CHAPTER ONE

1-1 Introduction:

The thyroid is a ductless endocrine gland that regulates the metabolic function through the production of three hormones thyroxine(T4),triiodothyronine (T3) and thyrocalcitonin. It's highly vascular organ that secretes its hormone directly into the blood stream. *(Carol -1981)*

The thyroid gland is part of endocrine system that maintains body metabolism, growth and development through the synthesis, storage and secretion of thyroid hormones. *(Sandra -2001)*

High-resolution ultrasound is used to evaluate the thyroid gland as it lies superficially within the neck. The examination is easy to perform and well tolerated by patients. *(Sandra 2001)*

The thyroid gland consist of two lateral lobes connected by an isthmus and is located at the front and sides of the neck. Each lobe measures approximately 5cm in length,3cm in width and 2cm in depth. *(Carol 1981)*

Thyroid ultrasound provides the best information about the shape and structure of the thyroid gland. It can identify very small nodules and can differentiate between solid and cystic nodules. *(Sandra-2001).*
The term "thyroid nodule" refers to any abnormal growth that forms a lump in the thyroid gland. (Sandra -2001).

Thyroid nodule can occur in any part of the gland. Some nodules can be felt quite easily, while others can be hidden deep in the thyroid tissue or located very low in the gland where they are difficult to feel.

Ultrasound of the thyroid is used to define the texture of palpable lesions, determine if the lesion is single or multiple, the size and location of the nodules as well as evaluation of adjacent lymph node adenopathy may be imaged by ultrasound. (Sandra -2001).

Ultrasound is used to define the anatomic structures within the thyroid gland rather than physiology of the gland. (Sandra -2001).

Cysts are almost always no cancerous (benign), although in some cases the fluid may be taken out for additional testing.

If there are several masses or nodules, this indicates the presence of enlargement of thyroid gland (goiter). If there is only one mass, it may be cancerous and needs further evaluation. Specialized thyroid ultrasound such as color Doppler flow studies can add valuable information by showing an image of blood circulation in the gland, this study can assess some ambiguous masses in greater details, to further refine diagnosis.

In some cases, needle could be inserted to remove some tissue for evaluation in laboratory [needle biopsy], ultrasound is used during this procedure to help the physician guide the needle to the mass needs to be evaluated. Also cystic lesions could be evaluated.

These days, with modern imaging studies such as ultrasound (US), computerized tomography (CT), and magnetic resonance imaging (MRI),
more and more thyroid nodules are being found incidentally. This means the nodules are found during studies that are being done for reasons other than examination of the thyroid gland.

Although the majority of thyroid nodules are benign (not cancerous), there is nodules do contain cancer. Therefore, the primary purpose for evaluating a thyroid nodule is to determine whether cancer is present.

Blood tests should be done to assess the function of the thyroid. These tests include the thyroid hormones, T3 and T4, and the hormone that stimulates the thyroid gland to produce thyroid hormone, called thyroid stimulating hormone (TSH). The laboratory test for the thyroid can measure amount of T3 or T4 in the blood. This amount is elevated in patients with hyperthyroidism and decreased in patients with hypothyroidism. (Sandra -2001)

1-2: Problem of the study:

The use of ultrasonography in diagnosing thyroid nodules is very rare because most surgeons referred the patients to lap rotary to know what the histopathology of thyroid nodule is (malignant or benign). The cell type thyroid nodules are confirmed by fine needle aspiration only in many hospitals.

Ultrasound may also will be of a good benefit in diagnosing whether thyroid nodule is malignant or benign through specific sonographic criteria.
1-3: **Objectives of the study:**

**1-3-1: General objectives:**

To evaluate the sonographic features of thyroid nodules versus biopsy

**1-3-2: Specific objectives:**

- To classify the thyroid nodule by using the grayscale and color Doppler
- To determine the sonographic finding of thyroid nodules which include margin, texture, size and echotexture
- To show if thyroid nodules contain microcalcification or not
- To show the vascularity of thyroid nodules by using color Doppler

**1-4: Hypotheses:**

Diagnosing of malignancy and benignity of thyroid nodules can be done by using gray scale ultrasound and Doppler study
CHAPTER TWO

Literature Review

2-1: Anatomy:

The normal thyroid gland is a brownish–red highly vascular endocrine gland consisting of two lobes connected across the midline by an isthmus.

Each lobe extends superiorly up to the oblique line of thyroid cartilage and inferiorly to the fourth or fifth tracheal rings, while the intervening isthmus overlies the second and third tracheal rings. The gland weighs about 20-25 gm in the adult and enlarges physiologically at puberty and during menstruation and pregnancy. (GALAL- 2013)

2-1-1: Development of thyroid gland:

The thyroid develops from a bud which pushes out from the floor of the pharynx; this outgrowth then descends to its definitive position in the neck. It normally loses all connection with its origin which is commemorated, however, by the foramen caecum at the junction of the middle and posterior thirds of the tongue and by the inconstant pyramidal lobe on the isthmus.

:Structure of thyroid gland :2-1-2

The thyroid gland is surrounded by fibrous sheath. Microscopically it is seen to consist of follicles lined by cuboidal epithelial cells. The space
which these cells surround is occupied by a jelly-like iodine-containing substance called colloid which comprises the stores of thyroid hormones.

