Chapter one
Introduction

Ultrasound is now the best investigating method in glands as MRI and CT could give the same diagnostic value but they are expensive and CT has ionizing effects so it's not preferable in such sensitive organs.

In the past the thyroid volume was estimated clinically by palpation; now ultra sound provides accurate measurement of thyroid size and volume.

Anatomically, the normal thyroid gland consists of two lobes which lie on the anterolateral surface of the trachea extending from the thyroid cartilage superiorly to the sixth tracheal ring inferiorly. They are asymmetrical with the right lobe being larger than the left, and the thyroid gland is larger in males than in females.

Volumetric evaluation of the thyroid gland is based on the use of an ellipsoid model. Hence, a value is obtained that replaces clinical evaluation of volume. With the ellipsoid model, the height, the width, and the depth of each lobe are measured and multiplied. The obtained result is then multiplied by a correction factor.

1-1 Problem of the study

Thyroid gland plays a vital role in the development of children, it is dimension varies according to ethnic group which may lead to wrong interpretation of the sizes if we adopt dimension attributed to other nation, therefore normative values is important.

1-2Objectives:

1-2-1General objective:

The general objective of this study is to estimate the volume of thyroid gland in school age children in order to establish a Sudanese record of thyroid volume in this age group.

1-2-2 Specific objectives:

- To find the difference in thyroid volume in respect to: age, ethnic group,gender,physical characteristics and lobe side.
- To find thedifferences in thyroid volume among the same group of age due to the difference in age.
- To find the relationship between the age , physical characteristics , ethnic group and the volume of the gland.

1-3 significance of the study

This study will provide bases of normal thyroid dimensions for Sudanese in respect to their age and gender, as well it will explore the relationship between the Rt and left lobe including body mass index

1-4 overview of the study

This study falls into five chapters; with chapter one is an introduction which includes:
Problem of the study
Objectives of the study
Significance of the study
Overview of the study

Chapter two which is literature review includes:
Anatomy
Physiology
Pathology
Significance of iodine
Previous study

Chapter three which is material and methods includes:
Materials
Methods

Chapter four which is results contains :

Results

Chapter five which is discussion includes:

Discussion

Conclusion

Recommendations

Reference

Appendix A

Appendix B

Chapter two

Theoretical background and Literature review

2-1 Anatomy:

The thyroid gland or simply, the thyroid, in vertebrateanatomy, is one of the largest endocrine glands. The thyroid gland is found in the neck, below the thyroid cartilage (which forms the laryngeal prominence, or "Adam's apple"). The thyroid gland controls how quickly the body uses energy, makes proteins, and controls how sensitive the body is to other hormones.

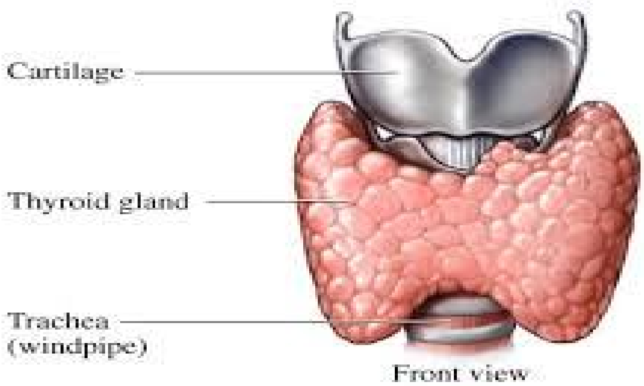

Figure2-1 normal thyroid gland

It participates in these processes by producing thyroid hormones, the principal ones being triiodothyronine (T_3) and thyroxine which can sometimes be referred to as tetraiodothyronine (T_4). These hormones regulate the growth and rate of function of many other systems in the body. T_3 and T_4 are synthesized from iodine and tyrosine. The thyroid also produces calcitonin, which plays a role in calcium homeostasis.

Hormonal output from the thyroid is regulated by thyroid-stimulating hormone (TSH) produced by the anterior pituitary, which itself is regulated by thyrotropin-releasing hormone (TRH) produced by the hypothalamus.(Boron, WF.; Boulapep and EL2012).

The thyroid gets its name from the Greek adjective for "shield-shaped", due to the shape of the related thyroid cartilage

The thyroid gland is a butterfly-shaped organ and is composed of two cone-like lobes or wings, lobus Dexter (right lobe) and lobus sinister (left lobe), connected via the isthmus. The organ is situated on the anterior side of the neck, lying against and around the larynx and trachea, reaching posteriorly the esophagus and carotid sheath. It starts cranially at the oblique line on the thyroid cartilage (just below the laryngeal prominence, or 'Adam's Apple'), and extends inferiorly to approximately the fifth or sixth tracheal ring. It is difficult to demarcate the gland's upper and lower border with vertebral levels because it moves position in relation to these during swallowing.(Yalçin and Ozan. February 2006).

The thyroid gland is covered by a thin fibrous sheath, the capsula glandulae thyroidea, composed of an internal and external layer. The external layer is anteriorly continuous with the pretracheal fascia and posteriolaterally continuous with the carotid sheath. The gland is covered anteriorly with infrahyoid muscles and laterally with the sternocleidomastoid muscle also known as sternomastoid muscle. On the posterior side, the gland is fixed to the cricoid and tracheal cartilage and cricopharyngeus muscle by a thickening of the fascia to form the posterior suspensory ligament of Berry. The thyroid gland's firm attachment to the underlying trachea is the reason behind its movement with swallowing. In variable extent, Lalouette's Pyramid, a pyramidal extension of the thyroid lobe, is present at the most anterior side of the lobe. In this region, the recurrent laryngeal nerve and the inferior thyroid artery pass next to or in the ligament and tubercle.(Dorland's 2012).

Between the two layers of the capsule and on the posterior side of the lobes, there are on each side two parathyroid glands.

The thyroid isthmus is variable in presence and size, can change shape and size, and can encompass a cranially extending pyramid lobe (lobus pyramidalis or processus pyramidalis), remnant of the thyroglossal duct. 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.

In a healthy patient the gland is not visible yet can be palpated as a soft mass. Examination of the thyroid gland is carried out by locating the thyroid cartilage and passing the fingers up and down, examining for abnormal masses and overall thyroid size. (Fehrenbach and Herring 2012).

Then, place one hand on each of the trachea and gently displace the thyroid tissue to the contralateral side of the neck for both sides while the other hand manually palpates the displaced gland tissue; having the patient flex the neck slightly to the side when being palpated may help in this examination. Next, the two lobes of the gland should be compared for size and texture using visual inspection, as well as manual or bimanual palpation. Finally, ask the patient to swallow to check for mobility of the gland; many clinicians find that having the patient swallow water helps this part of the examination. In a healthy state, the gland is mobile when swallowing occurs due its facial encasement. Thus when the patient swallows, the gland moves superiorly, as does the whole larynx.

The thyroid is supplied with arterial blood from the superior thyroid artery, a branch of the external carotid artery, and the inferior thyroid artery, a branch of the thyrocervical trunk, and sometimes by the thyroid ima artery, branching directly from the subclavian artery. The venous blood is drained via superior thyroid veins, draining in the internal jugular vein, and via inferior thyroid veins, draining via the plexus thyroideus impar in the left brachiocephalic vein.

Lymphatic drainage passes frequently the lateral deep cervical lymph nodes and the pre- and parathracheal lymph nodes. The gland is supplied by parasympathetic nerve input from the superior laryngeal nerve and the recurrent laryngeal nerve.(Fehrenbach and Herring 2012).

2-1-1 Embryological development:

Floor of pharynx of embryo between 18 and 21 days

In the fetusat 3–4 weeks of gestation, 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 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 anterior to the hyoid bone. During migration, the thyroid remains connected to the tongue by a narrow canal, the hypoglossal duct.

Thyrotropin-releasing hormone (TRH) and thyroid-stimulating hormone (TSH) start being secreted from the fetal hypothalamus and pituitary at 18-20 weeks of gestation, and fetal triiodothyronine (T_3) remains low (less than 15 ng/dL) until 30 weeks of gestation, and increases to 50 ng/dL at term. Fetal self-sufficiency of thyroid hormones protects the fetus against e.g. brain development abnormalities caused by maternal hypothyroidism.(Zoeller April 2003).

