THE ROLE OF DUPLEX ULTRASNOGRAPHY, ISOTOPE SCANNING AND CT IN EVALUATION OF THYROID SWELLINGS

Thesis

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Radiodiagnosis

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بسم الله الرحمن الرحيم

وقل رب زدني علماً

صدق الله العظيم

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TO MY FAMILY

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First and foremost thank are due to **GOD**, the most kind and the most merciful.

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CONTENTS

INTRODUCTION AND AIM OF THE WORK

Thyroid diseases present with a wide-range of clinical findings ranging from classic symptoms and signs to various non-specific manifestations.

For the last few years, the diagnosis was based on clinical examination and little laboratory investigation **(Braverman *et al.*, 1981; Wood *et al.*, 1988)**.

For many years ago, radionuclide studies have been the most commonly used imaging method in the evaluation of nodular abnormalities of the thyroid gland **(Heidendal *et al.*, 1992)**. They also provide information on substernally extending thyroid tissue or distant metastases **(Part *et al.*, 1987)**.

Duplex ultrasonography of the thyroid is a safe non-invasive modality without radiation hazards. High frequency ultrasounds are effective means for assessing the internal morphology of the gland, detecting nodules and guiding aspiration biopsy **(Desser *et al.*, 1998)**. Also has provided additional information in differentiating cystic from solid thyroid nodules and detecting multiple non palpable thyroid lesions **(Katz *et al.*, 1993)**.

In addition, Doppler ultrasonography is very important in diagnosis of selected cases of thyroid lesions such as thyroiditis and graves disease **(Clautice *et al.*, 1997)**.

Computed tomography provided complementary method for defining the morphology of the thyroid gland and the anatomic extension of the thyroid abnormalities in relation to normal structures of the neck and mediastinum **(Silverman *et al.*, 1984)**.

Computed tomography is also useful in determining the infiltrating of the thyroid masses into surrounding tissues **(Hopkins *et al.*, 1998)**. Demonstrate regional lymph node, also bone or cartilage involvement **(Takashima *et al.*, 1992)**.

In this study, we aim to emphasis the rule of different imaging modalities including:-

- Ultrasonography.
- Thyroid isotope scanning.
- Doppler ultrasonography.
- Computed tomography.

In the diagnosis of thyroid lesions and the value of these modalities as a guidance to the management of different thyroid diseases.

CHAPTER (I)
EMBRYOLOGY OF THYROID GLAND

Embryologically the medial portion of each lobe (median anlage) arises from the floor of the first pharyngeal pouch in the midline at about the fourth week of foetal development and descends inferiorly to its final adult location over the next several weeks.

The lateral portion of each lobe (lateral complex) arises from the fourth pharyngeal pouch at about the same time and descends to join the lateral aspect of the median anlage. The line of descend of these two components of each lobe constitutes the thyroglossal duct extending from the base of the tongue to the normal thyroid location. Residual functioning thyroid tissue may be left at various locations along this line, there by forming thyroglossal duct cysts and frequently the pyramidal lobe, which is commonly seen rising superiorly and medially from the left thyroid lobe (Fig. 1).

Components of the thyroid may descend beyond the normal thyroid location, with functioning thyroid tissue on rare occasions being found as far inferiorly as the anterior mediastinum. Complete failure of thyroid descend may result in a central mass on the back of the tongue of a newborn, which represents the child's only functioning thyroid tissue. Thyroid scintigraphy is extremely important in demonstrating function in such tissue, generally associated with absence of functioning tissue at the normal thyroid site. Such children may be euthyroid of hypothyroid, and surgical excision of the posterior tongue mass should be undertaken only with full knowledge of potential endocrine ramification (*i.e.* hypothyroidism).

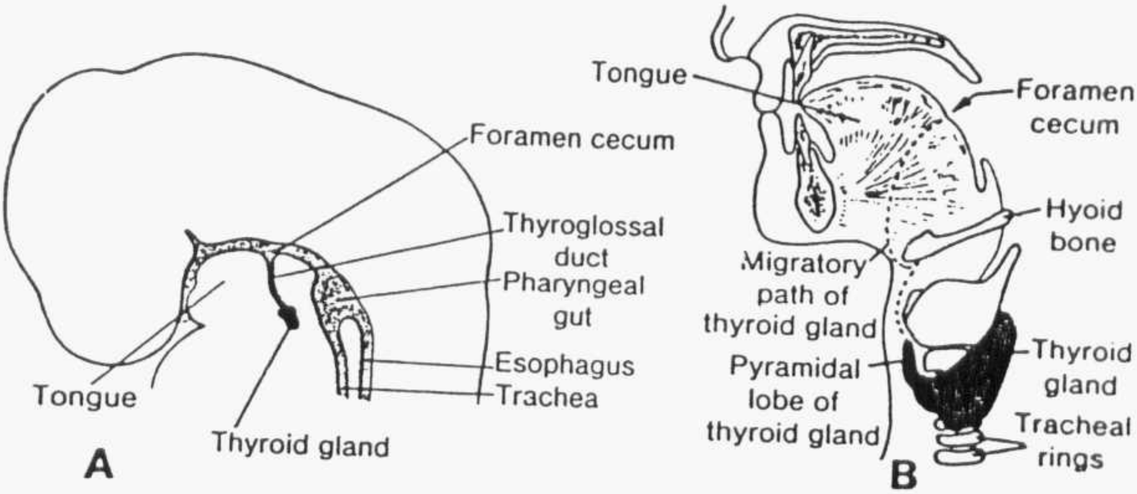


***Fig. (1) [a]** The thyroid primordium arises as an epithelial diverticulum in the midline of pharynx immediately caudal to the tuberculum impair. **[b]** Position of the thyroid gland in the adult. Broken line indicates the path of migration **(Sadler, 1996)**.*

Developmental abnormalities of the thyroid that may influence thyroid scintigraphy include failure of descent, as just described, a focus of functioning tissue anywhere along the line of the thyroglossal duct, between the foramen caecum and the thyroid itself, occasionally in association with thyroglossal duct cyst, hemiagenesis of one lobe, more commonly the left lobe, with persistence of the opposite lobe and isthmus in configuration referred to as the hockey-stick sign, sometimes also including agenesis of the isthmus itself, and the common finding (in up to 30 to 40% of patients) of a pyramidal lobe, frequently but not always pyramidal in shape, arising along the medial aspect of the body of right or left lobes and occasionally from the isthmus and descending toward the midline. The pyramidal lobe is more frequently visualized by scintigraphy in the presence of Graves' disease or Hashimoto's thyroiditis.

