent is necessary to ensure good acoustic contact between the transducer and skin and allow total transssimation of the sound beam.



Fig (3.1) shows SonoScape ultrasound machine

## **3.2 Methods:**

### **3.2.1 Technique used:**

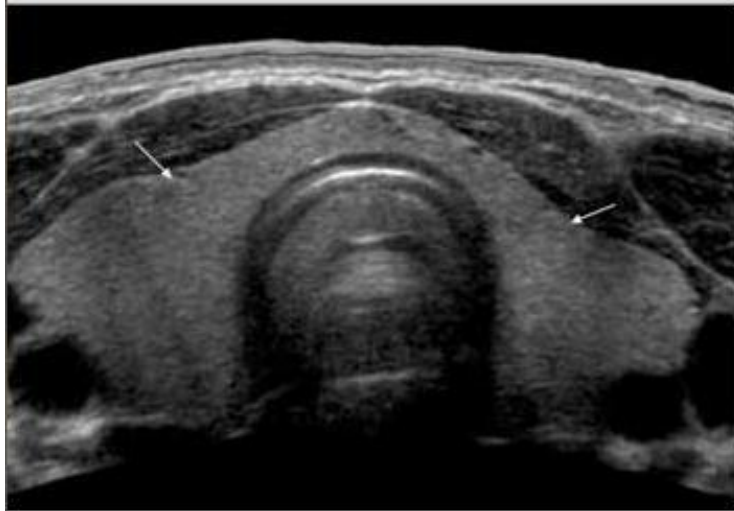
The patient should be examined in the supine position with the neck extended. Scanning should be done in sagittal, transverse, and oblique planes to optimally visualize the common carotid artery, internal jugular vein, both lobes of the thyroid as well as the isthmus.

### **3.2.2 Image interpretation:**

To ensure combined validity and reliability the ultrasound results was verified by experience sonographer who had expertise in performing ultrasound scanning.



### **3.2.3 Sonographic appearance:**



**Fig (3.2) transverse scans of normal thyroid gland.**

### **3.2.4 Data collection:**

Data will be collected by special design data collecting sheet from an ultrasound scan.

### **3.2.5 Data analysis:**

By using Excel program and the result were presented in form of graphs and tables.

### **3.2.6 Ethical consideration:**

Justice and human dignity was observed by treating selected patients equally when telling them to participate in the research as sample of this Study. The patients were free to decide whether to participate or not.

No identification or individual details were published.

# Chapter Four

## Results

## Chapter four

### Results

#### 4.1 Results:

Table (4.1) : Frequency distribution of patients under study according to gender.

Table (1) Gender

<b>Gender</b>	<b>frequency</b>	<b>percentage</b>
male	5	10%
female	45	90%
total	50	100%

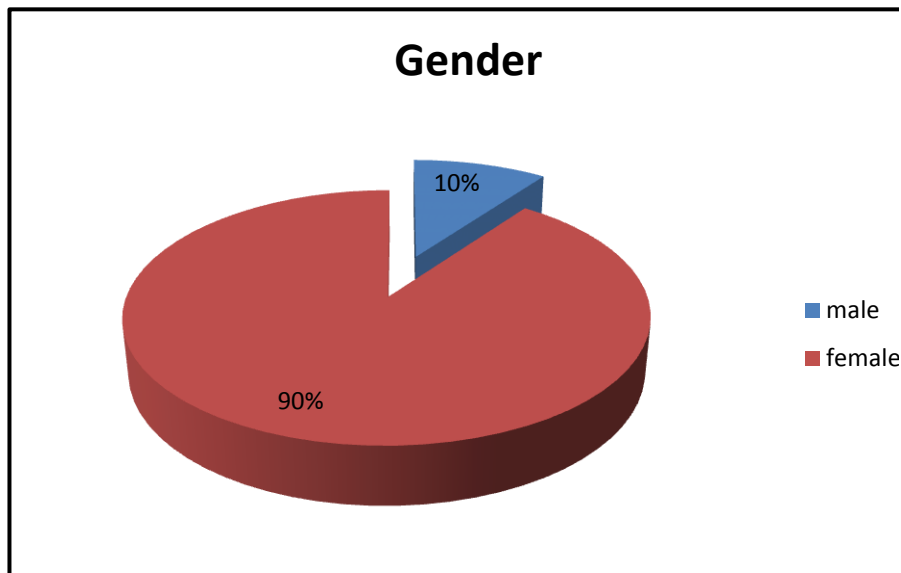


Figure (4.1) : Frequency distribution of patients under study according to gender.