(Fig (2-1)

Fig (2-1) Microscopic structure of the thyroid gland

2-1-3 Relational anatomy:
The thyroid gland consists of two lateral lobes connected by an isthmus and is located at the front and the side of the neck. Each lobe measure approximately 5 cm in length, 3 cm in width and 2 cm in depth. The thyroid is usually symmetrical with the right lobe larger than the left lobe. The lateral or superficial surface is convex and covered by the skin, the superficial and deep fascia, the sternocleidomastoid muscle, the strap muscles and visceral layer of the deep fascia. The cone-shaped lobes have their apices directed upwards and lateral to the mid portion of the thyroid cartilage. The medial thyroid surface is molded over of trachea, esophagus, and the superior and inferior thyroid arteries. While the posterolateral edge overlaps the parathyroid glands and the common carotid arteries. The size and shape of thyroid gland varies with gender, age and body surface area, with females having a slightly larger than males. In tall
individuals, the lateral lobes of thyroid have longitudinally elongated shape on sagittal scan, where as in shorter individuals the gland is more oval. As a result, the normal dimensions of the gland have a wide range of variability. The lobes are equally normal in size in newborn, the gland measures 18 to 20mm in long, with an anterior posterior \( \{ \text{AP} \} \) diameter of 8 to 9mm, By 1 year of age the mean length is 25mm and the AP diameter is 12 to 15 mm. \textbf{(Sandra -2001)}

The isthmus is the smallest part of the gland and measure 2 to 6 mm in its AP diameter. \textbf{(Sandra -2001)}

Anteriolateral. Along the anterior surface of thyroid gland lie the strap muscles, including sternothyroid, omohyoid, sternohyoid and sternocliedmastoid. The sternohyoid and omohyoid are seen in ultrasound as a thin, hypoechoic band anterior to the gland the srenocliedmastoid muscle is seen as a large oval band that lies anterior and lateral to the gland. \textbf{(Sandra -2001)}

Posteriolateral. Posteriolateral anatomy includes the carotid sheath with common carotid artery, internal jugular vein, and vagus nerve. The longus colli muscle is posterior and lateral to each thyroid lobe and appears as a hypoechoic triangular structure adjacent to the cervical vertebrae. \textbf{(Sandra -2001)}

Medial anatomy consists of larynx, trachea, inferior constriction of pharynx, and esophagus. The esophagus primarily a midline structure, maybe found to the left of trachea. The posterior border of each lobe is related posteriorly to the superior and inferior parathyroid d glands and the anatomic between the superior and inferior thyroid arteries. \textbf{(Sandra-2001)} (Fig 2-2)
Fig (2-2) **Gross** Anatomy of the thyroid and surroundings.

(From: Netter FH, The Ciba Collection of Medical Illustrations, vol. 4, Endocrine system and selected metabolic disease.)
2-1-4 Blood supply:

The arterial blood supply of the thyroid gland very is very rich

Superior thyroid arteries, branches of external carotids

Inferior thyroid arteries arising from thyrocervical trunks of the subclavian arteries. (Galal-2013)

The thyroid gland has an abundant blood supply. It has been estimated that the normal flow rate is about 5 ml/g of thyroid tissue each minute. The blood volume of normal humans is about 5 liters and total blood flow 5 liters/min. This mass moves through the lungs about once a minute, through the kidneys once in five minutes, and through the thyroid approximately once an hour. Although the thyroid represents about 0.4% of body weight it accounts for 2% of total blood flow. In disease the flow through the gland may be increased up to 100-fold. (Christophe. www.thyroidmanager.org)

This abundant blood supply is provided from the four major thyroid arteries. The superior pair arises from the external carotid and descends several centimeters through the neck to reach the upper poles of the thyroid, where they break into a number of branches and enter the substance of the gland. The inferior pair spring from the thyrocervical trunk of the subclavian arteries and enter the lower poles from behind. Frequently, a fifth artery, the thyreoidea ima, from the arch of the aorta, enters the thyroid in the midline. There are free anastomoses between all of these vessels. In addition, a large number of smaller arteriolar vessels derived from collaterals of the esophagus and larynx supply the posterior aspect of the thyroid. The branching of the large arteries takes place on the surface of the gland, where they form a network. Only after much
branching are small arteries sent deep into the gland. These penetrating vessels arborize among the follicles, finally sending a follicular artery to each follicle. This, in turn, breaks up into the rich capillary basket like network surrounding the follicle. (Christophe. www.thyroidmanager.org)

The veins emerge from the interior of the gland and form a plexus of vessels under the capsule. These drain into the internal jugular, the brachiocephalic, and occasionally the anterior jugular veins (Christophe. www.thyroidmanager.org).
2-1-5 Lymphatic's:

Lymph from the upper part of the gland drains to the upper deep cervical nodes, that from the lower pars drains to paratracheal nodes of the superior and middle mediastinum. (Christophe.www.thyroidmanager)

2-1-6 Innervations:

The gland receives fibers from both sympathetic and parasympathetic divisions of the autonomic nervous system. The sympathetic fibers are derived from the cervical ganglia and enter the gland along the blood vessels. The parasympathetic fibers are derived from the vagus and reach the gland by branches of the laryngeal nerves. Both myelinated and nonmyelinated fibers are found in the thyroid, and occasionally in the ganglion cells as well. The nerve supply does not appear to be simply a secretory system. The major neurogenic modifications of thyroid physiology have to do with blood flow and are reviewed in Chapter 4. However neurotransmitters have direct effects on thyroid follicular cells, which vary from one species to another. The physiological relevance of these effects remains to be proved. (Christophe.www.thyroidmanager.org)

2-2 Thyroid physiology:

Thyroid gland is ductless endocrine gland that regulates metabolic function through the production of three hormones; thyroxine \{T4\}, Triiodothyronine \{T3\} and thyrocalcitonin. It is highly vascular organ that secretes its hormones directly into the blood stream. (Carol -1981)

The thyroid gland is a part of endocrine system that maintains body metabolism, growth, and development through the synthesis, storage and
secretion of thyroid hormones. These hormones are triiodothyronine\{T3\} and thyroxin\{T4\} and calcitonin. \textbf{(Carol -1981)}

The mechanism, for producing thyroid hormones is iodine metabolism. The thyroid gland traps iodine from the blood and, through a series of chemical reactions, produces the thyroid hormones \{T4\} \{T3\}. These is stored in the colloid of the gland. When the thyroid hormones are needed by the body, it is released into the blood stream by the action of thyrotropin, or thyroid-stimulating hormones \{TSH\}, which is produced by pituitary gland. \textbf{(Carol -1981)}

The secretion of TSH is regulated by thyrotropin-releasing factor, which is produced by hypothalamus \{located in the brain\}. The level of thyrotropin releasing factor is controlled by the basal metabolic rate, a result of low concentration of thyroid hormones, causing an increase in thyrotropin-releasing factor. This causes increased secretion of TSH and a subsequent increase in the release of thyroid hormones. When the blood level of the hormones is returned to normal, the basal metabolic rate returns to normal and TSH secretion stop. \textbf{(Carol -1981)}.