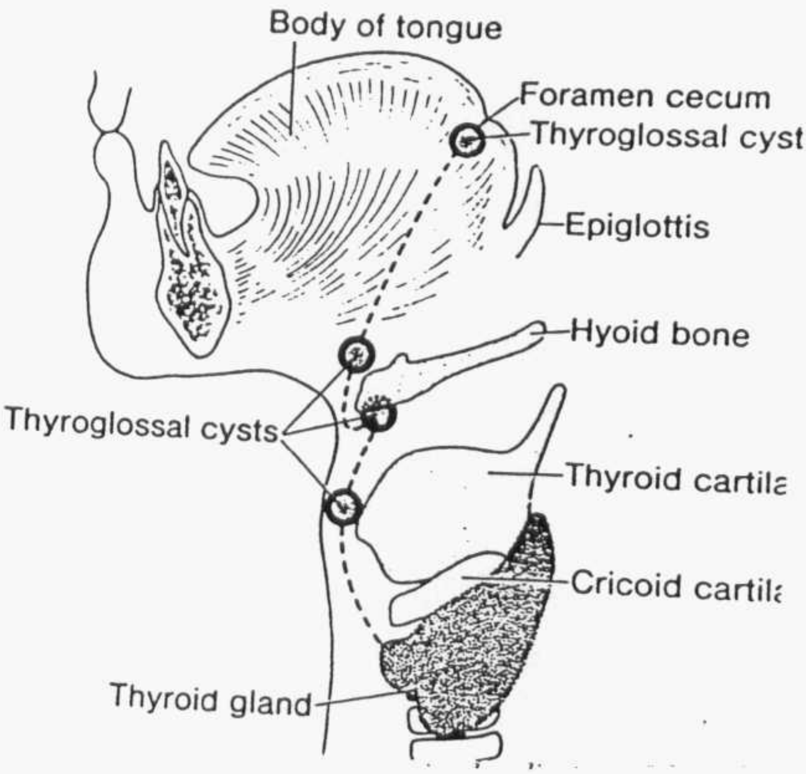


Fig. (2) Schematic drawing indicating localization of thyroglossal cyst. These cysts most frequently found in the hyoid region ***(Sadler, 1996).***

CHAPTER (II)
ANATOMY OF THYROID GLAND

Thyroid gland, one of the endocrine glands whose chief secretion is controlled by anterior pituitary, lies in the front of the neck, wrapping round the front and sides of the larynx and upper trachea. It is approximately "H-shaped", and consists of a central part, the isthmus, and a lateral lobe on each side **(McMinn *et al.*, 1995)**.

The isthmus is about 1 cm broad and deep, and overlies the second, third and fourth cartilaginous rings of the trachea. On each side, it joins the lateral lobe which is about 6 cm long. Each lateral lobe lies against the side of the upper part of the trachea and the lower end of the larynx, extending up to near the middle of the thyroid cartilage and down as far as the sixth tracheal ring (Fig. 3).

An occasional small pyramidal lobe extends for a variable distance upwards from the isthmus, it represents the embryological remnants of parts of the thyroglossal duct, the down-growth from the tongue from which the thyroid gland is developed. Other remnants of the duct may form a fibrous band or a swelling (a thyroglossal cyst) in the middle of the neck which, is attached to the base of the tongue, moves upwards on putting the tongue out **(McMinn *et al.*, 1995)**.

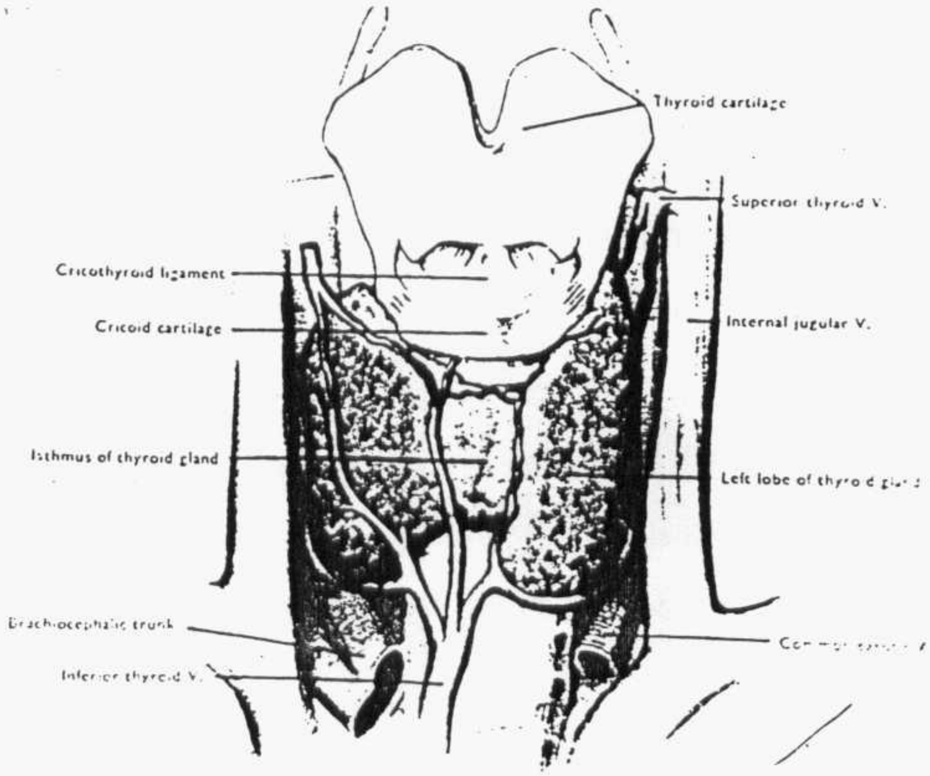


Fig. (3) *The anatomy of the anterior surface of the thyroid gland* ***(Cunningham, 1979)***.

Lying anterior to the isthmus of the gland are the sternothyroid muscles and the anterior jugular veins. The lateral lobes are covered anterolaterally by the other infrahyoid muscles and the anterior borders of the sternomastoid muscles. Posterolaterally lie the carotid sheaths whilst posteromedialy are the trachea, larynx and oesophagus (Fig. 4).

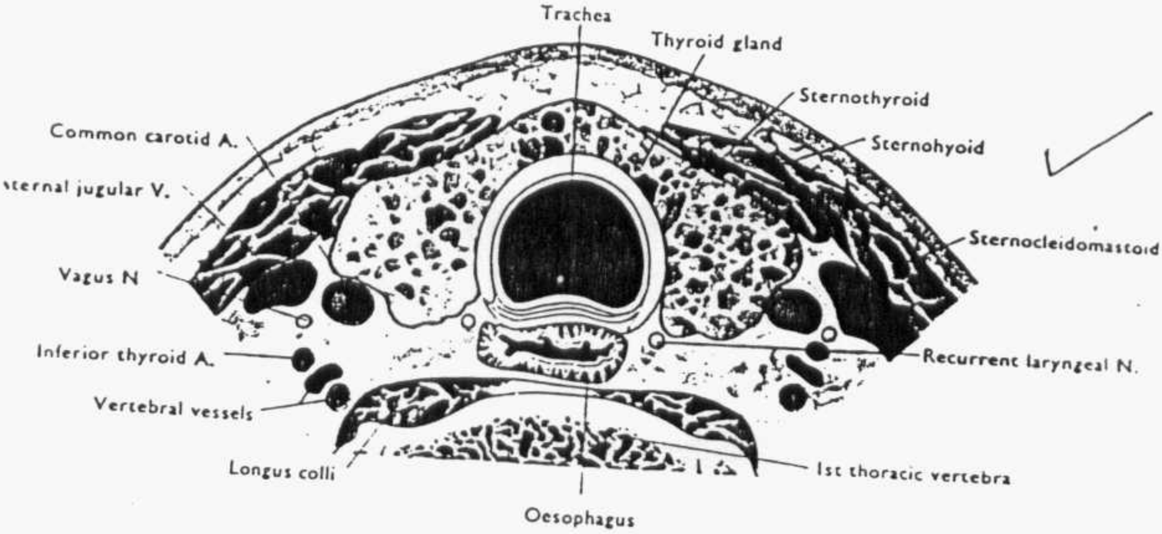


Fig. (4) *Transverse section at the neck at the level of (C-) cervical vertebra, shows the thyroid gland and the surrounding structures* ***(Cunningham, 1979)***.