However, preterm births can suffer neurodevelopmental disorders due to lack of maternal thyroid hormones due their own thyroid being insufficiently developed to meet their postnatal need. The portion of the thyroid containing the Para follicular C cells, those responsible for the production of calcitonin, are derived from the neural crest. This is first seen as the ultimobranchial body, which joins the primordial thyroid gland during its descent to its final location in the anterior neck.

Aberrations in embryological development can cause various forms of thyroid dysgenesis.

2-1-2Histology

At the microscopic level, there are three primary features of the thyroid :(first discovered by Websterson in (1664)Histological section through the thyroid of a horse. 1 follicles, 2 follicular epithelial cells, 3 endothelial cells

2-1-2-1Feature description

FolliclesThe thyroid is composed of spherical follicles that selectively absorb iodine (as iodide ions, I-) from the blood for production of thyroid hormones, and also for storage of iodine in thyroglobulin. Twenty-five percent of the body's iodide ions are in the thyroid gland. Inside the follicles, in a region called the follicular lumen, colloid serves as a reservoir of materials for thyroid hormone production and, to a lesser extent, acts as a reservoir for the hormones themselves. Colloid is rich in a protein called thyroglobulin.

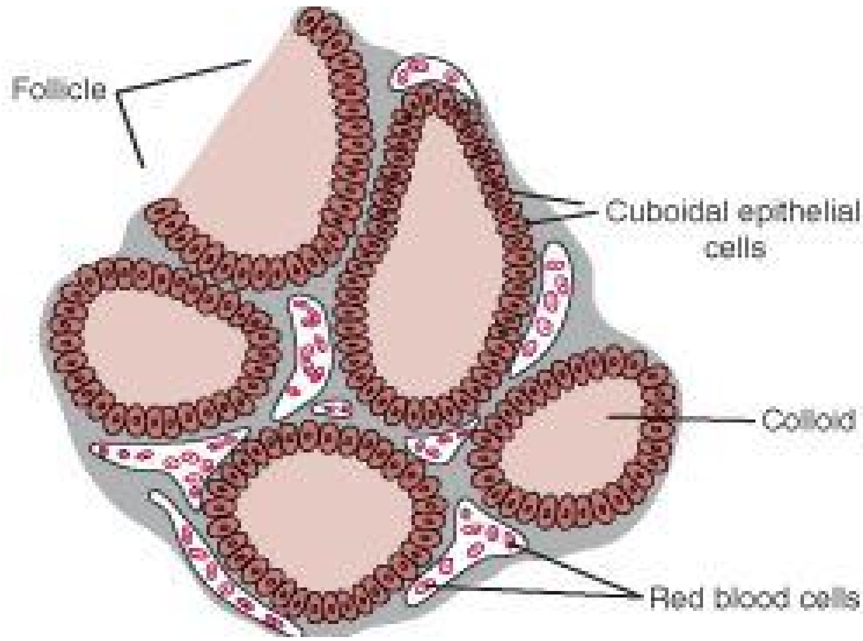

Figure 2-2 thyroid gland histology

2-1-1-2Thyroid epithelial cell

The follicles are surrounded by a single layer of thyroid epithelial cells, which secrete T_3 and T_4. When the gland is not secreting T_3 and T_4 (inactive), the epithelial cells range from low columnar to cuboidal cells. When active, the epithelial cells become tall columnar cells.

Scattered among follicular cells and in spaces between the spherical follicles are another type of thyroid cell, Para follicular cells, which secrete calcitonin.

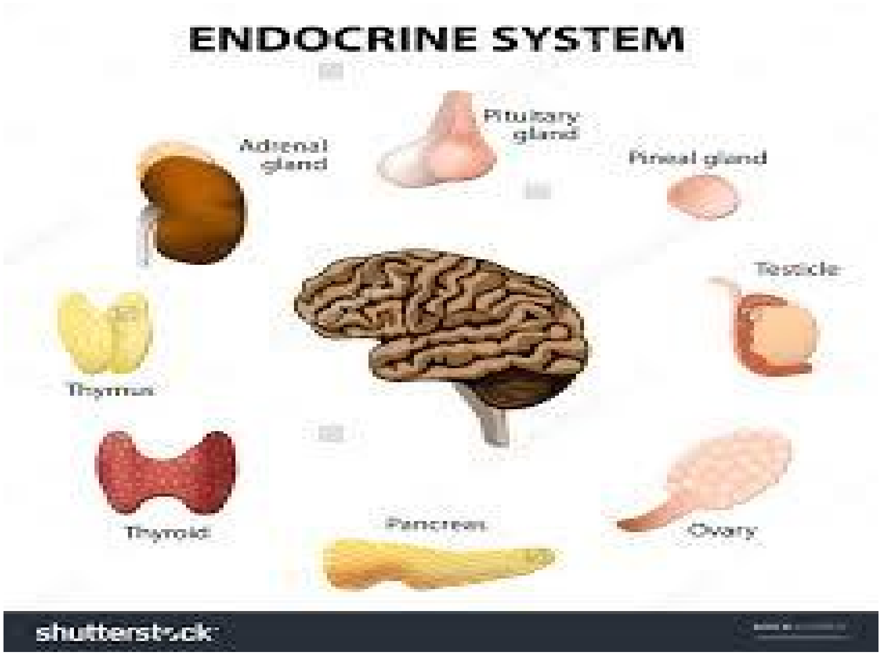

Figure 2-3 thyroid gland as a part of endocrine system

2-2 Physiology:

The primary function of the thyroid is production of the hormones T3, T4 and calcitonin. Up to 80% of the T4 is converted to T3 by organs such as the liver, kidney and spleen. T3 is several times more powerful than T4, which is largely a pro hormone, perhaps four or even ten times more active.(Nussey and Whitehead 2001).

2-2-1T_3 and T_4 production and action:

Synthesis of the thyroid hormones, as seen on an individual thyroid follicular cell:- Thyroglobulin is synthesized in the rough endoplasmic reticulum and follows the secretory pathway to enter the colloid in the lumen of the thyroid follicle by exocytosis.- Meanwhile, a sodium-iodide (Na/I) symporter pumps iodide (I^-) actively into the cell, which previously has crossed the endothelium by largely unknown mechanisms.- This iodide enters the follicular lumen from the cytoplasm by the transporter pendrin, in a purportedly passive manner.

- In the colloid, iodide (I^-) is oxidized to iodine (I^0) by an enzyme called thyroid peroxidase.- Iodine (I^0) is very reactive and iodinates the thyroglobulin at tyrosylresidues in its protein chain (in total containing approximately 120 tyrosyl residues).- In conjugation, adjacent tyrosyl residues are paired together.- The entire complex re-enters the follicular cell by endocytosis.- Proteolysis by various proteases liberates thyroxin and triiodothyronine molecules, which enters the blood by largely unknown mechanisms.

Thyroxin (T_4) is synthesized by the follicular cells from free tyrosine and on the tyrosine residues of the protein called thyroglobulin (TG). Iodine is captured with the "iodine trap" by the hydrogen peroxide generated by the enzyme thyroid peroxidase (TPO) and linked to the 3' and 5' sites of the benzene ring of the tyrosine residues on Tg, and on free tyrosine. Upon stimulation by the thyroid-stimulating hormone (TSH), the follicular cells reabsorb Tg and cleave the iodinated tyrosine from Tg in lysosomes, forming T_4 and T_3 (in T_3, one iodine atom is absent compared to T_4), and releasing them into the blood. Deiodinase enzymes convert T_4 to T_3. Thyroid hormone secreted from the gland is about 80-90% T_4 and about 10-20% T_3.

Cells of the developing brain are a major target for the thyroid hormones T_3 and T_4. Thyroid hormones play a particularly crucial role in brain maturation during fetal development. A transport protein that seems to be important for T_4 transport across the blood–brain barrier (OATP1C1) has been identified. A second transport protein (MCT8) is important for T_3 transport across brain cell membranes.