Table (4.2) : Frequency distribution of patients under study according to age.

Table (2) Age

Age	Frequency	percentage
Less than 20 years	2	4%
From 20 to 30	11	22%
From 31 to 40	12	24%
From 41 to 50	14	28%
From 51 to 60	10	20%
Greater than 60 years	1	2%
total	50	100%

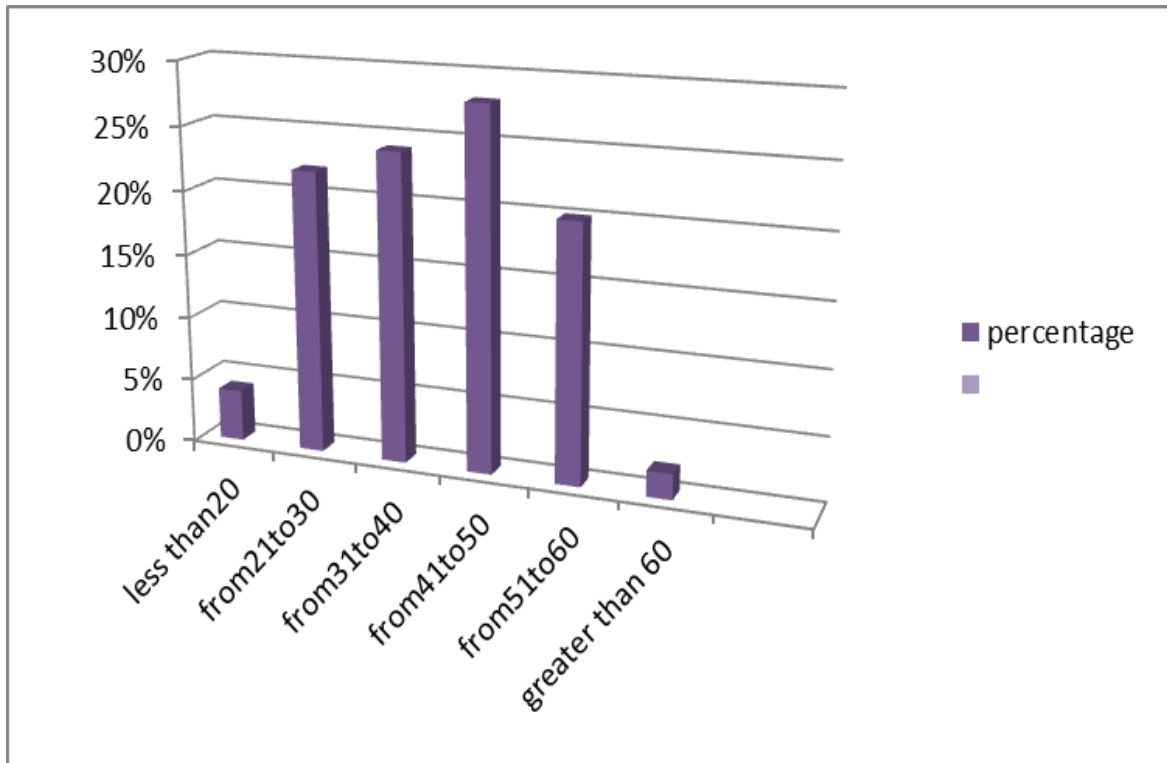


Figure (4.2) : Frequency distribution of patients under study according to age.

Table (4.3) : Frequency distribution of patients under study according to origin.