In the interval between the oesophagus and trachea, the recurrent laryngeal nerves course upwards towards the larynx. A superior and inferior parathyroid gland are embedded in the posterior surface of each lateral lobe (Fig. 5).

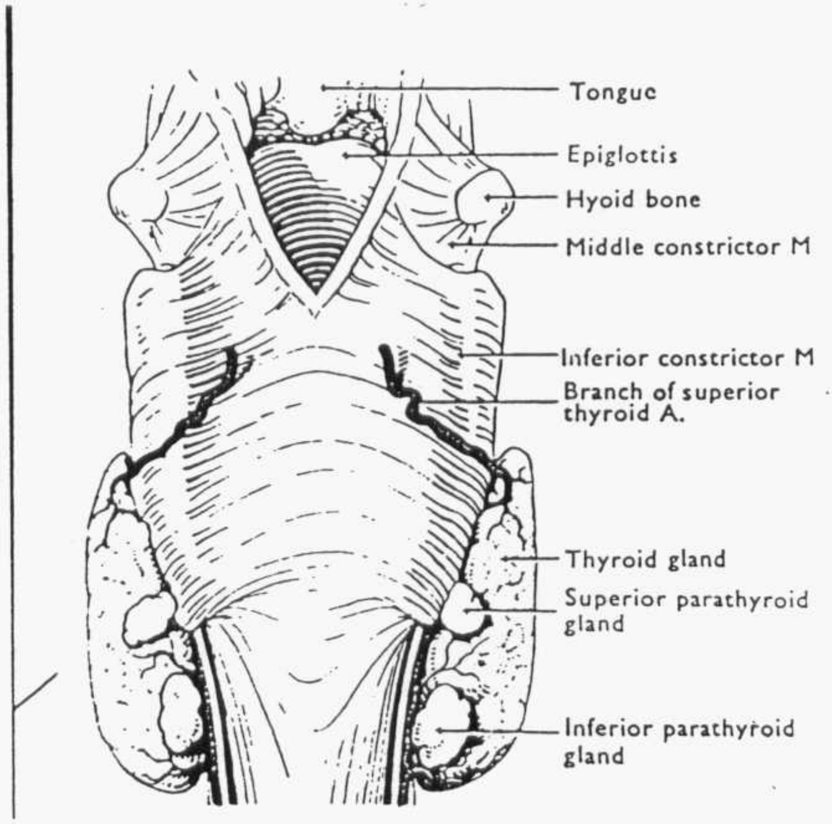


Fig. (5) Posterior view of the thyroid and parathyroid glands ***(Cunningham, 1979).***

The fascia links the gland to the larynx so that during swallowing both structures are elevated simultaneously **(Gosling *et al.*, 1996)**.

The superior laryngeal nerve accompanies the superior thyroid artery as it approaches the upper pole of the gland. The nerve divides into an internal laryngeal nerve, which pierces the thyrohyoid membrane to provide sensory innervation to the laryngeal mucosa above the level of the vocal cords, and the external branch, which descends to innervate cricothyroideus. The recurrent laryngeal nerve ascends in the chest and neck between the trachea and oesophagus (in the tracheoesophageal groove). At the level of the thyroid gland, the nerve is embedded in the fascia on the posterior surface of the thyroid gland. If injured during thyroid surgery, there may be temporary or permanent alteration to the voice. The axons making up the recurrent laryngeal nerves were originally part of the cranial roots of the accessory nerve **(Mathers *et al.*, 1996)**.

Blood Supply of the Thyroid Gland

Three arteries, supply and three veins drain the thyroid gland, which is highly vascular organ:

Arterial Supply

(1) The superior thyroid artery arises from the external carotid artery and passes to the upper pole.

(2) The inferior thyroid artery arises from the thyrocervical trunk of the first part of the subclavian artery and passes behind the carotid sheath to the back of the gland.

(3) The thyroidea ima artery is inconstant, when present it arises from the aortic arch or the brachiocephalic artery.

Venous Drainage

(1) The superior thyroid vein drains the upper pole to the internal jugular vein.

(2) The middle thyroid vein drains from the lateral side of the gland to the internal jugular.

(3) The internal thyroid veins often several drain the lower pole to the brachiocephalic veins.

As well as these named branches, numerous small vessels pass to the thyroid from the pharynx and trachea so that even when all the main vessels are tied, the gland still bleeds when cut across during a partial thyroidectomy (Fig. 6) **(Ellis, 1992)**.

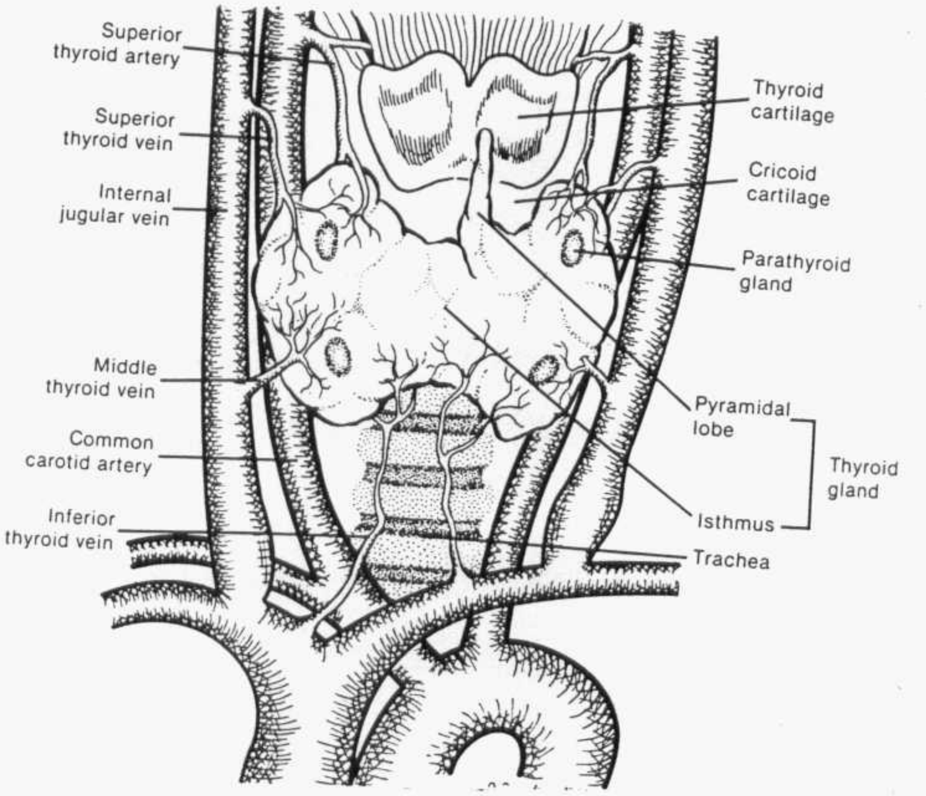


Fig. (6) Normal arterial and venous supply of thyroid gland ***(Mathers et al., 1996)***.