Calcitonin decreases the concentration of calcium in the blood by first acting on bone to inhibit its breakdown. With less bone being reabsorbed, less calcium moves out of bone into blood. Calcitonin secretion increases after any concentration of blood calcium increase. Thus calcitonin helps to maintain homeostasis of blood calcium. It helps prevent an excess of calcium in the blood \{hypercalcemia\} from occurring. \textbf{(Carol -1981)}.

The immediate control of synthesis and liberation of T3 and T4 is by thyroid stimulating hormone (TSH) produced by anterior pituitary. TSH is
secreted in response to the level of thyroid hormones in the blood by a negative feedback mechanisms. *(Ellis 12Edition).*

2-3 **Sonographic evaluation of the thyroid:**

The patent should be lying on his back (supine) with the neck hyper extended over a pillow under shoulders. The pillow should be about 10 cm thick. *(Palmer- 1995)*

We use 7.5MHz linear transducer, if available, if not use 5 MHz linear or a convex probe *(Palmer- 1995)*

Scan should be done in both longitudinal and transverse planes with oblique projection if necessary. *(Palmer- 1995)*

During the examination, it may be necessary to rotate the head from left and right. Particularly for vascular studies. *(Palmer- 1995)*

Sonographer should obtain a patient history before the ultrasound examination. Pertinent information regarding the patients general health, thyroid medication, previous imaging studies(i.e., scintigraphy), family history of hyperparathyroidism or thyroid cancer, or prior history of radiation or surgery to the neck should be noted in the examination record. *(Sandra -2001)*

The patient is placed in the supine position with the pillow under both shoulders to provide a moderate hyperextension of the neck. This position allows the lower lobes of the gland to be more readily visualized with ultrasound. *(Sandra -2001).*

A high-resolution linear 7.5 to 10 MHz transducer should be used. Each lobe requires careful scanning in both longitudinal and horizontal planes. The lateral, mid and the medial parts of each lobe are examined in the longitudinal plane and so labeled. *(Sandra-2001).*

The superior, mid and the inferior portions of the gland are examined individually and labeled in the transverse plane. If possible the patient
head should be turned to the opposite side to enable better visualization of each lobe. Having the patient swallow allows visualization of lower pole of thyroid gland. These raise the entire gland and bring the lower pole in the field of view. (Sandra -2001).

Land marks for the transverse image include the common carotid artery, the trachea and the jugular vein. The common carotid artery is circular pulsatile structure directly adjacent to the gland. The oval- shape jugular vein is lateral to carotid artery. The trachea is noted in the middle of the neck with posterior shadowing. (Sandra-2001).

Transverse and longitudinal images of the isthmus must also be obtained. The examination must be extending laterally to include the region of carotid artery and jugular vein to identify enlarged cervical lymph nodes. (Sandra -2001).

2-4 Sonographic characteristic:

1. The thyroid characteristically is homogenous structure of medium – level echogenecity situated on either side of the trachea with an isthmus joining right and left lobes. The common carotid arteries and jugular veins are circular sonolucent vessels that lie lateral to the thyroid in the transverse plane and serve as land mark for localization. (Carol -1981) Fig 2-3 and 2-4.

2. The sternocliedmastoid,longus coli and strap muscles are hypo echoic Compared to the thyroid tissue. (Carol -1981).

3. The superior and inferior thyroid vessels best seen in the longitudinal plane. (Carol -1981).
2-5. Thyroid pathology:
2-5-1 Thyroid cyst:

Cysts are thought to represent cystic degeneration of a follicular adenoma.

The degenerative changes of nodules correspond to their sonographic appearance. Purely cystic fluid results from serous or colloid fluid. (Sandra -2001)

Thyroid cyst is a fluid-filled sac that has grown on the thyroid. The cyst may be very small (less than 1 mm in diameter) or so large that it may be visible to the naked eye, appearing as a lump on your throat. Some cysts are entirely filled with fluid ("cystic") and others are composed of both fluids and solids ("complex"). If the cyst is large and complex, a doctor may want to biopsy its components to make sure that it is not cancerous.

People with smaller cysts (3mm or smaller) on their thyroid typically don't have any symptoms. Most of these people will not realize that they have a cyst until a doctor discovers it during an exam.

People with larger cysts do not necessarily have any symptoms either, although they may feel or see a lump at the base of their throat. However, sometimes those with large cysts may feel it pressing against their windpipe, have pains in their neck, have trouble swallowing, or less frequently, have a change in the tone and quality of their voice as it presses against their vocal cords. Cysts are rarely cancerous, but malignant cysts tend to feel hard, grow large quickly, and cause a change in your voice more often than benign cysts. Occasionally large cysts can affect the function of your thyroid and cause you to overproduce or under-produce the hormone that stimulates the thyroid (thus causing a hyperactive or under-active thyroid).
Simple cysts are relatively uncommon, accounting for approximately 20 percent of all thyroid nodules. These lesions are usually solitary and considered benign. (Caro-1981)

Cyst may cause thyroid enlargement and displace adjacent structures. Hemorrhage into the cyst occasionally occurs. (Carol -1981)

The sonographic characteristic of the thyroid cyst is an echoic well circumscribed with smooth walls and posterior enhancement. Hemorrhage within the cyst may produce low-level echoes and septations. Also single, small papillary projection may sometimes be seen arising from the wall of the cyst. (Palmer- 1995). Fig( 2-5)

Fig (2-5): simple thyroid cyst

By Prof Dr A Rahman
2-5-2 Thyroiditis:

Thyroiditis is an inflammatory condition that primarily occurs in women, present as diffusely enlarged thyroid, and is generally associated with pain and tenderness of the affected area. Thyroiditis can be divided into the following categories:

1- Acute pyogenic: results from pyogenic infection and produces the classic symptoms of fever, pain and elevated leukocytes count.

2- Riedel thyroiditis: usually occurs in middle-aged women. It is secondary to fibrosis and results in thyroid becoming hard.

3- DeQuerians thyroiditis: occurs secondary to viral infection. Especially of the respiratory tract.