Table (3) Origin

<b>Origin</b>	<b>frequency</b>	<b>percentage</b>
North	11	22%
South	2	4%
West	13	26%
Middle	24	48%
East	0	0%
Total	50	100%

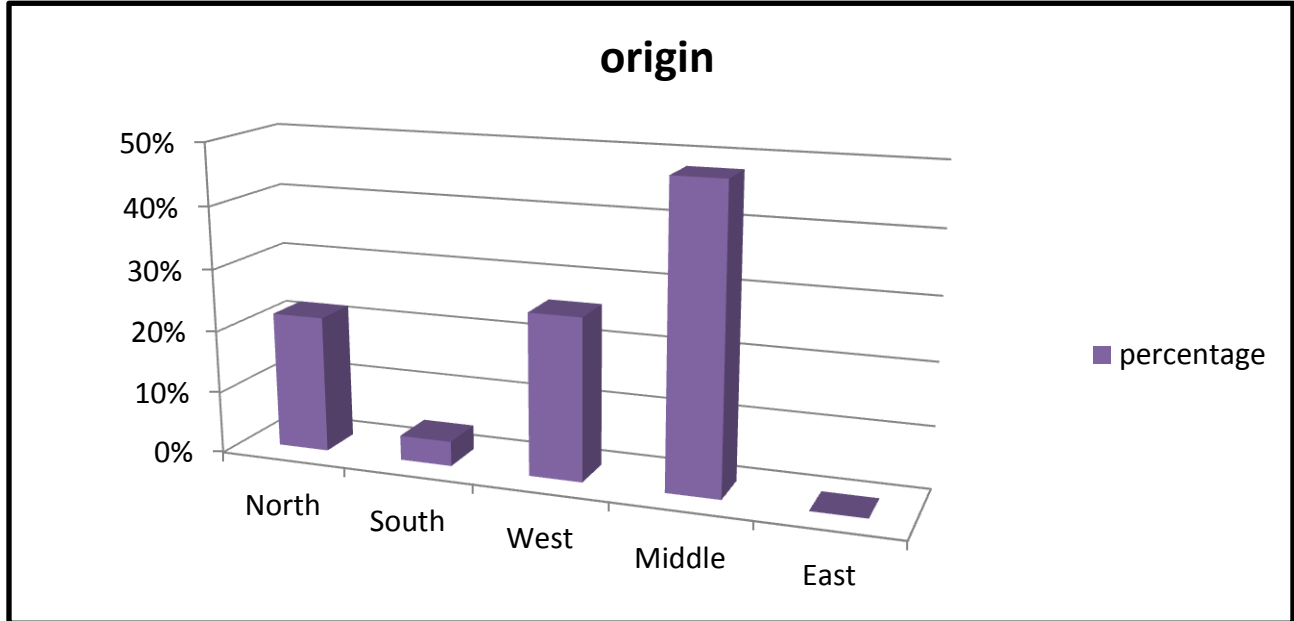


Figure (4.3) :Frequency distribution of patients under study according to origin.

Table (4.4) : Frequency distribution of patients under study according to symptoms.

Table (4) Symptoms

Symptoms	Frequency	Percentage
Palpation	29	58%
Neck swelling	20	40%
Loss of weight	24	48%
sweating	16	32%