Non-genomic actions of T_4 are those that are not initiated by liganding of the hormone to intranuclear thyroid receptor. These may begin at the plasma membrane or within cytoplasm. Plasma membrane-initiated actions begin at a receptor on the integrin alphaV beta3 that activates ERK1/2. This binding culminates in local membrane actions on ion transport systems such as the Na(+)/H(+) exchanger or complex cellular events including cell proliferation. These integrins are concentrated on cells of the vasculature and on some types of tumor cells, which in part explains the proangiogenic effects of iodothyronines and proliferative actions of thyroid hormone on some cancers including gliomas. T_4 also acts on the mitochondrial genome via imported isoforms of nuclear thyroid receptors to affect several mitochondrial transcription factors. Regulation of actin polymerization by T_4 is critical to cell migration in neurons and glial cells and is important to brain development.

T_3 can activate phosphatidylinositol 3-kinase by a mechanism that may be cytoplasmic in origin or may begin at integrin alpha V beta3.

In the blood, T_4 and T_3 are partially bound to thyroxin-binding globulin (TBG), transthyretin, and albumin. Only a very small fraction of the circulating hormone is free (unbound) - T_4 0.03% and T_3 0.3%. Only thefree fraction has hormonal activity. As with the steroid hormones and retinoic acid, thyroid hormones cross the cell membrane and bind to intracellular receptors (α_1, α_2, β_1 and β_2), which act alone, in pairs or together with the retinoid X-receptor as transcription factors to modulate DNA transcription.(Nussey and Whitehead 2001).

2-2-2T_3 and T_4 regulation

The production of thyroxin and triiodothyronine is regulated by thyroid-stimulating hormone (TSH), released by the anterior pituitary. The thyroid and thyrotropes form a negative feedback loop: TSH production is suppressed when the T_4 levels are high.[19] The TSH production itself is modulated by thyrotropin-releasing hormone (TRH), which is produced by the hypothalamus and secreted at an increased rate in situations such as cold exposure (to stimulate thermogenesis). TSH production is blunted by somatostatin (SRIH), rising levels of glucocorticoids and sex hormones (estrogen and testosterone), and excessively high blood iodide concentration.

An additional hormone produced by the thyroid contributes to the regulation of blood calcium levels. Para follicular cells produce calcitonin in response to hyperkalemia. Calcitonin stimulates movement of calcium into bone, in opposition to the effects of parathyroid hormone (PTH). However, calcitonin seems far less essential than PTH, as calcium metabolism remains clinically normal after removal of the thyroid (thyroidectomy), but not the parathyroid.(Nussey and Whitehead 2001).

2-3 Disorders

Thyroid disorders include

- hyperthyroidism (abnormally increased activity),
- hypothyroidism (abnormally decreased activity) and

- Thyroid nodules, which are generally benign thyroid neoplasms, but may be thyroid cancers.

All these disorders may give rise to goiter, that is, an enlarged thyroid.

2-3-1Hyperthyroidism

Hyperthyroidism, or overactive thyroid, is the overproduction of the thyroid hormones T_3 and T_4, and is most commonly caused by the development of Graves' disease , human autoimmune disease in which antibodies are produced which stimulate the thyroid to secrete excessive quantities of thyroid hormones. The disease can result in the formation of a toxic goiter as a result of thyroid growth in response to a lack of negative feedback mechanisms. It presents with symptoms such as a thyroid goiter, protruding eyes (exophthalmos), palpitations, excess sweating, diarrhea, weight loss, muscle weakness and unusual sensitivity to heat. The appetite is often increased.

Beta blockers are used to decrease symptoms of hyperthyroidism such as increased heart rate, tremors, anxiety and heart palpitations, and anti-thyroid drugs are used to decrease the production of thyroid hormones, in particular, in the case of Graves' disease. These medications take several months to take full effect and have side-effects such as skin rash or a drop in white blood cell count, which decreases the ability of the body to fight off infections. These drugs involve frequent dosing (often one pill every 8 hours) and often require frequent doctor visits and blood tests to monitor the treatment, and may sometimes lose effectiveness over time. Due to the side-effectsand inconvenience of such drug regimens, some patients choose to undergo radioactive iodine-131 treatment. Radioactive iodine is administered in order to destroy a portion of or the entire thyroid gland, since the radioactive iodine is selectively taken up by the gland and gradually destroys the cells of the gland. Alternatively, the gland may be partially or entirely removed surgically, though iodine treatment is usually preferred since the surgery is invasive and carries a risk of damage to the parathyroid glands or the nerves controlling the vocal cords. If the entire thyroid gland is removed, hypothyroidism results.(Siegenthaler, W 2007)

2-3-2Hypothyroidism

Hypothyroidism is the underproduction of the thyroid hormones T_3 and T_4.

Hypothyroid disorders may occur as a result of

- Congenital thyroid abnormalities (Thyroid deficiency at birth. See congenital hypothyroidism),
- autoimmune disorders such as Hashimoto's thyroiditis,
- iodine deficiency (more likely in poorer countries) or
- The removal of the thyroid following surgery to treat severe hyperthyroidism and/or thyroid cancer.

Typical symptoms are abnormal weight gain, tiredness, baldness, cold intolerance, and bradycardia. Hypothyroidism is treated with hormone replacement therapy, such as levothyroxine, which is typically required for the rest of the patient's life. Thyroid hormone treatment is given under the care of a physician and may take a few weeks to become effective.

Negative feedback mechanisms result in growth of the thyroid gland when thyroid hormones are being produced in sufficiently low quantities, as a means of increasing the thyroid output; however, where hypothyroidism is caused by iodine insufficiency, the thyroid is unable to produce T_3 and T_4 and as a result, the thyroid may continue to grow to form a non-toxic goiter. It is termed non-toxic as it does not produce toxic quantities of thyroid hormones, despite its size. Thyroid Disorders Information (MedicineNet. Retrieved on 2010-02-07)

2-3-3 Initial hyperthyroidism followed by hypothyroidism:

This is the overproduction of T_3 and T_4 followed by the underproduction of T_3 and T_4. There are two types: Hashimoto's thyroiditis and postpartum thyroiditis.

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. At the beginning, the gland may be overactive, and then becomes underactive as the gland is damaged resulting in too little thyroid hormone production or hypothyroidism. Some patients may experience "swings" in hormone levels that can progress rapidly from hyper-to-hypothyroid (sometimes mistaken as severe mood swings, or even being bipolar, before the proper clinical diagnosis is made). Some patients may experience these "swings" over a longer period of time, over days or weeks or even months. Hashimoto's is more common in females than males, usually appearing after the age of 30, and tends to run in families meaning it can be seen as a genetic disease. Also more common in individuals with Hashimoto's Thyroiditis are type 1 diabetes and celiac disease.

Most thyroid nodules do not cause any symptoms, and most are discovered on an incidental examination. Doctors usually perform a needle aspiration biopsy of the thyroid to determine the status of the nodules. If the nodule is found to be non-cancerous, no other treatment is required. If the nodule is suspicious then surgery is recommended.(Treatment for Thyroid disease Retrieved on 2010-02-07).

2-3-4Congenital anomalies

A persistent thyroglossal duct or cyst is the most common clinically significant congenital anomaly of the thyroid gland. A persistent sinus tract may remain as a vestigial remnant of the tubular development of the thyroid gland. Parts of this tube may be obliterated, leaving small segments to form cysts. These occur at any age and might not become evident until adult life. Mucinous, clear secretions may collect within these cysts to form either spherical masses or fusiform swellings, rarely larger than 2 to 3 cm in diameter. These are present in the midline of the neck anterior to the trachea. Segments of the duct and cysts that occur high in the neck are lined by stratified squamous epithelium, which is essentially identical to that covering the posterior portion of the tongue in the region of the foremen cecum. The anomalies that occur in the lower neck more proximal to the thyroid gland are lined by epithelium resembling the thyroidal acinar epithelium. Characteristically, next to the lining epithelium, there is an intense lymphocytic infiltrate. Superimposed infection may convert these lesions into abscess cavities, and rarely, give rise to cancers.

2-3-4Other disorders : Limited research shows that seasonal allergies may trigger episodes of hypo- or hyperthyroidism.