Nerve Supply of the Gland

The nerves are derived from the superior, middle, inferior cervical sympathetic ganglia, they reach the thyroid gland through the branches of the vagus, which runs along the arteries supplying the gland **(Moore, 1988)**.

Lymph Drainage of the Gland

The lymph vessels pass directly from the subcapsular plexus to the deep cervical lymph nodes, a few descend in the front of the trachea to the pretracheal lymph nodes **(Moore, 1988)**.

CHAPTER (III)
NORMAL SONOANATOMY OF THE THYROID GLAND

Normal thyroid tissue is acoustically homogeneous with moderate density echoes with a firm fibrous capsule surrounding the gland.

In transverse scans, the trachea is central and seen anteriorly it casts strong acoustic shadow. The carotid artery and internal jugular vein are identified, a Valsalva manoeuvre by the patient will cause jugular vein distension (Fig. 7).

Fig. (7) Showing normal sonographic appearance of the thyroid gland in transverse scan.

The thyroid vessels are seen anterior to the gland, the strap muscles are anterolateral and the longus coli can often be identified posteriorly.

On longitudinal sections, the strap muscles and the longus coli border the gland anteriorly and posteriorly respectively. The upper and lower poles appear as conical projections.

The normal dimensions of the lobes have a wide range of variability.

In the newborn the gland is18-20 mm long, with an anteroposterior diameter of 8-9 mm. By one year of age, the mean length is 25 mm and the anteroposterior diameter is 12-15 mm **(Toma *et al.*, 1992)**.

In adult, the mean length is approximately 40-60 mm and the mean anteroposerior diameter is 13-18 mm. The mean thickness of the isthmus is 4-6 mm **(Solbiati *et al.*, 1992b)**.

Sonography is an accurate method to use in calculating thyroid volume. In approximately one-third of cases, the sonographic measurement of volume differs from the physical size estimate derived from examinations **(Jarlov *et al.*, 1991)**.

Thyroid volume measurements may be useful for goiter size determinations in order to assess the need for surgery, to permit calculation of the dose of iodine 131 needed for treating thyrotoxicosis, and to evaluate the response to suppression treatments **(Kerr, 1994)**.

Appearance of the Thyroid Gland by Colour Doppler

Normal thyroid tissue is of homogeneous echo texture with small areas of colour flow dispersed throughout the gland. This typical pattern in normal gland was termed (normal back-ground flow) **(Clark *et al.*, 1995)**.

Normally, peak systolic velocities reach 20-40 cm/sec in the major thyroid arteries and 15-30 cm/sec in intra-parenchymal arteries. It should be noted that these are the highest velocities in vessels supplying superficial organs **(Solbiati *et al.*, 1998)**.

CHAPTER (IV)
NORMAL CT ANATOMY OF THE THYROID GLAND

The lobes of the thyroid gland appear as wedge shaped structure of high attenuation (an enhanced soft tissue structure) in non contrast CT scan. This is the result of its physiological normal high iodine content, its CT numbers ranges between 70 and 100 Hounsfield units (Hu). Hounsfield measurements taken after contrast administration will increase by 25 Hu (Fig. 8). The upper pole of the thyroid gland can be seen between the thyroid laminae and the infrahyoid strap muscle, whereas the body of the thyroid gland lies lateral to the cricoid cartilage and trachea, anterior and medial to the carotid artery and jugular vein. The thyroid isthmus can be seen usually connecting the two lobes anterior to the trachea. A pyramidal lobe is reported to be present in 40% of people, this is a process of the thyroid that extends upwards from the upper border of isthmus anterior to the cricoid and thyroid cartilage. This process is usually found more on the left than on the right side **(Carter, 1985)**.

The thyroid gland varies in size with age, sex and general nutrition being larger in young, in women and in well nourished peoples. The normal parathyroid glands usually are not seen on CT **(Lee *et al.*, 1989)**.

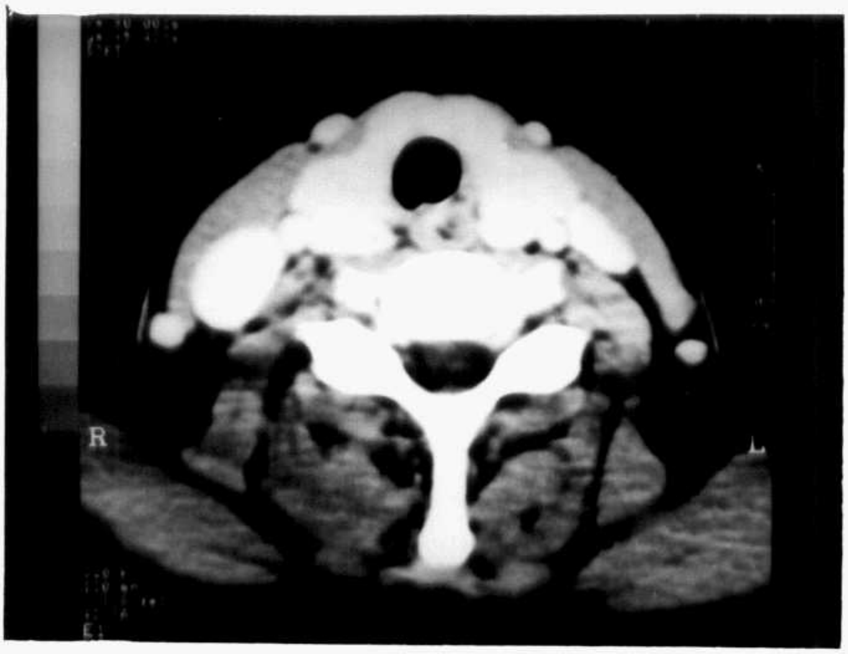


Fig. (8) Normal CT scan of the thyroid gland.

Sometimes the inferior thyroid artery and veins, identified in the fat posterior to the carotid artery, anterior to the longus coli muscles and lateral to the oesophagus, mark the location of the normal parathyroid glands, as well as the recurrent laryngeal nerves **(Lee *et al.*, 1989)**.