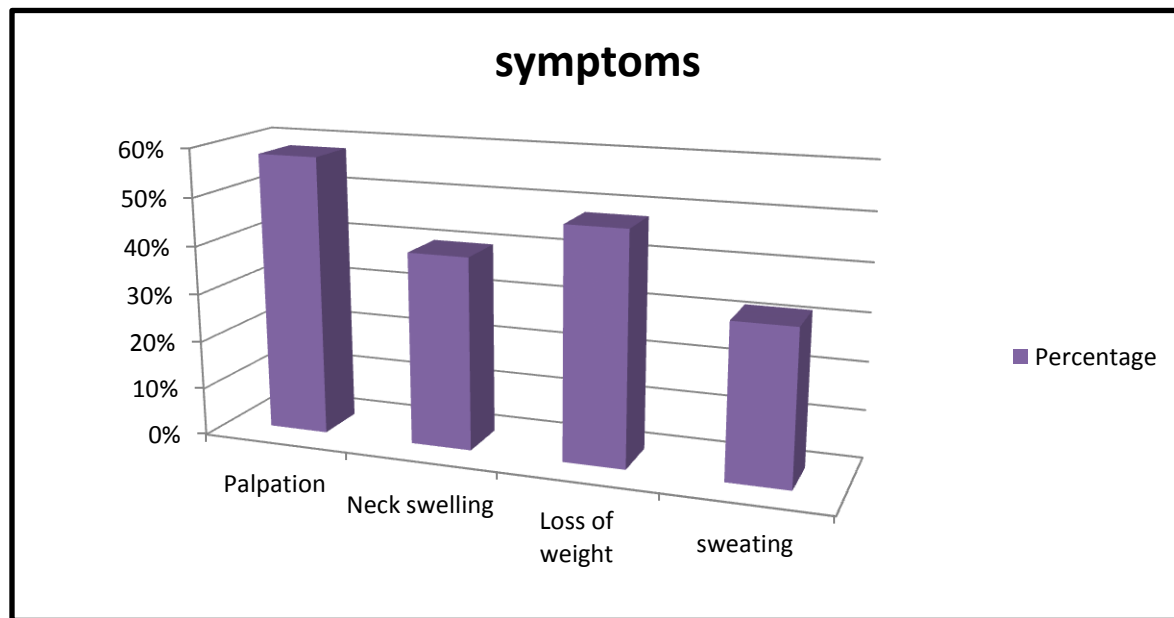


Figure (4.4) :Frequency distribution of patients under study according to symptoms.

Table (4.5) : Frequency distribution of patients under study according to signs.

Table (5) Signs

<b>Signs</b>	<b>frequency</b>	<b>Percentage</b>
Tachycardia	35	70%
Eye sign	5	10%
Finger tremor	9	18%

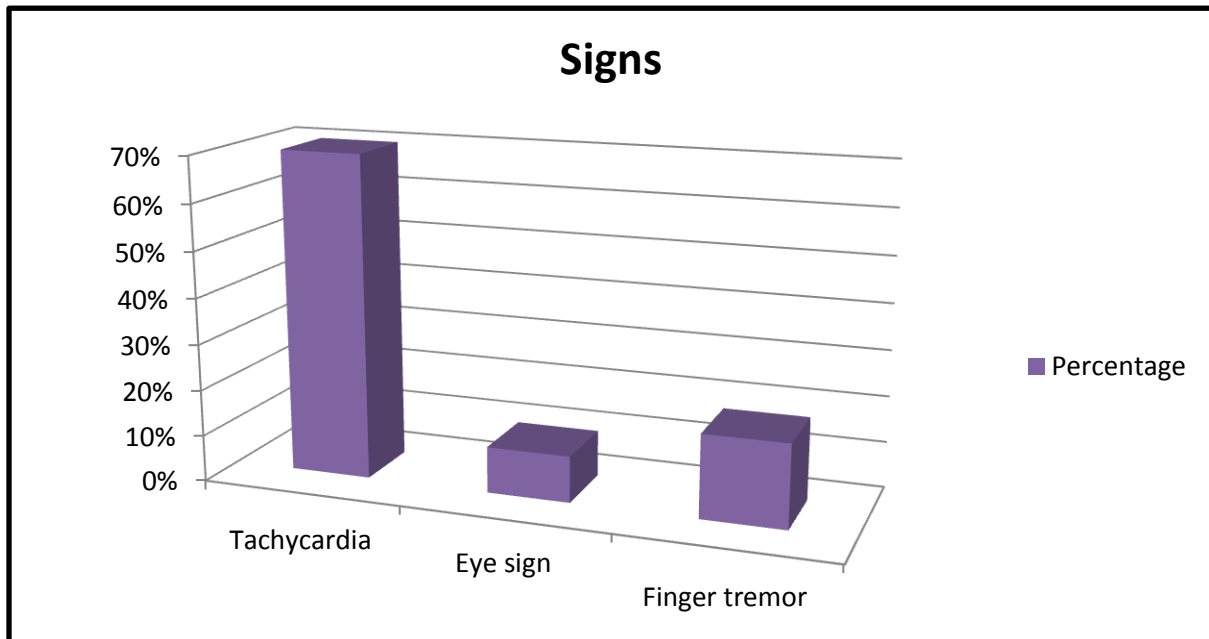


Figure (4.5) :Frequency distribution of patients under study according to signs.

Table (4.6) : Frequency distribution of patients under study according to ultra sound findings.