An ectopic thyroid is an entire or parts of the thyroid located in another part of the body than what is the usual case.Yamamoto et al (February 1988).

Some rapid-cycling versions of bipolar disorder seem to have a complex relationship with thyroid dysfunction; however the specifics of the relationship are poorly understood.(Melton, Sarah2013)

2-3-5cancers

In most cases, thyroid cancer presents as a painless mass in the neck. It is very unusual for thyroid cancers to present with symptoms, unless they have been neglected. One may be able to feel a hard nodule in the neck. Diagnosis is made using a needle biopsy and various radiological studies.(Sharpe & Dohme 2010)

2-3-6Non-cancerous nodules

Many individuals may find the presence of thyroid nodules in the neck. The majority of these thyroid nodules are benign (non-cancerous). The presence of a thyroid nodule does not mean that one has thyroid disease. Most are discovered on an incidental examination. Doctors usually perform a needle aspiration biopsy of the thyroid to determine the status of the nodules. If the nodule is found to be non-cancerous, no other treatment is required. If the nodule is suspicious then surgery is recommended.

2-4 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 supplementally with levothyroxine, which facilitates normal growth and development.

Thyroxin is critical to the regulation of metabolism and growth throughout the animal kingdom. Among amphibians, for example, administering a thyroid-blocking agent such as propylthiouracil (PTU) can prevent tadpoles from metamorphosing into frogs; in contrast, administering thyroxin will trigger metamorphosis. In amphibian metamorphosis, thyroxin and iodine also exert a well-studied experimental model of apoptosis on the cells of gills, tail, and fins of tadpoles. Iodine, via iodolipids, has favored the evolution of terrestrial animal species and has likely played a crucial role in the evolution of the human brain. Iodine (and T4) trigger the amphibian metamorphosis that transforms the vegetarian aquatic tadpole into a carnivorous terrestrial adult frog, with better neurological, visuospatial, olfactory and cognitive abilities for hunting, as seen in other predatory animals. A similar phenomenon happens in the neotenic amphibian salamanders, which, without introducing iodine, don't transform into terrestrial adults, and live and reproduce in the larval form of aquatic axolotl.

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.(Patrick June 2008)

2-5 previous studies:

Wang Hei (1476) anatomically described the thyroid gland and recommended that the treatment of goiter should be dried thyroid. Paracelsus, some fifty years later, attributed goiter to mineral impurities in the water.

Thomas Wharton (1656)named the gland the thyroid, meaning shield, as its shape resembled the shields commonly used in Ancient Greece.

Theodor Kocher(1909) from Switzerland won the Nobel Prize in Medicine "for his work on the physiology, pathology and surgery of the thyroid gland".

Yousef et al (2010) established a local reference of thyroid volume in Sudanese normal subjects using ultrasound. A total of 103 healthy subjects were studied, 28 (27.18%) females and 75 (72.82%) males. Thyroid volume was estimated using ellipsoid formula. The mean age and range of the subjects was 21.8 (19–29) years; the mean body mass index (BMI) was 22.3 (16.46–26.07) kg/m2. The overall mean volume ± SD volume of the thyroid gland for both lobes in all the patients studied was 6.44 ± 2.44 mL. The mean volume for both lobes in females and males were 5.78 ± 1.96 mL and 6.69 ± 2.56 mL, respectively. The males' thyroid volume was greater than the females'. The mean volume of the right and left lobes of the thyroid gland in males and females were 3.38 ± 1.37 mL and 3.09 ± 1.24 mL, respectively. The right thyroid lobe volume was greater than the left

Ahidjo, et al. (2005) determined the normal thyroid volume using ultrasound in Maiduguri, North-Eastern Nigeria. One hundred and forty three subjects were studied consisting of 72 (50.30%) females and 71 (49.70%) males. The mean age of the subjects was 38.60 13.10 years.The overall mean volume of the thyroid gland for both lobes in all the patients studied was 8.55cm3 ±1.82. The mean volume for both lobes in females and males were 7.58cm3 and 9.72cm3 respectively. The males thyroid volume was higher than the females (p = 0.000)..(The mean volume of the right and left lobes of the thyroid gland in males and females were 4.48cm3 and 4.07cm3 respectively. The right thyroid lobe volume was higher than the left (p = 0.000).

Schlögl S., Werner E., Lassmann M.,(2005) performed a study with a commercially available three-dimensional (3-D) system Freescan added to a conventional ultrasound scanner compares the accuracy of conventional thyroid volumetry to several methods of 3-D volume determination. In vitro measurements were performed on thyroid phantoms with known volumes. The standard deviation of the normalized differences was 8.0% (3-D segmentation) and 10.5% (conventional). For the accuracy of volume determination in human thyroids we performed a postmortem study. The thyroid volume was calculated conventionally by the ellipsoid model and by two 3-D methods (segmentation and the newly developed multiplanar volume approximation). The reference volume was determined after resection by submersion. The standard deviation of the normalized differences was 26.9% for the conventional method, 9.7% for 3-D segmentation and 11.5% for the multiplanar volume approximation.

Marchie et al (2012) stated that: The US thyroid gland volume in school-aged children in Benin City from this study ranges between 1.17 cm 3 and 7.19 cm 3 , mean volume range of 1.76-4.95 cm 3 , median volume range of 1.73-4.73 cm 3 , and range of standard deviation from 0.39 cm 3 to 1.49 cm 3 . The average mean thyroid volume is 2.32 cm 3 with the following average dimensions; anteroposterior right lobe =1.06 cm, mediolateral right lobe = 1.01 cm and craniocaudal right lobe = 2.34 cm, and anteroposterior left lobe = 1.01 cm, mediolateral left lobe = 1.04 cm and craniocaudal left lobe = 2.41 cm for both boys and girls respectively.,..

Chapter three

Material and methods

3-1Material

This is an analytical study conducted in Alshikh Mustafa Alamin high school for girls and hassona high school for boys since the year 2014. The data will be collected using ultra sound machine used was portable GE machine with linear high frequency (7MHz) transducer

3-1-1 study group:

A total of 50 healthy children were involved in this study after having the approval from the school and their parents, following information's was reported: age, gender, geographic area, living area ,weight, thyroid volume of RT and LT lobes and isthmus thickness.

3-1-2 machine used:

Portable general electric machine containing Doppler modalities and linear probe.

3-2 methods:

3-2-1 Study design:

The data of this study collected using descriptive cross-sectional method.

3-2-2Study population

The researcher excluded the students with thyroid enlargement, thyroglossal cysts and other gland abnormalities.

3-2-3Technique:

Subjects were asked to give information's about their age, geographic information and resident information's and weighted in kg .then with the ellipsoid model, the height, the width, and the depth of each lobe are measured and multiplied. The obtained result was then multiplied by a correction factor, which is π/6 or 0.524 .The subjects were examined in supine position, with pillow placed under their shoulders to hyperextend the neck. US gel was applied over the thyroid area. The transducer was directly placed on the skin over the thyroid gland, and an image of each lobe was obtained in transverse and longitudinal planes. The craniocaudal and the sagittal dimensions of both lobes were measured on the longitudinal image. The transverse dimension was measured on transverse scan images.

Data were collected in a master data sheet containing subject'sages,weights, geographic area, resident place, RT and LT lobe of thyroid lobes and isthmus as study variables.

Then the measurements were analyzed with significant test to determine the presence of the association between variables if any.

Then the results were presented in a form of tables and scatter diagram.

3-2-4 image interpretation:

Images were being interpreted in the ultrasound machine screen then saved in external hard desk for further evaluation.