The right recurrent laryngeal nerve branches from the vagus nerve at the anterior border of the right subclavian artery and passes caudally, looping around the vessel, before ascending medially in the tracheoesophageal groove. The left recurrent laryngeal nerve leaves the vagus nerve adjacent to the anterior surface of the aortic-arch and passes around the arch through the aortopulmonary window to ascend in the tracheoesophageal groove. Both nerves enter the larynx under the lower border of the cricopharyngeal muscle **(Lee *et al.*, 1989)**.

CT provides accurate delineation of the lymph nodes in the neck. Normal lymph nodes usually are homogeneous and of soft tissue density, similar in attenuation value to muscle on both pre-contrast and post-contrast images. Peripheral enhancement of the lymph node normally is not seen **(Lee *et al.*, 1989)**. Normal lymph nodes usually range in size from 3 to 5 mm in diameter. However, they may be up to 1.5 cm in diameter in the upper neck (*e.g.* jugulodigastric, submandibular nodes) **(Lee *et al.*, 1989)**. Deep cervical lymph nodes normally measures 1 cm or less in their longest diameter with the exception of the jugulodigastric node which can measure up to 1.2 cm **(Burgener and Kormano, 1996)**.

The lymph nodes in the head and neck generally are divided into 10 major groups. The first six groups (occipital, mastoid, parotid, submandibular, facial and submental) form a lymphoid ring at the junction between the head and neck and usually are easily palpable.

Sublingual and retropharyngeal nodes (groups 7-8) lie deep to these lymph nodes and may be difficult to assess clinically. Identification of retropharyngeal nodes, which are most frequently located along the lateral borders of the longus capitis muscle at C_1, C_2 is particularly important for tumours of the nasal cavity, nasopharynx, hard and soft palate.

The anterior cervical group of lymph nodes (group 9) is located below the level of the hyoid bone between the two carotid sheaths. It consists of a superficial group along the course of the anterior jugular vein and a deep group (juxta-visceral) adjacent to the thyroid, trachea and oesophagus **(Lee *et al.*, 1989)**.

The lymph nodes of the lateral cervical group (group 10) are divided into 2 groups:-

- Superficial (external jugular).
- Deep (internal jugular, spinal accessory and transverse cervical).

The superficial group follows the course of the external jugular vein. The three chains of the deep group form a triangle of lymph nodes that are the major sites of metastases from laryngeal and hypopharyngeal carcinoma. The nodes of the internal jugular chain are located in the anterior triangle deep to the sternocleidomastoid muscle and follow the course of the internal jugular vein. They normally tend to be largest in the upper neck. The jugulodigastric node is the largest node in the upper portion of the internal jugular chain and usually is seen slightly above the hyoid bone near the junction between the internal jugular vein and posterior belly of the digastric muscle.

The lymph nodes of the spinal accessory chain are located lateral and posterior to the spinal accessory nerve between the sternocleidomastoid and trapezius muscles. They join the internal jugular vein group above the hyoid bone. Lymph nodes immediately posterior to the jugular vein are anterior and medial to the nerve and are considered internal jugular vein lymph nodes.

The transverse cervical chain forms the base of the deep group of the lateral cervical nodes and joins the inferior jugular and spinal accessory chains. These nodes are seen in the supraclavicular area and the inferior aspect of the posterior triangle **(Lee *et al.*, 1989)**.

The deep cervical (internal jugular) lymph nodes are the most important group of the lower neck. They are confined to the carotid space and divided into the upper, middle, and lower groups. The most prominent node is the jugulodigastric node located at the intersection between the posterior belly of the digastric muscle and the internal jugular vein. This level is also the boundary between the upper and middle deep cervical lymph nodes. The jugulo-omohyoid node is located at the crossing of the omohyoid muscle and the jugular vein, dividing the middle from the lower deep cervical group. The superficial cervical lymph nodes extend along the external jugular vein superficial to the sternomastoid muscle **(Burgener and Kormano, 1996)**.

Juxta-visceral lymph nodes include prelaryngeal, paratracheal and paraesophageal lymph nodes are all located in the visceral space **(Burgener and Kormano, 1996)**.

CHAPTER (V)
ISOTOPE SCANNING OF THE THYROID GLAND

Radionucleide scanning of thyroid gland has been the most widely used imaging modalities for evaluating palpable thyroid swelling.

The superficial anatomical position of the thyroid makes it easily accessible to radioisotope scanning. Isotopic scanning can usually give an outline of the size, position, shape and function of the thyroid **(Norcross and Siber, 1986)**.

Fig. (9) ^{99m}Tc thyroid scan with a cold nodule in the isthmus (Price, 1993).

Scanning of the thyroid after a tracer dose of an isotope will show the nodule as hot, warm or cold. *A hot nodule* is one that takes up isotope, whilst the surrounding thyroid tissue does not, as it is inactivated by the suppressed TSH secretion resulting from the high levels of thyroid hormones of the hyper-functioning nodule. *A warm nodule* takes up isotope and so does normal thyroid tissue surrounding it. *The cold nodule* takes up no isotope **(Charles and Russell, 1992)**.

Types of Isotopes

The principal radionucleides currently used to scan or image the thyroid include 2 isotopes of iodine and the metastable isomer of technetium-99m (^{99m}TC) in its pertechnetate form. Radioiodine is trapped by the thyroid gland and is organically bound in a similar way to dietary iodine. Pertechnetate is rapidly trapped by the thyroid but is not bound **(Charles and Russell, 1992)**.

a. *Isotopes of Iodine*

i. Radioiodine-131 (^{131}I)

A. Physical Characteristics

Radioiodine-131 has a physical half-life of 8.05 days and emits a higher energy gamma (364 keV) and particulate emissions. Beta-particles with average energy = 192 keV, max energy = 607 keV are emitted and deposit the majority of their energy within 2.2 mm of their site of origin **(Blumhart and Williams, 1992)**.

B. Dose and Production

Radioiodine-131is reactor produced. Diagnostic dose = 2-5 mCi/oral for whole body iodine scans for following a patient with thyroid carcinoma. While therapeutic dose = 80-150 µCi/gm of thyroid tissue for Grave's disease, 100-200 mCi for thyroid carcinoma. Thyroid hormone should be discontinued for several (2.6) weeks in advance of study or treatment. A serum TSH level is very helpful to gauge the adequacy of thyroid hormonal withdrawal. Unless the TSH level is increased, the validity of an ^{131}I body scan, especially if it is normal, should be questioned. Radioiodine-131 is administered orally in liquid or capsule form and scans are performed 24 hours later **(Blumhart and Williams, 1992)**.

C. Indications

The long half-life, high-energy gamma, and beta-emissions described above limit the usefulness of ^{131}I for imaging purposes. Its administration results in a very high radiation dose to the thyroid, 90% of which is the result of beta-decay. Radioiodine-131 is not the tracer if choice for imaging applications, except in the case of delayed imaging for thyroid carcinoma metastases or mediastinal masses, where the higher energy gamma and improved target-to-back-ground ratio following washout are useful. Because of the beta emission, however, the agent is useful for therapeutic purposes **(Blumhart and Williams, 1992)**.