Table (6) ultra sound findings

<b>U/S findings</b>	<b>Frequency</b>	<b>Percentage</b>
Nodular change	26	52%
Cystic change	16	32%
Calcification	6	12%
Diffuse increase in size	21	42%
Retro sternal extension	1	2%

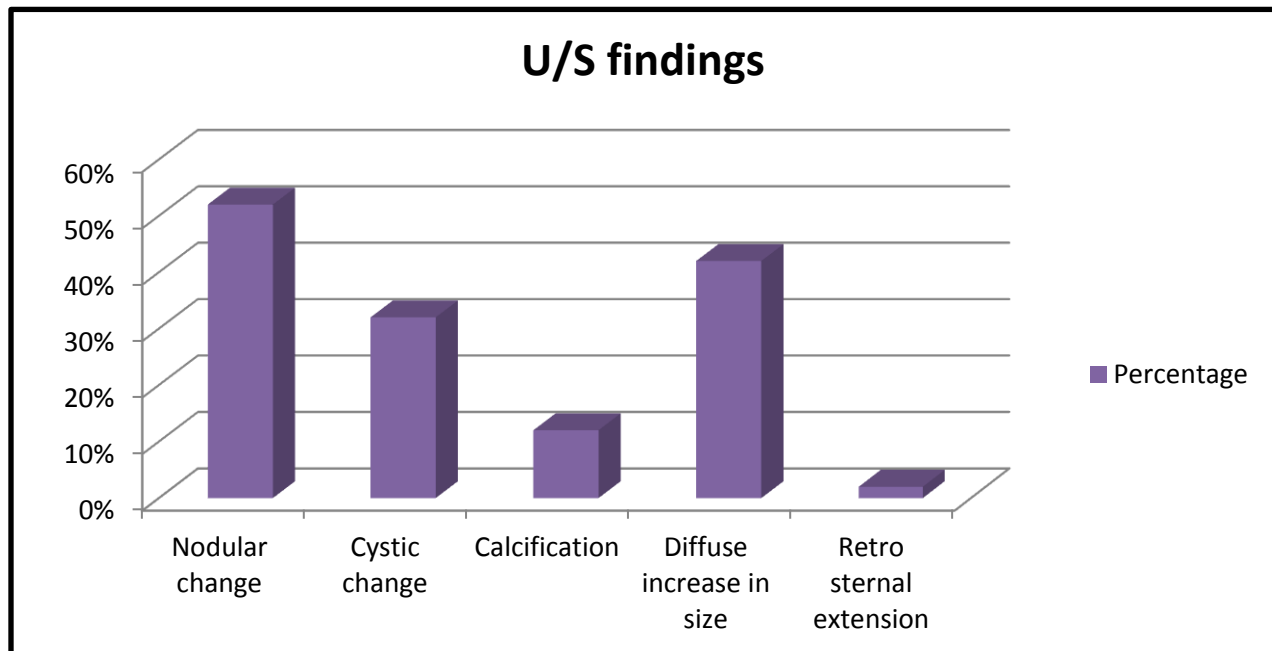


Figure (4.6) :Frequency distribution of patients under study according to ultra sound findings.



Table (4.7) : Frequency distribution of patients under study according to texture of thyroid gland .

Table (7) Texture

<b>Texture</b>	<b>Frequency</b>	<b>Percentage</b>
Homogenous	40	80%
Heterogonous	10	20%
Total	50	100%