Diagram 4-1 thyroid scanning technique

Chapter four

Results

Table 4-1 Mean and standard deviation of thyroid dimension in respect to gender

Group Statistics			
Thyroid	Gender	Mean	Std. Deviation
Rt lobe length	Female	2.9217	.44217
	Male	3.1020	.32471
Rt lobe width	Female	1.2443	.20205
	Male	1.2425	.19098
Rt lobe AP	Female	1.0943	.19062
	Male	1.1220	.21222
Isthmus	Female	.2503	.06451
	Male	.2325	.06197
Lt lobe width	Female	2.8460	.34755
	Male	2.9945	.29398
Lt lobe Length	Female	1.2823	.27199
	Male	1.1240	.14809
Lt lobe AP	Female	1.0197	.16470
	Male	1.0010	.13171

Table4-2 significant t-test of thyroid dimension in respect to gender

Independent Samples Test		
	t-test for Equality of Means	
Thyroid	T	Sig. (2-tailed)
Rt lobe length	-1.562	.125
Rt lobe width	.032	.975
Rt lobe AP	-.481	.633
Isthmus	.973	.336
Lt lobe width	-1.571	.123
Lt lobe Length	2.374	**.022**
Lt lobe AP	.424	.673

Table 4-3 significant test according to Geographical area (East, West, North and South)

ANOVA				
		Sum of Squares	F	Sig.
Rt lobe length	Between Groups	.053	.102	.958
	Within Groups	8.010		
	Total	8.063		
Rt lobe width	Between Groups	.023	.191	.902
	Within Groups	1.854		
	Total	1.877		
Rt lobe AP	Between Groups	.030	.241	.867
	Within Groups	1.889		
	Total	1.919		
Isthmus	Between Groups	.010	.799	.501
	Within Groups	.188		
	Total	.197		
Lt lobe width	Between Groups	.044	.125	.945
	Within Groups	5.366		
	Total	5.410		
Lt lobe Length	Between Groups	.040	.218	.883
	Within Groups	2.823		
	Total	2.863		
Lt lobe AP	Between Groups	.026	.357	.784
	Within Groups	1.095		
	Total	1.120		

Table4-4 : Significant test according to living area (Khartoum, Khartoum north and Soba)

		Sum of Squares	F	Sig.
length_Rt	Between Groups	.295	.894	.416
	Within Groups	7.768		
	Total	8.063		
width_Rt	Between Groups	.014	.175	.840
	Within Groups	1.863		
	Total	1.877		
AP_Rt	Between Groups	.008	.099	.906
	Within Groups	1.911		
	Total	1.919		
Ithmus	Between Groups	.014	1.790	.178
	Within Groups	.184		
	Total	.197		
width_Lt	Between Groups	.045	.198	.821
	Within Groups	5.365		
	Total	5.410		
Length_Lt	Between Groups	.087	.737	.484
	Within Groups	2.776		
	Total	2.863		
AP_Lt	Between Groups	.011	.243	.785
	Within Groups	1.109		
	Total	1.120		

Table 4-5: Significant testaccording to age

ANOVA				
		Sum of Squares	F	Sig.
length_Rt	Between Groups	.055	.160	.853
	Within Groups	8.009		
	Total	8.063		
width_Rt	Between Groups	.114	1.518	.230
	Within Groups	1.763		
	Total	1.877		
AP_Rt	Between Groups	.044	.545	.583
	Within Groups	1.875		
	Total	1.919		
Ithmus	Between Groups	.018	2.405	.101
	Within Groups	.179		
	Total	.197		
width_Lt	Between Groups	.003	.012	.988
	Within Groups	5.407		
	Total	5.410		
Length_Lt	Between Groups	.092	.779	.465
	Within Groups	2.771		
	Total	2.863		
AP_Lt	Between Groups	.021	.441	.646
	Within Groups	1.100		
	Total	1.120		

Table4-6:significant test correlating the AP diameter of RT lobe and isthmus thickness with weight

Coefficients				
		Coefficients		
	Model	B	T	Sig.
1	(Constant)	21.986	2.682	.010
	AP Rt	26.392	3.614	.001
2	(Constant)	12.473	1.479	.146
	AP Rt	21.695	3.073	.004
	Isthmus	60.465	2.748	.008
a. Dependent Variable: weight				

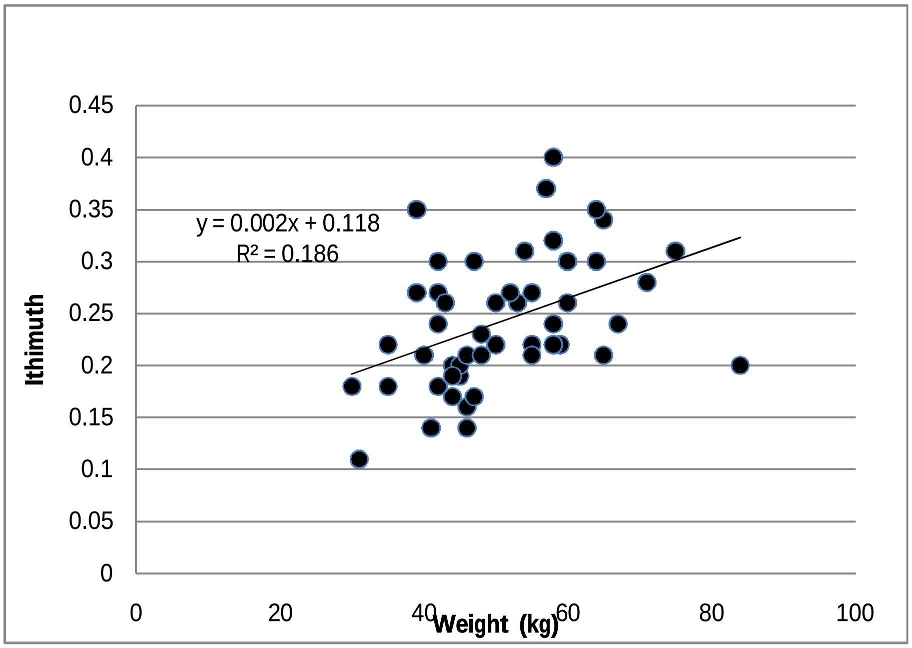

Diagram 4-1: correlation of isthmus size and subject weight

Table 4-7:mean and stander deviation of each thyroid lobe diameter

Paired Samples Statistics			
		Mean	Std. Deviation
Pair 1	Length Rt	2.9938	.40566
	Length Lt	1.2190	.24171
Pair 2	Width Rt	1.2436	.19572
	Width Lt	2.9054	.33227
Pair 3	AP Rt	1.1054	.19788
	AP Lt	1.0122	.15122

Table 4-8 significant test Correlating thyroid isthmus and subject weight

Paired Samples Test			
		T	Sig. (2-tailed)
Pair 1	Length Rt & Length Lt	29.354	.000
Pair 2	Width Rt & width Lt	-37.864	.000
Pair 3	AP Rt & AP Lt	3.569	.001