4- Hashimotos thyroiditis: is the most common inflammatory disease of the thyroid. This condition usually occurs in patients with autoimmune disease incites a massive infiltration of lymphocytes. (Carol-1981)

Clinical findings:

Patients may present with pain, tenderness, elevated temperature, leukocytosis, gland enlargement and possible weight loss. (Carol-1981)

Sonographic characteristics:

- Most commonly decreased echogenicity of diffusely enlarged gland.
- Associated abscesses appear as irregular sonlucent areas, which may contains hemorrhage or depress.
• There may be echogenic structures with posterior acoustic shadowing representing calcification.
• Hypoechoic nodules may occur due to lymphocytic infiltration.
• Echo texture between the nodules may be heterogeneous because of fibrosis especially in hashimoto thyroiditis (Carol -1981)

Fig (2-6).

Fig (2-6): Enlarged thyroid lobe with decrease echogenecity and showed multiple small sonolucent area represents abscess.
2-5-3 Goiters:

Goiter is any enlargement of thyroid gland which due to compensatory hypertrophy and hyperplasia of the follicular epithelium caused by a derangement that hampers hormone secretion. Other causes of goiter include Gravis disease, thyroiditis, neoplasm or a cyst. *(Sandra-2001)*

The overall glandular structures varies from diffuse uniform enlargement to distortion by various mixed tissue elements. These elements may include cysts, enlarged follicle containing colloid. Thickened enlarged vessels, or individual nodules. There may be associated hemorrhage, calcification and necrosis. These various histological patterns result in the following classification:

- **Simple non toxic goiter**: Diffuse enlargement of the thyroid that is not associated with hyperthyroidism.
- **Nodular or multi nodular goiter**: Enlarged thyroid with multiple nodule, usually. Asymmetrical and complex due to adenomatous changers and degeneration. Can be classified as toxic [hyperthyroidism] or non toxic [hypothyroidism].
- **Diffuse toxic goiter**: Diffuse enlargement associated with hyperthyroidism [graves disease] this condition, often progresses to multi nodular goiter.
- **Colloid goiter**: Thyroid enlargement with the gland appearing soft due to follicle distended with colloid.
- **Endemic goiter**: Diffuse enlargement of the thyroid that develop in certain geographic location due to low iodine content in the normal diet. *(Carol-1981)*
Clinical findings:

Patients may present with diffuse thyroid enlargement and palpable mass the patient may show evidence of hyper or hypothyroidism. *(Carol -1981).*

Sonographic characteristics:

- Depending on the type of goiter, the lesion may have a highly variable appearance ranging from diffuse homogenous enlargement to a complex mass.
- A goiter may contain rounded, son lucent cystic component or have multiple nodular components and distorted glandular structure.
  - Fibrosis septa may produce linear echogenic bands.
  - Hemorrhage, calcification, necrosis or cystic degeneration may occur. *(Carol -1981)* Fig (2-7)
Fig (2-7): scan demonstrate enlarged thyroid gland containing multiple nodules.

2-5-4 Adenoma:

Thyroid adenoma is the benign growth within the thyroid gland. It may be associated with thyroid hormone secretion but it does not have malignant characteristics. . (Carol -1981)

Adenomas are the most common benign tumor of the thyroid and usually occur in the younger age groups. They are solid tumors composed of epithelial cells that form a recognizable glandular structure. This neoplasm's tend to be solitary but can be multiple .They can be functioning or none functioning. Depending on the dominant histological pattern. The tumor may be classified as a fetal, empymonal, a typical, or Hurthle cells. . (Carol -1981)

Clinical finding:  Signs and symptoms of hyperthyroidism, Palpable neck mass. . (Carol -1981)

Sonographic characteristic:  
1-Most commonly a well encapsulated solid mass of homogenous echogenicity.
2- An adenoma may have cystic degeneration or calcification.
3-A characteristic feature is a 2 to 3mm son lucent halo around the periphery, which represents compressed thyroid tissue and capsules. (Carol -1981). Fig (2-8)
Thyroid cancer is the most common endocrine malignancy. A relatively rare neoplasm, it occurs most often in women over age of 40. It usually solitary and variable size. There is an increase incidence of thyroid malignancies in individual who previously have been treated with x-ray therapy in childhood for lymphadenitis, acne, or other condition of face, neck, or chest. (Carol-1981)

There are four primary types of thyroid carcinoma:

1- Papillary (65percent) The most common type of thyroid malignancy that is usually found in patients below age 40 and more frequently in females. The tumor may be extremely small or up to 10cm in
diameter. The tumor is complex and contain cystic areas, papillary projection, degeneration, fibrosis and calcification. It spreads via lymphatic and frequently involves cervical lymph nodes. Papillary thyroid cancer is one the least aggressive malignancies and is associated with decreased function of the gland.  . (Carol-1981)

2-Follicular (15 percent) the most common thyroid neoplasm in the older age group. The tumor may be solitary or multiple and tend to involve stromal tissues, blood vessels and adjacent structures.  . (Carol-1981)

3-Medullary (10 percent) less common than other thyroid malignancies. It is usually a well-circumscribed that contain granular micro calcification in half the cases. Cervical lymph nodes metastasis may occur. . (Carol-1981)

4-Anaplastic (10 percent) highly malignant, rapidly growing, and aggressive tumor that usually occurs after age 60. This tumor is commonly associated with nodular goiter . (Carol-1981)

The metastasis behavior of thyroid carcinoma varies according to its cell type. Papillary carcinoma most frequently spreads to regional lymph nodes. Follicle carcinoma rarely invades local lymph nodes, but often involves venous structures and spreads to distant sites. Ana plastic malignancies spread widely, both to cervical nodes and other part of the body, especially lungs and bone . (Carol-1981)

**Clinical finding:**

Patients may present with rapidly growing palpable mass, pain and tenderness, difficulty swallowing, and lymph node enlargement. . (Carol-1981).
Sonographic characteristic:

1- Most commonly a solid complex mass with heterogeneous echo pattern and irregular margins.
2- Carcinomas are more hypo echoic than normal thyroid tissues.
3- Hemorrhage, necrosis, and calcification may be present fig (2-9).
4- The tumor may contain papillary projection.
5- Attenuation of the sound beam results from solid, dense composition of the tumor.
6- A halo is present in small percentage of cases.
7- Enlarged lymph nodes may be seen with papillary and Anaplastic tumors. *(Carol 1981)*

Fig (2-9) Solid thyroid mass containing small foci consistent with calcification
2-5-6 Lymphoma:

Lymphomas (generally non- Hodgkin's) represents 4 percent of thyroid malignancies. Usually affecting the elderly women. Lymphoma most often involves both lobes, though it may be unilateral. There is strong association with hashimoto thyroiditis. The 5 years survival rate for thyroid lymphoma varies widely depending on the stage of the tumor at the time of detection. (Carol 1981)

Clinical finding:

Patients may present with rapid enlargement of the thyroid gland, enlarged lymph nodes, and obstructive symptoms relating to the esophagus and trachea. (Carol-1981)

Sonographic characteristic:

1-Most commonly a well –defined hypoechoic mass.