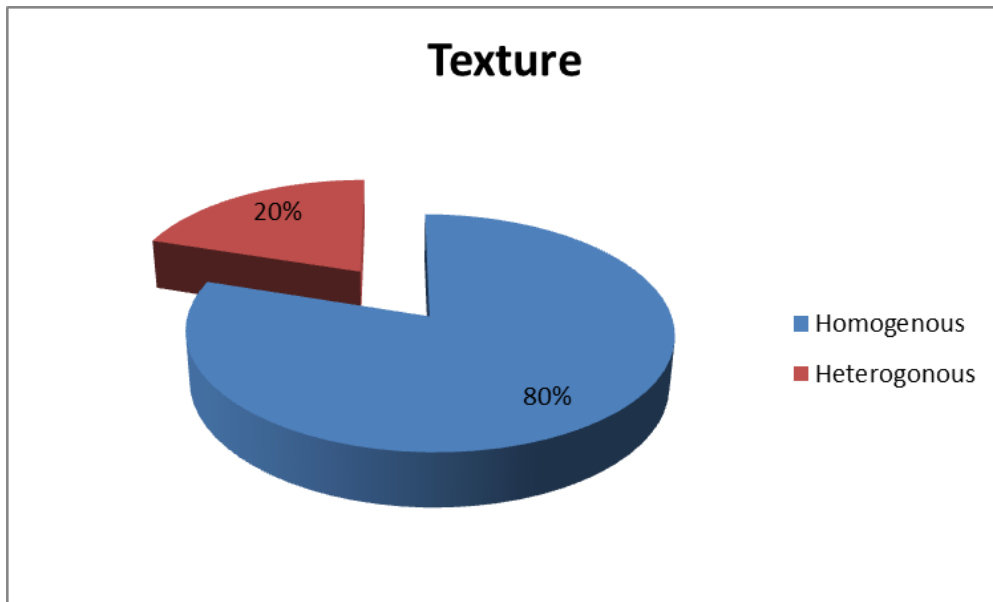


Figure (4.7) :Frequency distribution of patients under study according to texture of thyroid gland.

Table (4.8): Frequency distribution of patients under study according to conclusion of U/S findings.

Table (8) conclusion

Conclusion of U/S finding	Frequency	Percentage
Simple goiter	13	26%
Multi nodular goiter	23	46%
Diffuse goiter	10	20%
Toxic goiter	4	8%
Total	50	100%

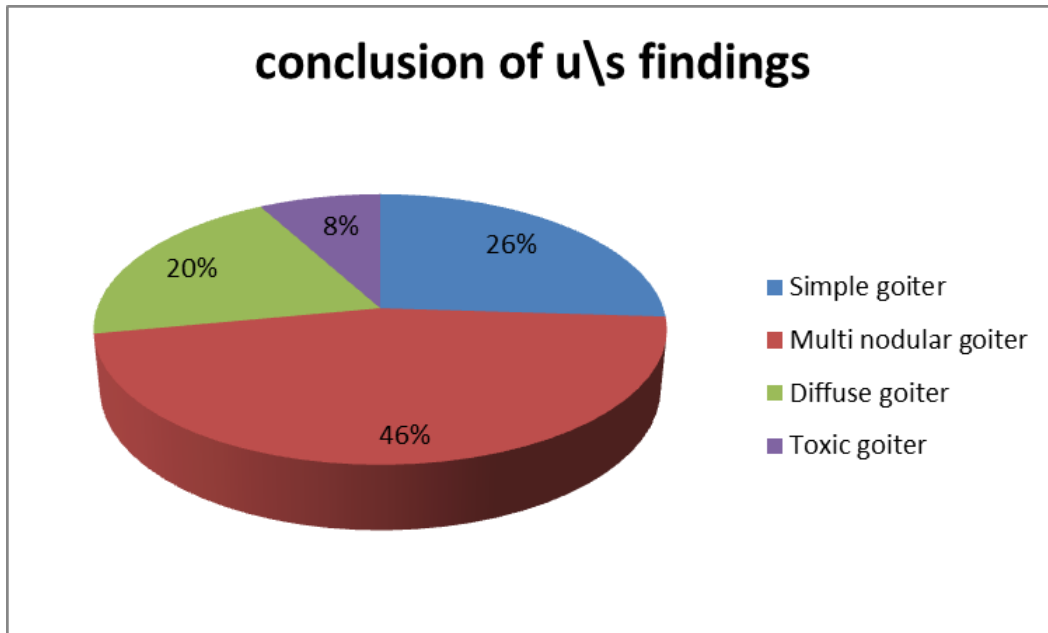


Figure (4.8) :Frequency distribution of patients under study according to conclusion of u/s findings.

# **Chapter Five**

**Discussion, Conclusion and Recommendations**

## Chapter five

### Discussion, Conclusion and Recommendations

#### 5.1 Discussion:

Thyroid disease increased in incidence during the last years in Sudan. Using of ultrasound in assessment of thyroid gland, give the clinician a clear picture about the anatomical and functional abnormalities of the gland that is beside other investigations like laboratory and histology investigations.

In this study 50 patients had done ultrasound, the majority of this study populations are females (90%), (table 1), so this reflect the incidence of thyroid diseases is more frequent in female gender, this result agree with a research was conducted on 2014 by Saffa A. Hassan, that is showed the female patients were more than male in the sample (84%), and agree with research was conducted on 2006 by Khalf Allah Abd Allah Hamid, that showed that the incidence of thyroid diseases is more frequent in females (80%) and only (20%) were males.