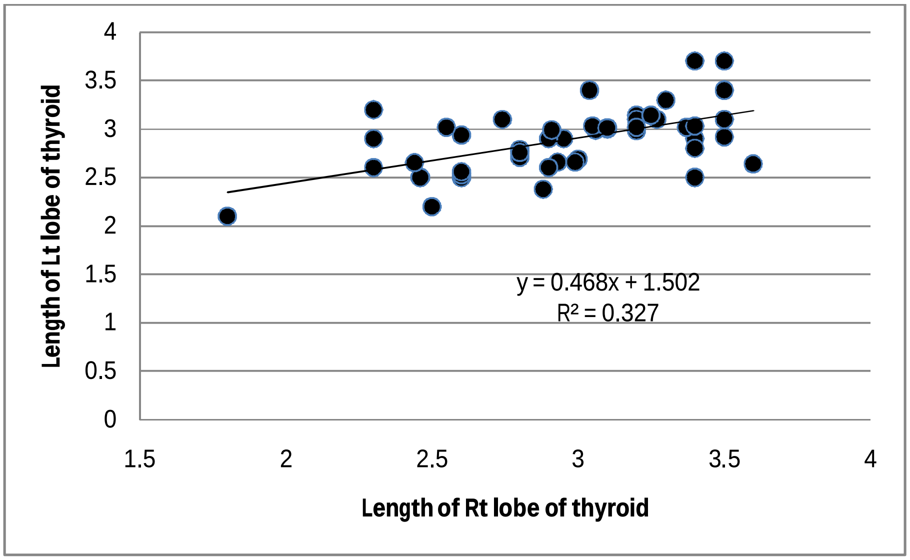

Diagram 4-2: correlation of RT and LT lobe lengths

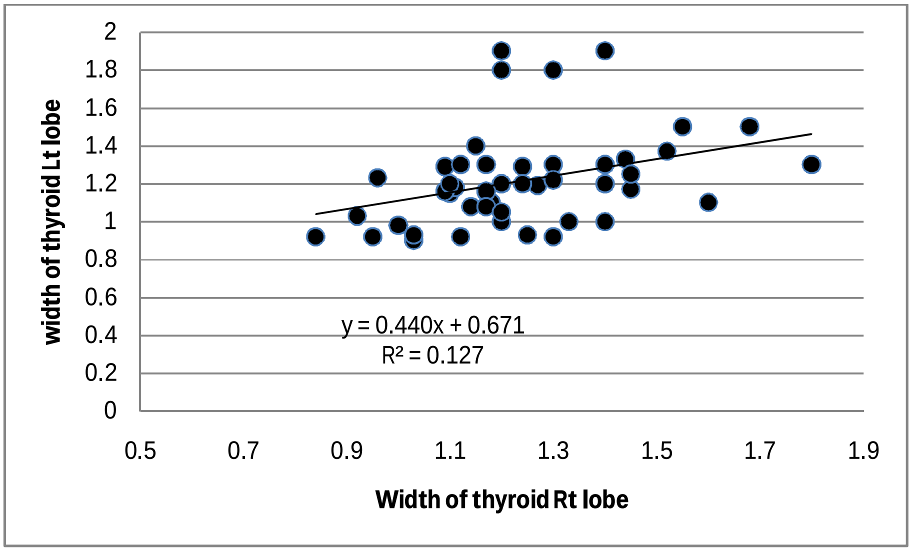

Diagram 4-3: correlation of RT and LT lobe widths

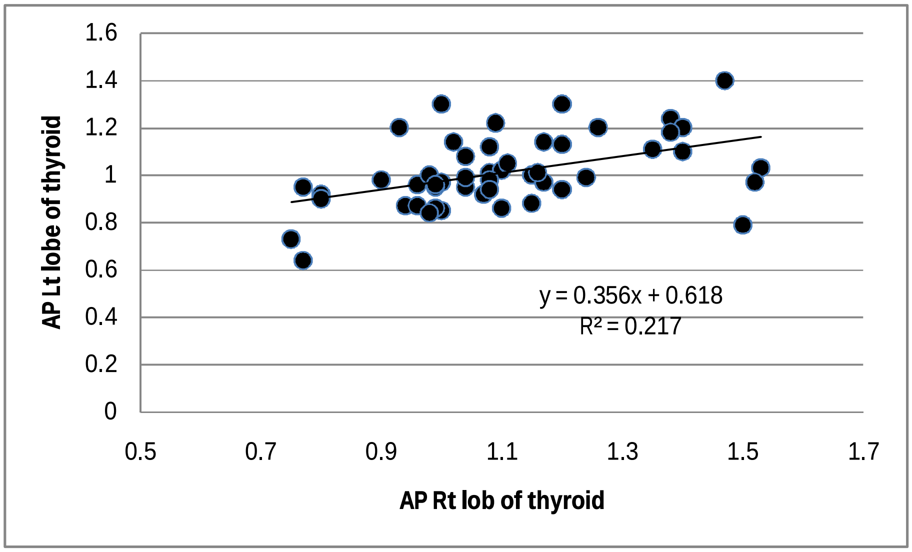

Diagram 4-4: correlation of RT and LT lobe AP diameters

chapter five

Discussion, Conclusion and Recommendation

5-1 **Discussion**

The study showed that the mean thyroid volume in school age children is (4.02gr) for both males and females in age group of (12-15years).

This study result showed in Table(4.1) established that there is no significant difference between the mean measurements of males and females except in the left lobe length which is lower in males by(0.022) which is not like the previous study carried out for adults by Elsafi et al(2010)and of Ahidjo et al. (2005) ,this could be because of different in ages of subjects which is (21.8 and 38.6 years)for those studies respectivelywhile the mean age of subjects in this study was (14.18 years).

Also the results of this study as shown in tables (4.2 and 4.3) revealed that there is no significant association between the thyroid measurements and subjects geographic areas or living areas, the justification of that is because those children were mved from their geographic areas early enough that they haven’t been affected by it.

Similar results concerning the relationship between the age and thyroid measurement; where there is no significant difference in thyroid measurements with age (Table 4.4) this result is expected and convenient with the small age range included in the study (13-15years).

The result of this study as shown in Table (4.5) which is Stepwise linear regression emphasizes that only AP of Rt lobe and Isthmus were significantly correlated in a linear model with subject weight; while scatter diagram (4.1) showed that there is a direct linear relationship between subject weight and isthmus size which is increased by a factor of 0.0024 cm/kg.

The results of table (4.6 and 4.7) showed that the RT lobe measurements are significantly larger than those of the LT lobe, the scatter diagrams of (4.2, 4.3 and 4.4) showed that there is a direct linear relationship where the measurementof the length.

Width and AP of left lobe increases by a factor 0.4685,0.4403,0.3566 cm respectively per each one unit increases of the similar dimension concerning the Rt lobe; this results are similar to all the previous studies mentioned in the scholar literature.

5-2 Conclusion:

The study concluded that the mean diameter of the RT lobe is (2.19 gr) and the LT lobe is (1.83gr) and that the RT lobe is larger than the LT lobe in volume and in all measurements individually

The study also concluded that there is no effect of age, geographic area or living area on the thyroid measurements.

The sex doesn't affect the measurements except in left lobe length in which male has slightly lower measurements than females.

The weight has strong effect on the isthmus and AP diameter of RT lobe.

5-3 Recommendations:

- This study highly recommended the researchers to do further studies in thyroid measurements with higher number of participants to have more accurate results.
- The study also recommended more researches which overcome its limitation in measuring subjects' heights and BMI.
- Another recommended researches are researches that studies the effects of some pathologies on the thyroid gland measurements
- Lastly recommendation is about establishing records for thyroid volume in other age groups like pediatrics and elderly people.