2-Decreased echogenecity of the entire gland occurs because of the frequently associated hashimoto thyroiditis fig (2-10).

3-There may be associated nodal involvement. (Carol A-1981)
Fig(2-10) Huge hypoechoiv well-defined mass

2-5-7 **Metastases:**

Metastases to the thyroid can occur by direct extension from adjacent structure, retrograde lymphomatic spread, or through blood- burned dissemination. Although most any malignancy can spread to the thyroid, the most frequent tumor is carcinomas of the kidney, breast, lung and melanoma. *(Carol-1981)*

**Clinical finding:**

Patients may present with palpable thyroid nodule that is rapidly increase in size. *(Carol -1981)*

**Sonopraphic characteristics:**

Most commonly an irregular mass with mixed echo pattern and irregular. *(Carol-1981)*

2-6 **Fine Needle Aspiration**

Fine needle aspirate (FNA) of a nodule, a type of biopsy, is the most common direct way to determine what types of cells are present in the thyroid gland and in nodules. The needle is very small, and while the procedure is simple and can be done in a doctor’s office, anesthetic usually is injected into the tissues traversed by the needle. Fine needle aspiration is possible if the nodule is easily felt. If the nodule is more difficult to feel, fine needle aspiration can be performed under the
guidance of ultrasound. The needle is inserted into the thyroid gland or the nodule and cells are withdrawn. Usually, several samples are taken in order to give the best chance of detecting abnormal cells. The cells are then examined by a pathologist under a microscope. The value of fine needle aspiration is dependent on the experience of the physician performing the procedure as well as the pathologist reading the specimen.

Diagnoses that can be made from fine needle aspiration include:

- **Benign thyroid tissue** (non-cancerous), which can be consistent with Hashimoto's thyroiditis or a colloid nodule or cyst. This result is obtained in about 60% of biopsies.
- **Cancerous tissue** (malignant), consistent with the diagnosis of papillary, follicular, or medullary cancer. This result is obtained in about 5% of biopsies. The majority are papillary cancers.
- **Suspicious biopsy**, showing a follicular adenoma. Though usually benign, up to 20% of these nodules are found ultimately to be cancerous.
- **Non-diagnostic**, usually because not enough cells are obtained. If repeated, up to 50% of these cases will be able to be diagnosed as benign, cancerous, or suspicious.

One of the most difficult problems for a pathologist is to be confident that a follicular adenoma—usually a benign nodule—is not a follicular cell carcinoma or cancer. In these cases, it is up to the physician and the patient to weigh the option of surgery on a case-by-case basis, with less reliance on the pathologist's interpretation of the biopsy. It is also important to remember that there is a small (3%) risk that a benign nodule diagnosed by fine needle aspiration may still be cancerous. Thus, even benign nodules should be followed closely by the patient and physician.
Another biopsy may be necessary, especially if the nodule is growing. While most thyroid cancers are not very aggressive, that is, they do not spread rapidly, the exception is poorly differentiated (anaplastic) carcinoma, which spreads rapidly and is difficult to treat.

2-7: Previous studies

2-7-1 (Koo et al-2009) who studied cystic thyroid nodules after aspiration mimicking malignancy: sonographic characteristics, he found that benign cystic nodules after aspiration can have suspicious malignant features. However, shadowing and a halo associated with malignant features are characteristic findings of cystic nodule shrinkage. Awareness of these findings and correlation with the FNA history can aid in preventing unnecessary FNA.

2-7-2 (Gonzalez et al -2010) who studied diagnostic Efficiency of sonographic findings of thyroid nodules in the detection of malignancy, they found that thyroid cytology is an efficient method to evaluate thyroid nodules larger than 10 mm. The presence of nodule microcalcifications is significantly associated with malignancy, while hyperechogenicity and anechogenicity are associated with benign nodules.

2-7-3: (Haber et al 2010) who studied role of ultrasonography in the diagnosis and management of thyroid cancer, they found that ultrasonography is valuable in the diagnosis and management of thyroid cancer.

2-7-4: (Popli.et al.-2011) who studied utility of gray-scale ultrasound to differentiate benign from malignant thyroid nodules; they found that gray-scale USG features of thyroid nodules are useful to distinguish patients with clinically significant thyroid nodules from those with innocuous nodules despite the overlap of findings. From our study, it is apparent that the USG findings of poorly defined margins, marked hypoechogenicity,
microcalcifications, and a taller-than-wider shape have a high diagnostic accuracy for identifying malignant thyroid nodules.

2-7-5: (Moon et al 2010) who studied, can vascularity at power Doppler US help predict thyroid malignancy, they found that vascularity itself or a combination of vascularity and gray-scale US features was not as useful as the use of suspicious gray-scale US features alone for predicting thyroid malignancy.

2-7-6: (Ozel et al 2010) who studied the diagnostic efficiency of ultrasound in characterization for thyroid nodules: how many criteria are required to predict malignancy, they found that by using ultrasound, thyroid nodules can be characterized effectively. The number of the US features used in this distinction varies in respect to the nodule size.