Most affected group are those of age range between (20-50) years, and the incidence of the thyroid diseases was decreased in group of age less than 20 years and above to 60 years.(table 2), This agree with a research was conducted on 2011 by Ahmed Ali Elhaj Mohammed, that showed the age group of most patients (76%) falls in range between (25-55) years.

The thyroid disease may be affected by geographic areas, and this may occur due to deficient of some diet factors including the iodine, the study revealed that the most affected areas with thyroid pathologies in Sudan is the middle of Sudan (48%) followed by the west of Sudan (26%), and the less affected area is the east of Sudan (0%).(table 3). That is similar agree with a research done by Ahmed Ali Elhaj on 2011 showed that the majority patients either from western Sudan 40% or from north 38%.

Some patient come with many symptoms and signs, in this study revealed that the most symptoms associated with thyroid pathologies is palpation (58%), and the most sign is tachycardia (70%).(table 4and 5).

The ultrasound finding revealed that most of thyroid pathologies associated with diffuse increase in size of thyroid gland (42%), nodular changes (52%), cystic changes (32%), calcification (12%), and retrosternal extension (2%).(table 6).

This study assessed the texture of the thyroid gland and most of cases had homogenous echo texture (80%), and the others had heterogeneous echo texture (20%).(table 7)This agree with research was done on 2014 by Safaa Alameen Hassan, that is revealed ultrasonography showed 86% of patients had homogeneous echotexture, while 14% of patients had heterogeneous echotexture, and this result dis agree with research done on 2006 by KHalaf allah Abd Allah, which were the majority of patients had heterogeneous echotexture, which represent 84% .

The conclusion of ultrasound finding revealed that (46%) of patients had multinodular goiter, (26%) simple goiter, (20%) diffuse goiter, and (8%) toxic goiter.(table 8) this agree with research done on 2011 by Ahmed Ali Elhaj Mohammed, which showed the majority of patients have multi nodular goiter (62%).

## **5.2 Conclusion:**

- The ultrasound has high accuracy in detecting thyroid pathologies, especially in small nodules.
- The ultrasound has limitation in differentiation between benign and malignant tumors.
- The study found that the most affected group with thyroid pathologies are female and their ages between 31-50 years.
- The common thyroid disease of this study is simple goiter.
- The middle region of Sudan has a high frequency of patient with thyroid pathologies.

### **5.3 Recommendations:**

1. The ultrasound has a big role in detecting thyroid pathologies that is support the need of ultra sound machines in each hospital and medical centers.
2. Thyroid scanning should be planned as one of the basic necessary exam to aid in diagnosis, management and follow up.
3. More training programmed should be planned for Sonographers and sonologists in the field of ultrasound especially in thyroid scanning to give accurate results.
4. Use modern equipment with high quality.
5. Doppler ultrasound is important for more accurate result.
6. Another research studies should be done with expanding period of time and include more sample data for more precise and accurate results.

## References:

- 1- Steven M. Penny, Examination Review for Ultrasound, 2011, Lippincott Williams, 351west Camden Street.
- 2- Carol A. Krebs, Ultrasound Atlas of Disease Process, 1993, Appleton and Lange, 25 Vanzant Street.
- 3- Jananai Parkkunam, Role of Ultrasound in Thyroid Disorders,2015, Otolaryngology Journal, 8, 2250-0359
- 4-Caren Dsouza, Role of Ultrasonography in Thyroid Swelling, 2014, International Journal of Medical Research, ISSN: 0976-9633.
- 5-Michael Mckinley, Human Anatomy, 2006.
- 6-Mohsen I. Siddig, Characterization of Thyroid Nodules in Khartoum State using Ultrasound, 2013, MS.C Research.
- 7-Carol M. Rumach, et al. Diagnostic ultrasound, 2011, fourth edit, Mosby, Inc., an affiliate of Elsevier Inc.
- 9-Biatta Sholosh, Amir A. Borhanni, Thyroid Ultrasound Technique and Diffuse Disease, 2011, Elsevier Inc.
- 10- Khalf Allah A. Hamid, Gray scale ultrasound assessment of thyroid swelling, 2006, MS.C Research.
- 11- Ahmed A. Elhaj, Ultrasound Study of Patients with Abnormal Thyroid Scintigraphy , 2011, MS.C Research.
- 12- Abdel Haleem M. Abd Alla, Role of High Frequency Ultrasound in Diagnosis of Thyroid Pathologies, 2005, MS.C Research.
- 13- Saied A. Hassan, Characterization of thyroid nodules using ultrasound in Sudanese, 2014, MS.C Research.
- 14-Robert A.sofferman, Ultrasound of the Thyroid and Parathyroid Glands, Springer Science+Business Media, LLC, 233 Spring Street, New York, NY 10013, USA.