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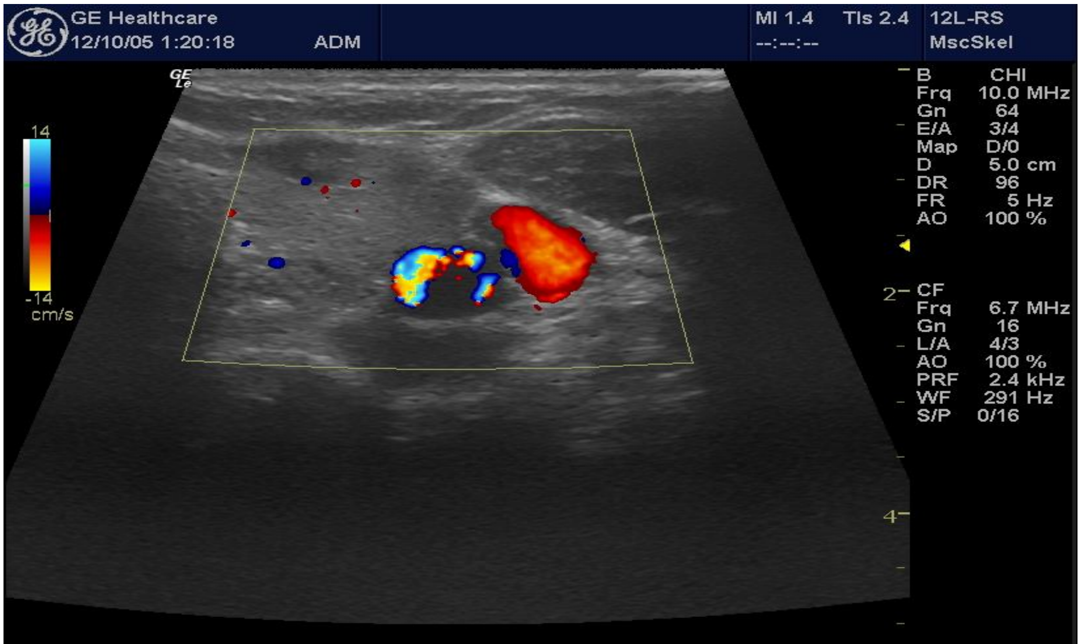
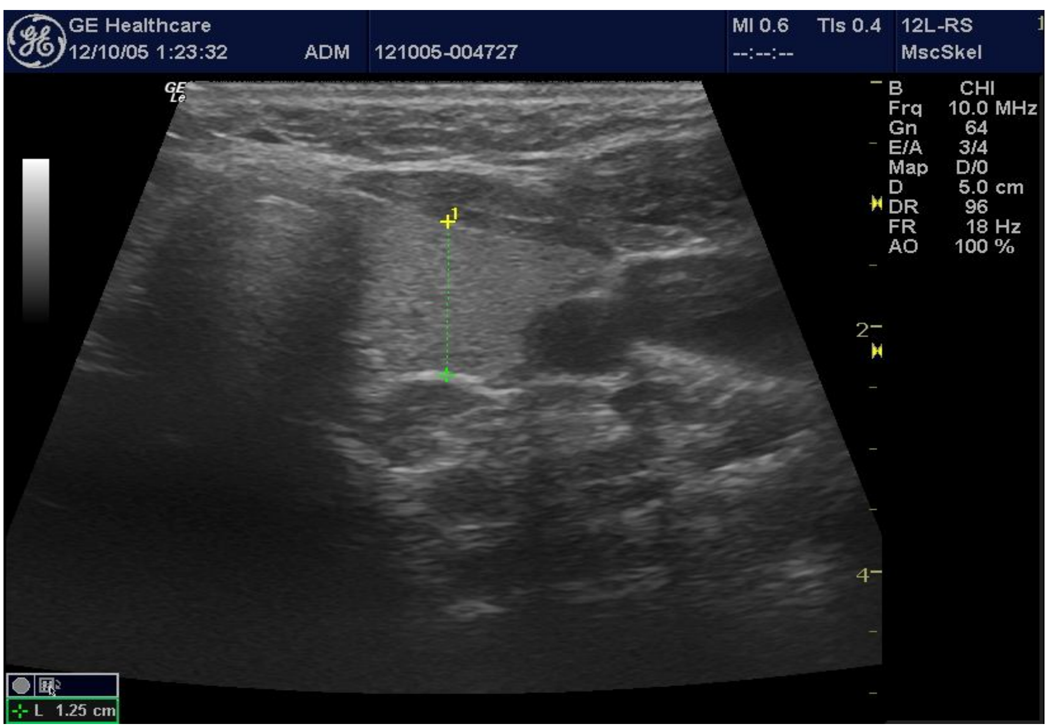
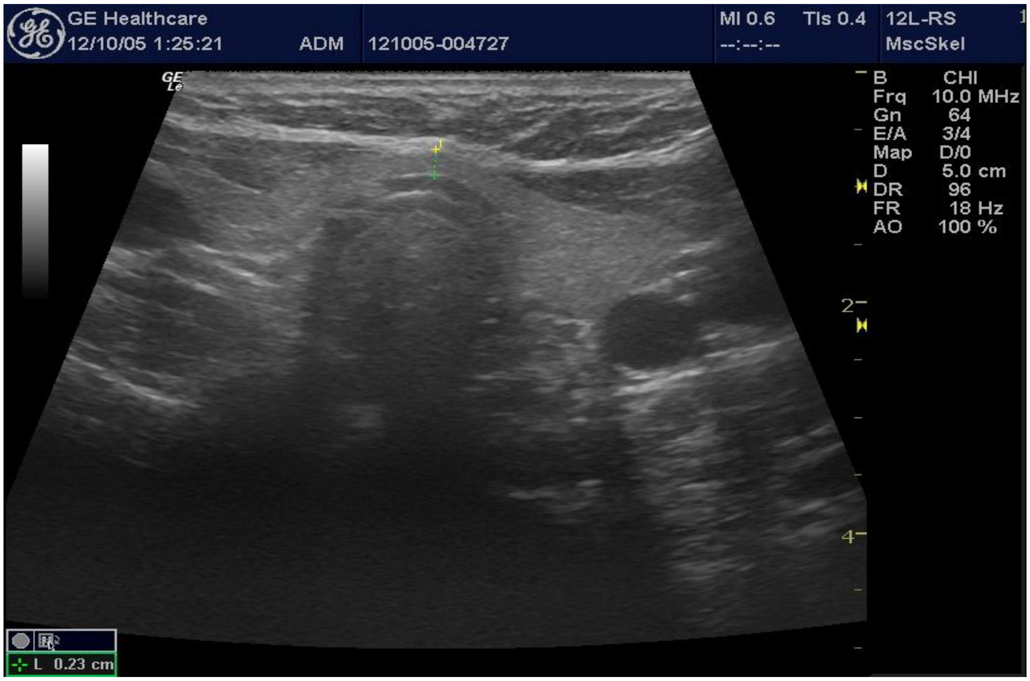
Appendix (1) images



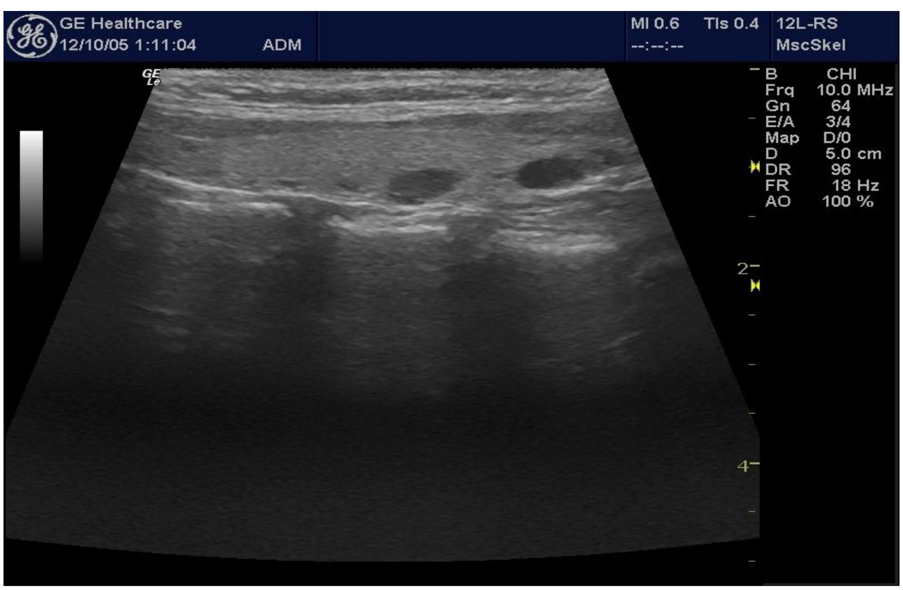
(Image-1)Doppler image in transverse position showing normal carotid artery and internal jugular vein in a 14 years female



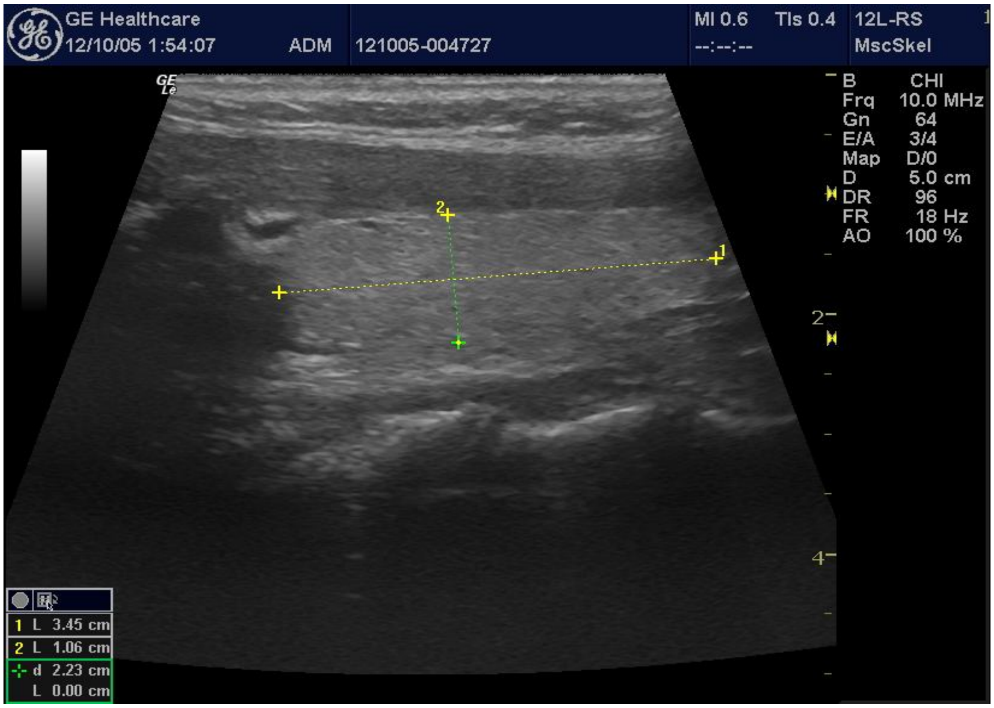
(Image-2)Transverse image of LT thyroid lobe measures (1.2cm) in a 14 years old female