2-7-7: (Park YJ et al 2012) who studied thyroid nodules with macrocalcification: sonographic findings predictive of malignancy, they found that sonographic characteristics of macrocalcification such as interruption, irregular thickness and the presence of soft tissue rim were associated with malignancy in thyroid nodules with macrocalcifications

2-7-8: (Alam T, et al 2014) who studied diagnostic accuracy of ultrasonography in differentiating benign and malignant thyroid nodules using fine needle aspiration cytology as the reference standard, they found that ultrasonography has a high diagnostic accuracy in detecting malignancy in thyroid nodules on the basis of features like echogenicity, margins, micro calcifications and shape.

2-7-9: (Lee MJ et al 2012) who studied partially cystic thyroid nodules on ultrasound: probability of malignancy and sonographic differentiation, they found that completely solid nodules, microcalcifications are associated with an increased risk of malignancy
2-7-10: (Ibrahim Y, et al 2015) who studied the impact of thyroid nodule size on the risk of malignancy in follicular neoplasms, they found that increased thyroid nodule size does not increase the malignancy rate for follicular neoplasms.

2-7-11: (Woliński K et al 2014) which studied use fullness of different ultrasound features of malignancy in predicting the type of thyroid lesions: a meta-analysis of prospective studies, they found that the taller-than-wide shape of the thyroid nodule was shown to be the strongest predictor of malignancy.
CHAPTER THREE

Methodology

:Study Design 3-1

Crossectional methods in which practical tests and analysis are done

3-2 Areas of study:

A-Wad Medan Teaching Hospital.

B-University Diagnostic Centre.

C-Abu Osher Hospital.

3-3 Duration of the study:

From April 2011 to March 2015

3-3 Study Population Sampling:

Sample size of hundred patients, male and female.

Inclusion criteria: All patients with thyroid nodules

Exclusion criteria: patients with normal thyroid ultrasound

3-4 Study variables:

Patient Name, Gender, Age, residency and Occupation.

Shape of Thyroid nodule, Vascularity, Echogenicity, number and size of thyroid nodules.
Clinical indication of patients had thyroid nodule.

Results of histopathology of each nodule which done by fine needle aspiration.

3-5 Tools of data collection:

The data was collected on carefully prepared forms specially designed for this thesis (Appendix). The sheet is made up of one paper include following information:

- Patient identification and this include name, age, occupation, residence and tribe.

- Clinical indications which include neck pain, palpable neck mass, difficulty in swallowing or breathing, sign of hypo or hyper thyroidism and weight loss.

- Ultrasound finding which include shape of thyroid nodule (regular or irregular), vascularity of nodule by using color Doppler, Echogenicity of nodule (cystic, solid and complex), size of thyroid nodule and if there is calcification within the nodule or not.

- Fine needle aspiration results (benign or malignant)

3-6 Equipment used:

- Toshiba, linear probe used 7.5 MHz PLM – 703 AT. Toshiba medical system corporation, Japan.

- Aloka, linear probe used 7.5 MHz UST – 934 N. Aloka co. LTD. Japan
3-7 **Patient preparation:**

Some facilities recommend limiting food and drink for one hour before the study to prevent discomfort. No other preparation is needed.

3-7-1 **Patient position:**

The patient is placed in the supine position with the pillow under both shoulders to provide a moderate hyperextension of the neck. This position allows the lower lobes of the gland to be more visualized with ultrasound.

3-7-2 **setting the correct gain:**

Vary the gain to obtain best image of thyroid gland

3-7-3 **Scanning technique:**

The thyroid gland is small and can be seen entirely by some transducer, but it's still evaluated by viewing the lobes individually.

**Transverse scanning**

Transverse plane anterior approach

1. Begin with the transducer perpendicular to the sterna notch.

2. Move the transducer slightly superior and towards patient's right, lateral enough to view the right lobe from its medial to lateral margins.

3. Keep the transducer perpendicular and scan superiorly through and beyond the right lobe to the level of the mandible. Note the isthmus medially.
4. Move the transducer inferiorly form the mandible back through and beyond the inferior margin of the right lobe to the level of sterna notch.

5. Move the transducer slightly superior and toward the patient's left, lateral enough to view the left lobe from its medial to lateral margins.

6. Keep the transducer perpendicular and scan superiorly through and beyond the right lobe to the level of mandible. Note the isthmus medially.

7. Move the transducer inferiorly form the mandible back through and beyond the inferior margin of the right lobe to the level of sterna notch.

8. Move to the midline of the sterna notch and scan superiorly.

Longitudinal scanning

Sagittal plane anterior approach

9. Begin with the transducer perpendicular at the midline of the sterna notch.

10. Move the transducer slightly superior and towards patient's right, enough to view the right lobe from its superior to inferior margins.

11. Keep the transducer perpendicular and scan towards patient's right laterally through and beyond the right lobe.

12. Move back onto the lobe and scan through to the mid line and the isthmus.

13. From the midline move the transducer slightly toward the patient's left, enough to view the left lobe from its superior to inferior margins.
14. Keep the transducer perpendicular and scan towards patient’s left laterally through and beyond the left lobe.

15. Move back onto the lobe and scan through to the mid line and the isthmus.

Imaging the inferior portion of the lobes can be improved by having the patient swallow. This raises the land superiorly.

The examination must be extending laterally to include the region of carotid artery and jugular vein to identify enlarged cervical lymph nodes.

3-8 Fine needle aspiration:

Fine Needle Aspiration were done to nodules by surgeon and radiologist and then referred to the laboratory to confirm the nature of tissues cells whether benign or malignant

3-9 Data analysis:

Analysis of data was done by using a computerized process to evaluate the role of ultrasound to describe the sonographic appearance of malignant and benign thyroid nodules.

3-10 Data presentation:

The data was presented in tables and graphs.