15- <http://www.endocrineweb.com/TFT.html>

16- [www.wikipedia.com](http://www.wikipedia.com).

## Appendix (1):

### Figures



Fig (1): Sagittal gray scale of thyroid gland on female 35 years show diffuse goiter.



Fig (2): Transverse gray scale of thyroid gland on female 25 years show diffuse goiter.



Fig (3): Transverse gray scale of thyroid gland on female male 50 years shows diffuse multinodular goiter.



Fig (4): Transverse gray scale of thyroid on Male 56 years shows MNG



Fig (5): Sagittal gray scale of thyroid gland on Female 31 years shows solitary nodule in left lobe.

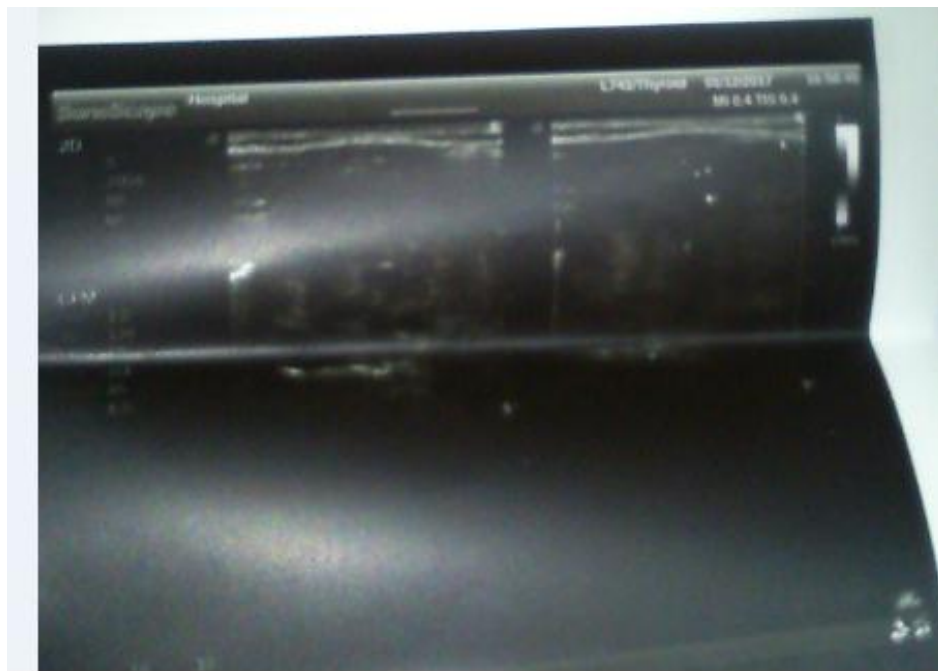


Fig (6): Transverse gray scale of thyroid gland on Female 53 years shows MNG.



Fig (7): Transverse gray scale of thyroid gland on Female 35 years shows MNG

## Appendix (2):

### Data collection sheet

#### 1- Patient information

- PT gender: Female ..... male.....
- PT age ..... Years
- Origin .....

#### 2- Clinical features:

- **Symptoms:**
  - Palpation Yes ( ) No ( )
  - Loss of weight Yes ( ) No ( )
  - Sweating Yes ( ) No ( )
  - Neck swelling Yes ( ) No ( )
- **Signs:**
  - Eye sign Yes ( ) No ( )
  - Tachycardia Yes ( ) No ( )
  - Finger tremor Yes ( ) No ( )

#### 3\_ Sonographic findings:

- Calcification Yes ( ) No ( )
- Cystic changes Yes ( ) No ( )
- Nodular changes Yes ( ) No ( )
- Retro sternal extension Yes ( ) No ( )
- Diffuse increase in size Yes ( ) No ( )

#### 3- Echo texture of thyroid:

Homogeneous ( ) Heterogeneous ( )

#### 4- Conclusion: .....