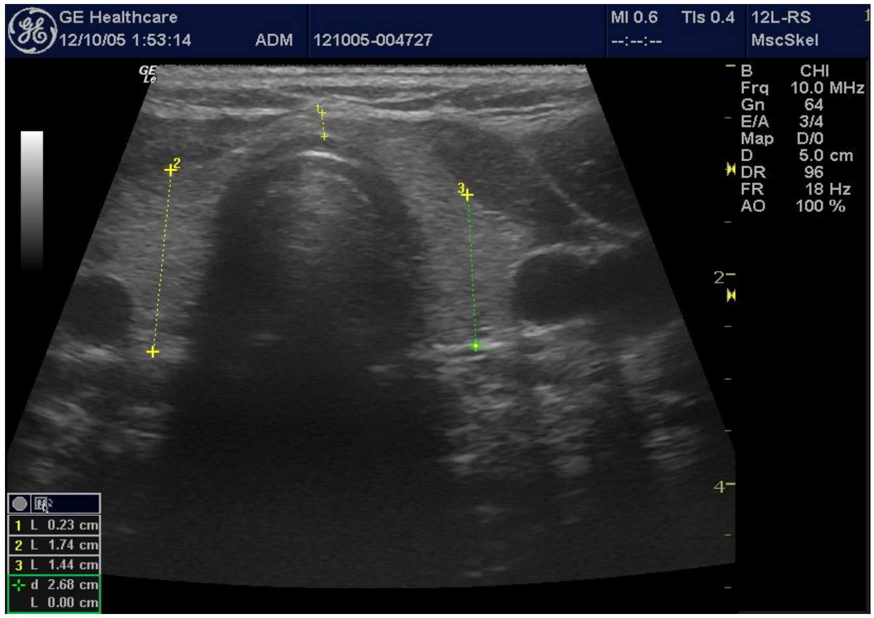
(Image-3)Transverce image of thyroid gland isthmus mresuring (0.23cm)in a 13 years male



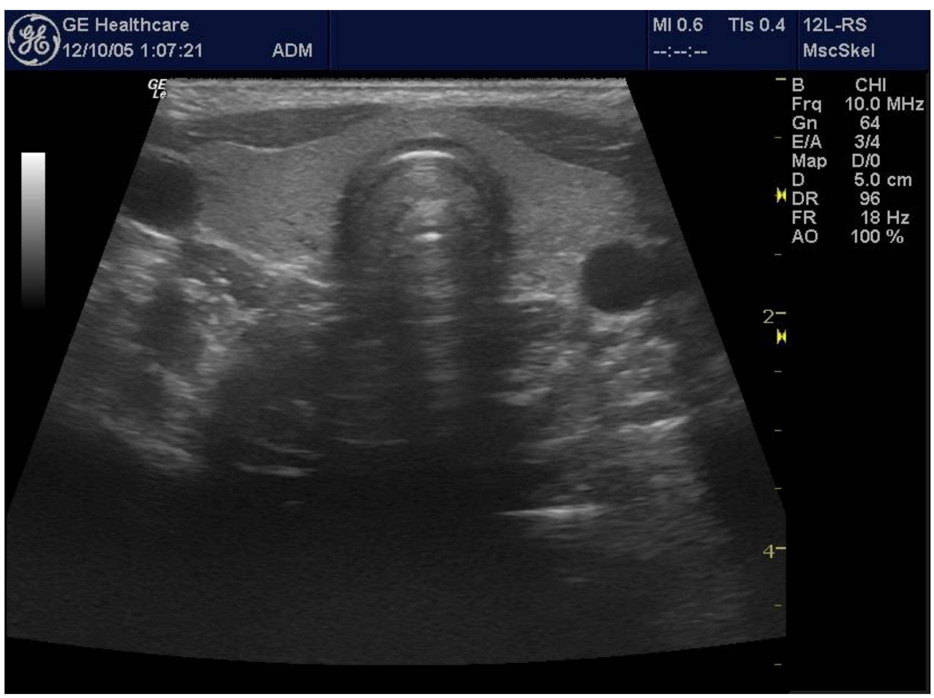
(Image-4)Siggtal image of LT thyroid lobe in a 15 years female showing a cystic nodule (the subject was excluded)



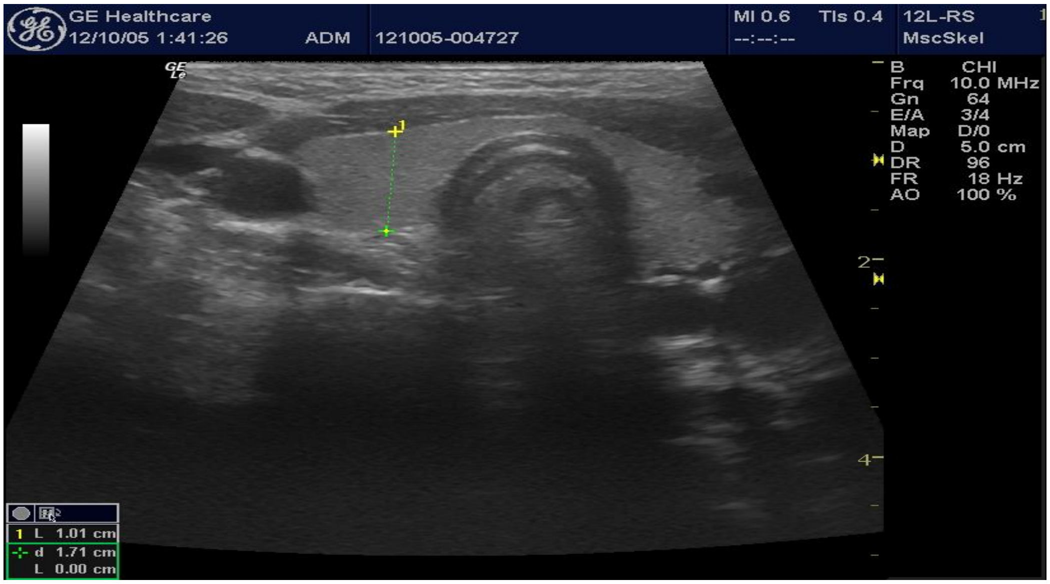
(Image-5)Sagittal image measuring both length and AP diameter of a thyroid gland of 14 years male measuring (3.4and1.06cm)respectively



(Image -6)Normal thyroid of a 15 years girl in transverse position shoeing isthmus ,AP diameter of RT and LT lobe which measures (0.23,1.47,1.44cm)respectively



(Image-7)Normal thyroid gland of a 14 years male in a transvers image showing the RT and LT lobe of the gland connected by the isthmus anteriorly and bounded by the trachea posteriorly.



(Image-8)Transverse image of the thyroid gland of a 14 years female measuring the AP diameter of the RT lobe which measures (1.01cm)

Appendix (2)

Master data sheet

No	Age	Sex	Geographical area	living area	weight	RT Lobe			V	Isthmus	V	LT lobe		
						long	Trans	AP				Long	trans	AP

Sex:

1=F , 2= M

Geographical area:

East: 3

West: 4

North: 5

South: 6

Living area:

Khartoum:10

Bahrey:20

Soba:30