3-11 Ethical consideration:

Ethical consideration was given to the right confidentially and anonymity of the research participants. Anonymity was achieved by using numbers for each research participants that would provide link between the
information collected and the participants. In addition confidentially was ensured by making the collected data accessible only to the researcher and consultant radiologist. The right to equality will be ensured by giving each patient the same facilities and the privacy of each patient was considered, so no individual patients detail throughout this study. Justice and human dignity was absorbed by treating selected patients equally when telling them to participate in the research as a sample of this study. The patients were free to decide whether to participate or not.
CHAPTER FOUR

The Results

4-1 The Gender Finding:

Table (4-1): Number of males and females

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Number of patients</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>74%</td>
<td>74</td>
<td>Female</td>
</tr>
<tr>
<td>26%</td>
<td>26</td>
<td>Male</td>
</tr>
<tr>
<td>100%</td>
<td>100</td>
<td>Total</td>
</tr>
</tbody>
</table>

Fig (4-1): Number of males and females

4-2: The age finding:
Table (4-2): Gender and age frequencies

<table>
<thead>
<tr>
<th>Sex</th>
<th>Range of age</th>
<th>No of pts</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>26-40</td>
<td>13</td>
<td>13%</td>
</tr>
<tr>
<td>Male</td>
<td>25-40</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>Female</td>
<td>41-55</td>
<td>26</td>
<td>26%</td>
</tr>
<tr>
<td>Male</td>
<td>41-51</td>
<td>10</td>
<td>10%</td>
</tr>
<tr>
<td>Female</td>
<td>56-66</td>
<td>35</td>
<td>35%</td>
</tr>
<tr>
<td>Male</td>
<td>52-66</td>
<td>14</td>
<td>14%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Fig (4-2): Gender and age frequencies

4-3: The residency finding:

Table (4-3): Residence frequencies

<table>
<thead>
<tr>
<th>Residence</th>
<th>No of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

39
Fig (4-4): Site of patients

<table>
<thead>
<tr>
<th>Site of Tribe</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Sudan</td>
<td>10%</td>
</tr>
<tr>
<td>Eastern Sudan</td>
<td>30%</td>
</tr>
<tr>
<td>Central Sudan</td>
<td>60%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**4-4 Shape of thyroid nodule:**

Table (4-4): Shape of thyroid nodules
<table>
<thead>
<tr>
<th>Shape of nodule</th>
<th>Number of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular margins</td>
<td>73</td>
<td>73%</td>
</tr>
<tr>
<td>Irregular margins</td>
<td>27</td>
<td>27%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Fig (4-4):** Shape of thyroid nodules of hundred patients examined by ultrasound.

### 4-5 Vascularity of thyroid nodules:

**Table (4-5):** Vascularity of thyroid nodules

<table>
<thead>
<tr>
<th>Vascularity of thyroid nodule</th>
<th>Number of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A vascular</td>
<td>91</td>
<td>91%</td>
</tr>
</tbody>
</table>
Fig (4-5): Vascularity of thyroid nodules

<table>
<thead>
<tr>
<th>Vascular</th>
<th>9</th>
<th>9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>
### 4-6 Echoginicity of thyroid nodule:

#### Table (4-6): Echogenicity of thyroid nodules

<table>
<thead>
<tr>
<th>Echogenicity of thyroid nodule</th>
<th>No of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cystic</td>
<td>60</td>
<td>60%</td>
</tr>
<tr>
<td>Hypoechogenicity</td>
<td>12</td>
<td>12%</td>
</tr>
<tr>
<td>Hyperechoenicity</td>
<td>25</td>
<td>25%</td>
</tr>
<tr>
<td>Isoechnogenicity</td>
<td>3</td>
<td>3%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

#### Fig(4-6): Echogenicity of thyroid nodules

### 4-7 Calcifications within thyroid nodule:
Table (4-7): Calcification within thyroid nodules

<table>
<thead>
<tr>
<th>Calcification</th>
<th>Number of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>With calcification</td>
<td>7</td>
<td>7%</td>
</tr>
<tr>
<td>Without calcification</td>
<td>93</td>
<td>93%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Fig (4-7): Calcification within thyroid nodules

4-8: Size of thyroid nodule:

Table (4-8): Size of thyroid nodules
<table>
<thead>
<tr>
<th>Size of thyroid nodule</th>
<th>Number of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 cm</td>
<td>82</td>
<td>82%</td>
</tr>
<tr>
<td>More than 2 cm</td>
<td>18</td>
<td>18%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Fig(4-8): Size of thyroid nodules
CHAPTER FIVE

5-1 Discussion:

This study was done on a hundred patients who had thyroid nodules, the questionnaires were done for 74 females and 26 males, represented it in tables and graphs.

Regarding the age of patients, it found that the ages of female patients ranged between 26 to 66 years old, and the age of male patients ranged between 25 to 66 years old.

It found that the age of patients had malignant thyroid nodules occurring more than 55 years old, while patients less than 55 years old had benign thyroid nodules, so the possibility of thyroid malignancy increased in patients more than 55 years old, and decreased if the patient is less than 55 years old.

Regarding the gender of patients, it found that 74 patients were female, while 26 patients were male. It found that most of the female patients had malignant thyroid nodules, while male patients had benign nodules. So the possibility of thyroid malignancy in female patients is more than that of male patients.

Regarding the residency finding, it found that 60 patients were from central Sudan, 30 patients who came from Eastern Sudan, and 10 patients had thyroid nodules came from Western Sudan. It found that most of the patients came from central Sudan and eastern Sudan had benign thyroid nodules, and most of the patients who were come from Western Sudan had malignant thyroid nodules. So in my opinion, the possibility of thyroid malignancy increased in patients who were come from Western Sudan.
Regarding to the vascularity of thyroid nodules (internal blood flow within the mass) it found that 91 patients had no internal blood flow by using Doppler, 9 patients had internal blood flow. It found that all the malignant thyroid nodules had internal blood flow and benign thyroid nodules had no internal blood flow. So the possibility of thyroid malignancy increased if the thyroid nodule had internal blood flow and decreased if there is no internal blood. This is differ from that (Ozel A, et al-2010) which they found that the intra nodualr vascularity is found also in benign nodules.

According to the shape of thyroid nodule, it found that 73 patients had well defined margin, 27 patients were ill defined margin. Malignant thyroid nodule which confirmed by FNAB had sonographic features were of ill defined margin while the most benign thyroid nodules which also confirmed by FNAB were of well defined margin, so if the thyroid nodule had sonographic feature is of ill defined margin this will increases the possibility of thyroid malignancy while the possibility of thyroid malignancy deceases if the thyroid nodule had well defined margin. And this agrees with (Moon HJ, et al-2010) which they found that all malignant thyroid nodules had irregular margin.