The chief disadvantage of ^{131}I is that 90% of its radioactive emission consists of beta particles which with the usual adult dose of 50 micro curies are responsible for a radiation dose of 50-100 rad to the thyroid **(Blumhart and Williams, 1992)**.

ii. Radioiodine-125 (^{125}I)

Radioiodine-125 is not used for imaging. The agent decays by electron capture with a physical half-life of 60.2 days. It emits a gamma photon of 35 keV. It is a low energy isotope as compared with ^{131}I. It delivers less radiation to the thyroid giving better delineation of superficial lesions. The agent is primarily used for radioimmunoassays and other *in vitro* procedures **(Blumhart and Williams, 1992)**.

iii. Radioiodine-123 (^{123}I)

Dose and Physical Characteristics

Its dose (200-400 μCi) ^{123}I decays by electron capture, has a physical half-life of 13.6 hours, and gamma energy of 159 keV **(Blumhart and Williams, 1992)**.

Indications

Radioiodine-123 is the agent of choice when evaluating substernal goiters because there is usually substantial mediastinal blood pool activity associated with Tc-pertechnetate. The maximal count rate in the thyroid occurs approximately 6 hours following the oral administration of the agent. Images are typically acquired 4 hours following administration of the tracer, and uptake values are determined at 4 and 24 hours **(Blumhart and Williams, 1992)**.

Advantages

Over other isotopes of iodine is that its gamma photon energy is ideal for imaging, its short half-life allows high activity to be given and it has no beta particle emission **(Walfish *et al.*, 1976)**.

β-Technetium-99 Pertechnetate

Chemistry and Pharmacology

Pertechnetate (TcO_4) is a monovalent anion trapped by the thyroid gland in the same manner as iodine (an active transport mechanism). After trapping pertechnetate slowly "washes" from the gland it does not undergo organification. Peak thyroid activity occurs between 20 and 40 min. after injection. Only 2-4% of the administered dose is trapped in the thyroid. Pertechnetate is secreted in human milk (discontinue breast-feeding for 48 hours after dosing) and also crosses the placenta to accumulate in the foetus **(Blumhart and Williams, 1992)**.

Iodine and pertechnetate share the same active transport uptake pathway. The uptakes of radioiodine and pertechnetate by the follicular trapping system are both decreased by perchlorate, thiocyanate ions, and expansion of the circulating iodide pool (iodinated contrast, dietary, or the antiarrhythmic agent amiodarone) **(Blumhart and Williams, 1992)**.

Dose and Technique

The typical dose used for thyroid imaging is 3 mCi intravenously. A rough estimate of thyroid uptake can be obtained from the Tc-pertechnetate exam by obtaining a one minute anterior planar image over the thyroid and salivary glands 5 minutes after injection of the tracer. A hypofunctioning gland will appear less intense than the salivary glands, a normal gland equal to the salivary glands, and a hyperfunctioning thyroid hotter than the salivary glands **(Price, 1993)**.

In comparison to ^{123}I studies, more background activity is usually present on pertechnetate images. Linear oesophageal activity, due to tracer secreted by the salivary glands, which is swallowed, may be seen. This can be cleared from the oesophagus by drinking water **(Blumhart and Williams, 1992)**.

A pinhole collimator is used for enhanced resolution and also facilitates oblique views **(Prince, 1993)**.

The size of nodules that can be detected by pertechnetate imaging depends upon the nodules function and size. Hot nodules may be seen even if they are very small, but a hypofunctioning (cold) nodule less than 0.8 to 1.0 cm in size lying within the gland may not be discernible **(Price, 1993)**.

In general, Tc-pertechnetate 5-mm pinhole imaging has a sensitivity of 80 to 95% for cold nodules between 8 to 18 mm, but nearly0% for nodules less than 5 mm **(Price, 1993)**.

There are reported cases of thyroid carcinomas that are capable of trapping but not organifying iodine. Therefore, it is possible to have a warm or hotnodule on a ^{99m}Tc scan that would be cold on ^{123}I. Therefore, any patient with a non-cold nodule on a ^{99m}Tc scan should be repeated with ^{123}I to avoid this disparity. Cold nodules with ^{99m}Tc scan will inevitably be cold with an ^{123}I scan **(Blumhart and Williams, 1992)**.

Indications

Pertechnetate is the preferred imaging agent when: patient has been taking thyroid blocking agents (propyl thiouracil) as thiouracil blocks oxidation and organification of iodide following its uptake by the thyroid gland, but will not interfere with trapping of pertechnetate; or if the patient is unable to take medication orally. The study must be completed in less than 2 hr. Thyroid functions (uptake studies) are not necessary **(Blumhart and Williams, 1992)**.

Contraindication

Pregnancy is an absolute contraindication to thyroid scanning, especially after the 12th week of gestation when the foetal thyroid begins to trap iodine. Prior to this time tests should be avoided if possible despite the fact that the foetal dose will be very low (1 mrad/mCi of ^{131}I). Iodine, thionamides, thyroid stimulating antibodies, and TRH all cross the placenta easily. Triiodothyronine and T_4 cross only minimally. The thyroid stimulating hormone does not cross the placenta **(Price, 1993)**.

Advantages

Technetium-99 has a half-life of 6 hours (major advantages), and, is a clean gamma emitter **(Blumhart and Williams, 1992)**.

Maximum thyroid uptake occurs about 20 min. after intravenous injection of ^{99m}Tc compared with 10-24 hr after an oral dose of the radioactive iodine **(Walfish *et al.*, 1976)**.

At present the two most common isotopes used for isotopic thyroid scanning are ^{123}I and ^{99m}Tc **(Price, 1993)**.

Thyroid Scintigraphy

In the past, thyroid imaging has customarily been performed with a rectilinear scanner, which has the advantages of producing a 1:1 anatomic image, useful for the detailed marking of palpable abnormalities. Rectilinear scanning also permits accurate assessment of thyroid size of several standard formulas in the literature but has the disadvantages of significantly poorer spatial resolution than scintillation camera pinhole imaging and generally decreasing availability of rectilinear scanners **(Blumhart and Williams, 1992)**.

In most laboratories now, the highest quality thyroid images, are obtained with a current technology ¼ or $^{3}/_{8}$ in thick sodium iodide scintillation camera and a pinhole collimator with a 2 to 3-mm whole size **(Price, 1993)**.

In an interesting surgical study of 149 thyroid nodules in 92 patients, **Ryo *et al.*, (1976)** found that ^{99m}Tc 5 mm pinhole scintigraphy had a 0% sensitivity for nodules less than 5 mm in diameter, 45% sensitivity for those 5-7 mm in diameter, 80 to 94% sensitivity for those 8-18 mm in diameter, and 100% sensitivity for nodules greater than 20 mm in diameter.

Where the highest quality images are required, such as in patients with palpable abnormalities or patients with a history of head and neck radiation during childhood, the customary technique consists of injection of 10-20 mCi ^{99m}Tc pertechnetate intravenously, followed 15 min. later by three thyroid images, an anterior, left anterior oblique, and right anterior oblique of 15 min. duration each.

If highest quality anatomic detail is not necessary, 15–minute pinhole imaging of the ^{123}I uptake close is adequate, customarily performed at the 4-hour time point **(Price, 1993)**.

It should be noted that although scintillation camera pinhole imaging provides the highest spatial resolution, there is significant three-dimensional distortion of the image, which can he problematic in marking palpable abnormalities and which is greatest with the most magnified images and the largest scintillation cameras **(Price, 1993)**.

For thyroid carcinoma scanning, the customary technique is to administer 5 mCi (range 1 to 10 mCi) of ^{123}I orally on the first day, with measurement of neck uptake and neck scintigraphy at 24 hours, followed by neck uptake and whole-body camera scintigraphy at 72 hours, including spot views of the neck and any other suspicious sites. For ready anatomic localization, we customarily inject 1 mCi ^{99m}Tc pertechnetate at 72 hr and obtain whole body images of the technetium simultaneously with the radio-iodine **(Price, 1993)**.

Because technetium goes to most of the same structures as radioiodine, including salivary glands, thyroid, stomach, bowel, and bladder, non specific iodine uptake in these structures can be readily differentiated from tumour uptake **(Price, 1993)**.

Radioiodine-123 scanning requires a high energy parallel hole collimator and is best performed with a ½ or $^{3}/_{8}$ inch thick sodium iodide crystal camera **(Price, 1983)**.

CHAPTER (VI)
PATHOLOGY OF THYROID GLAND SWELLING

Classification of the thyroid swellings **(Robbins *et al.*, 1994)**:-

(1) Toxic goiter

a. Thyrotoxicosis (hyperthyroidism).

b. Hypothyroidism (cretinism or myxoedema)

(2) Inflammatory (thyroiditis)

a. Hashimoto's thyroiditis.

b. Subacute granulomatous thyroiditis (De Quer Vains's)

c. Subacute lymphocytic thyroiditis.

d. Graves' disease.

e. Reidle's thyroiditis.

(3) Diffuse and multinodular goiter

a. Diffuse nontoxic (simple) goiter.

b. Multinodular goiter.

(4) Thyroid Tumours

a. Benign tumours

i. Follicular adenoma.

ii. Other benign tumours (dermoid cyst, lipoma, haemangioma and teratoma).

b. Malignant tumours:

i. Primary

- Papillary carcinoma.
- Follicular carcinoma.

- Anaplastic carcinoma
- Medullary carcinoma
- Thyroid metastasis

ii. Secondary (metastasis)

(5) Miscellaneous lesions (congenital anomalies).

1. Toxic Goiter

a. *Thyrotoxicosis (Hyperthyroidism)*

Thyrotoxicosis is a hypermetabolic state encountered must more often in women, caused by elevated levels of free T_3 and T_4 in the blood. When these elevated levels arise from hyper-function of the thyroid, as occurs in Graves' disease, the thyrotoxicosis may correctly be called hyperthyroidism. When the increased hormone levels reflect excessive leakage of hormone out of a non-hyperactive gland, however, it is properly referred to as thyrotoxicosis. Long usage often equates these terms. By either name, the syndrome is manifested by nervousness, palpitations, rapid pulse, fatigability, muscular weakness, weight loss with good appetite, diarrhoea, heat intolerance, warm skin, excessive perspiration, emotional lability, menstrual changes, a fine tremor of the hand (particularly when outstretched), eye changes, and variable enlargement of the thyroid gland **(Robins *et al.*, 1994)**.

Thyrotoxicosis may be caused by a variety of disorders, the three common causes collectively account for virtually

99% of cases. Among these, Graves' disease is the most frequent, particularly in patients younger tan 40 years of age. Alone it accounts for 85% of cases. This disease, which is truly "hyperthyroidism" is also known as diffuse toxic hyperplasia to differentiate it from the thyrotoxicosis related to toxic nodular goiter, whether it is a solitary nodular (presumably an adenoma) or multinodular. Metastatic, well-differentiated thyroid carcinoma may sometimes elaborate sufficient thyroid hormones to cause hyperthyroidism. Similarly, acute or subacute thyroiditis during the stage of active cell injury may be associated with sufficient release of stored hormones to induce transient manifestation of hyperthyroidism.

Choriocarcinomas and hydatidiform moles may produce not only chorionic gonadotropin but also sometimes at TSH-like material. Increased levels of thyroid hormones may rarely be caused by TSH secreting pituitary tumours or pituitary stimulation by excessive hypothalamic release of TRH. Thyroid hyper-function can be also induced by excess iodine ingestion in patient with various thyroid disorders. This pattern is sometimes referred to as (Jod-Basedow disease). The iodine ingestion permits T_3, T_4 synthesis and precipitates the thyrotoxicosis.

Equally rarely, patients receiving thyroid hormone medication for hypothyroidism or for other reasons may develop iatrogenic or factitious hyperthyroidism. In all, the same hypermetabolic syndrome results **(Robbins *et al.*, 1994)**.

b. *Hypothyroidism (Cretinism or Myxoedema)*

Hypothyroidism is defined as a clinical state resulting from inadequate production of thyroid hormones. Hypothyroidism may be congenital or may appear in children or adults. Adulthood hypothyroidism shows about a ten-fold predominance among females and develops most between 30 and 60 years of age.

The clinical features depend on the age at onset. Symptoms of avert adult hypothyroidism include lake of energy, cold intolerance, dryness of skin and hair, hoarseness of voice, and subcutaneous swelling that is most prominent around the eyes. Advanced hypothyroidism with subcutaneous swelling is called 'myxoedema" **(Kissane, 1990)**.

***2.* Inflammatory (Thyroiditis)**

a. *Hashimoto's Thyroiditis*

Hashimoto's (chronic lymphocytic) thyroiditis is the most common of the chronic thyroiditis, being 5-10 times more frequent than subacute thyroiditis **(Price, 1993)**.

Peak incidence is between the ages of 40 and 60 years, and it is about 6 times more common in women than in men. It is the most common thyroiditis in children. The diagnosis is based on serology, since the diseases is an autoimmune process with antigenic stimulation to thyroglobulin, colloid, and other thyroid cell antigens **(Yousem and Scheff, 1996)**.

The chief complaint is usually enlargement and tenderness of the thyroid gland. Hypothyroidism is present at presentation or develops later in 50% of cases **(Yousem and Scheff, 1996)**.

The disease shows no greater risk for carcinoma, but seems to predispose the patient to non-Hodgkin's lymphoma. Hashimoto's thyroiditis also occurs in the presence of thyroid lymphoma in 25 to 67% of cases **(Takashima *et al.*, 1988)**.