Regarding to the echogenicity of thyroid nodules, it found that 60 patients had cystic thyroid nodules, 25 patients had thyroid nodules had Sonographic features of hyperechogenicity, 12 patients had Sonographic features of hypoechogenicity and 3 patients had nodules similar to the texture of thyroid parenchyma.

It found that the malignant thyroid had Sonographic characteristic of hypoechogecity, while the cystic, Isoechoic and echogenic thyroid nodules were benign. So if the echogenicity of thyroid nodule is decreases ( hypoechoic) the possibility of thyroid malignancy increased.
and this agree with (Popli et al.-2011) which they found that the increase risk of thyroid malignancy occurred in hypoechoic nodules. Regarding to the presence of calcification within the thyroid nodules, hundred patients examined by ultrasound, it found that 93 patients of them had no calcification within its nodules. It found that 7 patients had thyroid nodules with calcification. It found that most malignant thyroid nodules confirmed by histopathology had internal micro calcification when scanned by ultrasound while the benign thyroid nodules which also confirmed by histopathology had no calcification when examined by ultrasound. So the presence of calcification within the thyroid nodule increases the possibility of thyroid malignancy and this matching with (Lee MJ et al-2012) which they found that the microcalcification within the nodule associated with an increase risk of thyroid malignancy and also agree with (Gonzalez et al 2010) who they found that the presence of nodule microcalcification is significantly associated with malignancy. According to the size of thyroid nodule it found that 82 patients had thyroid nodule less than 2cm. 18 patients had thyroid nodule more than 2cm. The size of benign thyroid nodules were of less than 2cm while the size of malignant thyroid nodules were of more than 2cm. So if the size of thyroid nodule is more than 2cm the possibility of thyroid cancer increased and this was differ from (Ucler R et al 2011) which they found that the malignancy rate was smaller for larger nodules and this was also differ from that (Ibrahim Y, et al 2015) which they found that increased thyroid nodule size does not increase the malignancy rate for follicular neoplasms.
5-2 Conclusion:

Thyroid ultrasound can distinguish between cystic and solid nodules and evaluate changes in size of nodules as patients are followed over a period of time.

Although individual sonographic features of thyroid nodules are not specific for benign or malignant lesions, a constellation of typical features has more diagnostic value. Hypoechogenicity, poorly defined irregular margins, and microcalcifications are characteristics that should increase the index of suspicion for a malignant nodule. Cytologic examination of fine-needle aspirates is the optimal diagnostic test, and ultrasonographic guidance for performance of the aspiration biopsy is often helpful and sometimes critical. Ultrasonography is also useful for detection of cervical lymph node metastatic lesions. Lymph nodes involved with metastatic thyroid cancer tend to become rounded and bulging, and they lose their hilar echoes as their structure becomes disrupted.

From the study, it is apparent that the ultrasound findings of poorly defined margins, marked hypoechogenicity, microcalcifications have a high diagnostic accuracy for identifying and predicting malignant thyroid nodules.
5-3 Recommendations:

- Patients for neck ultrasound especially thyroid scan should be examined with hyper extended neck so as to have satisfied results.
- Patients who have weight loss, difficulty in breathing or swallowing who showed normal ultrasound finding should be investigated carefully again using different types of high-frequency probes.
- Since the ultrasound centers are concentrated in big towns like Khartoum and Medani, more centers should be available throughout the state of Sudan, so such studies will be more accurate.
- Ultrasonography should be a routine investigation for sign and symptoms of neck diseases.
- Patients who have received therapeutic radiation to the head and neck may be monitored at regular intervals by ultrasound; the radiation puts these patients at higher risk for developing thyroid cancer or other abnormalities. In early stages this conditions may not cause symptoms or be apparent during physical examination, they can however be detected by ultrasound.
- Provision of ultrasound devices in hospital and rural centers, and train technicians to perform thyroid ultrasound technique.
- Further researchers in the same topic were recommended.
5-4 Appendixes:

Fig (5.1): 64 years old male presented with neck swallowing. Sonogram reveals solid irregular thyroid mass.

Fig (5.2): A 55 years old female presented with neck pain and swelling. Ultrasound reveals huge hypoechoic mass with cystic changes.
Fig (5.3): 44 years old presented with palpable neck mass. Sonogram reveals cystic thyroid mass.

Fig (5.4): 59 years old presented with neck pain. Sonogram reveals hypoechoic mass.
Fig (5.4): 59 years old presented with neck pain. Sonogram reveals hypoechoic mass.

Fig (5.6): 49 years old presented with neck pain. Sonogram reveals hypoechoic irregular nodule.
Fig (5.7): 58 years old presented with neck pain. Sonogram reveals hypoechoic mass with sonolucent halo.

Fig (5.8): 54 years presented with weight loss. Sonogram reveals hypoechoic mass with micro calcification
Fig (5.9): Sonogram reveals thyroid nodule with minimal blood flow

Fig (5.10): Sonogram reveals hypoechoic mass with irregular margin
Fig (5.11): A 42-year-old presented with neck pain. Sonogram reveals an isoechogenic mass with surrounded halo.

Fig (5.12): Thyroid ultrasound reveals a cystic thyroid mass.
Fig (5.13): 61 Years old presented with neck pain. Sonogramm reveal cystic mass.

Fig (5.14): 59 years old presented with neck pain sonogram reveals
Fig (5.15): 62 years old with huge echogenic mass

Fig (5.16): 59 years old presented with neck pain. Ultrasound reveals hypoechoic mass
Sudan University of science & technology
College of graduate studies
Data collection sheet
The Sonographic Features of Thyroid Masses versus Biopsy

1-No:..............................................................................................................

2-Name:

3-Age:

4-Gender :

5-Residence:

Clinical indication:

  A- Neck pain .....:

  ................. :B- Palpable neck mass

  .................:C- Difficulty in swallowing

  .................:D- Difficulty in breathing

  ......................:E- Weight loss

:Ultrasound finding
1-Shape of the thyroid nodule: Regular:……. Irregular……

2-Vascularity: Vascular:……… A vascular:……

3-Echogenicity of thyroid nodule:…………………………

4-Size of thyroid nodule:……………………………………

5- Calcification within thyroid nodule: Yes……, No………

Histopathology of the nodule: .................................
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