Hashimoto's disease has been associated with other autoimmune entities such as pernicious anaemia, Sjogren's syndrome, lupus, rheumatoid arthritis, Addison's disease, and Grave's disease **(Yousem and Scheff, 1996)**.

b. Subacute (de Quervain's) Thyroiditis

de Quervain's thyroiditis (subacute thyroiditis) is a disease of middle age (peak incidence second to fifth decades) occurring most commonly in women (3.6 to 1) after an upper respiratory infection. As many as 48% of the cases of thyroiditis were due to this thyroiditis. Coxsackie virus, adenoviruses, echo and mumps viruses have been implicated **(Livoli, 1994)**.

Pain, fever and fatigue are common presenting symptoms. It may present (50% of cases) early with acute toxic hyperthyroidism. However, after 1-2 months, there usually is a subsequent change to a euthyroid state. Hypothyroidism occurs approximately 2 to 4 months after clinical onset, and typically by 6 months after the acute onset, the patient returns to a euthyroid state. Patients are usually treated medically, as the prognosis is good for return of normal thyroid function **(Price, 1993)**.

c. *Subacute Lymphocytic Thyroiditis (Painless)*

This condition is an uncommon cause of goitrous hyperthyroidism. The only changes in the gland are foci of lymphocytic infiltration, sometimes accompanied by an increase in interstitial fibrous tissue **(Robbins *et al.*, 1994)**.

This form of thyroiditis usually comes to attention because of goitrous enlargement of the gland or hyperthyroidism or both.

There is no association with previous viral infection, and autoimmune reactions. Generally, the T_3 and T_4 levels are increased. Although this form of thyroiditis may occur at any age in either sex, it is most common in women and during the postpartum period **(Robbins *et al.*, 1994)**.

d. *Graves' Disease*

Is characterized by hyperthyroidism, ophthalmopathy, and diffuse enlargement of the thyroid. In most countries it is the second most common thyroid disease **(Kissane, 1990)**.

An aggregation of Graves' disease and Hashimoto thyroiditis in the same of families has been found and it is assumed that these two diseases are immunologically closed related autoimmune disorders **(Kissane, 1990)**.

Dysthyroid ophthalmopathy results in enlargement of the extraocular muscles, a feature which is well recognized pathologically **(Sutton, 1993)**.

e. ***Riedel's Thyroiditis (Invasive Fibrous Thyroiditis)***

Riedel's thyroiditis is a rare disease, the initial complaint of the patients is a stone-hard goiter that is density adherent to adjacent structure in the neck. Compression symptoms, such as dysphagia may occur. The process involves the whole gland or a part of one lobe.

The involved areas are stone hard and whitish and show no lobulation on cross section. The thyroid capsule is not usually discernible. Histologically, fibrous tissue, accompanied by inflammatory cells, replaces normal thyroid structures and invades the adjacent muscle tissue **(Kissane, 1990)**.

3. Diffuse and Multinodular Goiter

a. ***Diffuse Non Toxic (Simple) Goiter***

This designation specifies a form of goiter that (1) diffusely involves the entire gland without producing nodularity and (2) is not associated usually with either hyperfunction or hypofunction. Because the enlarged follicles are filled with colloid, the term colloid goiter has been applied to this condition. It occurs in both and endemic and a sporadic distribution.

A deficient intake of iodine is the dominant cause of the disease. The lack of iodine leads to decreased synthesis of thyroid hormone and a compensatory increase in TSH, leading to follicular cell hypertrophy and hyperplasia and goitrous enlargement **(Robbins *et al.,* 1994)**.

b. *Multinodular Goiter*

Nearly all long-standing simple goiters become transformed into multinodular goiters. They may be non toxic or may induce thyrotoxicosis (toxic multinodular goiter), also called Plummer's disease.

Multinodular goiters produce the most extreme thyroid enlargements and are most frequently mistaken for neoplastic involvement than any other form of thyroid disease.

Multinodular goiter is marked by its heterogeneity. Typical features include, nodularity created by islands of colloid filled or hyperplastic follicles, random irregular scarring, focal haemorrhage, focal calcification, microcyst formation **(Robbins *et al.,* 1994)**.

Goitrous enlargement may achieve weight 200 gm producing lateral pressure on the midline structure such as the trachea or oesophagus, in other instances, the goiter grows behind the sternum and clavicle to produce the so called "intrathoracic or plunging goiter" **(Taylor, 1978)**.

The main manifestations which bring the patient to medical advice are the complication such as pressure symptoms on the trachea, oesophagus, nerves and vessels; toxic changes in the normal thyroid tissue with haemorrhage cystic degeneration, infection and malignant transformation **(Taylor, 1978)**.

4. Thyroid Tumours

a. *Benign Tumours*

i. Follicular Adenoma

Follicular adenoma is an encapsulated non invasive tumour arising from follicular cells and showing follicular cell differentiation.

Follicular adenoma is a common tumour that can occur at any age but mainly in young adult. It is more common in females than in males.

Clinically it usually presents as a solitary thyroid nodule that causes compression. Haemorrhage into an adenoma may cause pain and an acute increase in the size of tumour **(Kissane, 1990)**.

Most thyroid tumours in general and carcinoma in particular present with painless thyroid mass that is found to be "cold" on scintigrams, because the large majority of clinically detectable thyroid nodules with prove to be benign and many not even neoplastic, so, adenoma presents as a solitary thyroid nodule that frequently appear "cold" on isotopic scans **(Damjanov, 1996)**.

The incidence of malignant transformation in adenoma is believed to be much less than 1% **(Degroot, 1975)**.

The principal importance of adenomas is their clinical differentiation from cancers, in addition, they may:-

(1) Slowly increase in size to cause pressure symptoms in the neck.

(2) Achieve a certain size and then plateau.

(3) Suddenly enlarge and become painful owing to intralesional haemorrhage.

(4) Rarely synthesize T_3 and T_4 and cause hyperthyroidism (functional adenoma).

(Robbins *et al.*, 1994)

ii. Other Benign Tumours

Solitary nodules of the thyroid gland may also prove to be cysts. The great preponderance of these lesions represent cystic degeneration of a follicular adenoma, the remainder probably arise in multinodular goiters.

Additional benign tumours (dermoid cyst, lipoma haemangioma and teratoma) **(Robbins *et al.*, 1994)**.

b. ***Malignant Thyroid Lesions***

i. Primary

In most patients with primary thyroid cancer, the tumours are of epithelial origin and are derived from either the follicular or the parafollicular cells. Malignant thyroid tumours of mesenchymal origin are exceedingly rare, as are metastases to the thyroid. Most thyroid cancers are well differentiated, and papillary carcinoma (including so-called mixed papillary and follicular carcinoma) now accounts for 75 to 90% of all cases **(Hay, 1991)**.

In constant, medullary, follicular and anaplastic carcinoma, combined, represent only 10 to 25% of all thyroid carcinomas currently diagnosed in North America **(Hay, 1991)**.

- ***Papillary Carcinoma***

Although it can occur in patients of any age, papillary cancer is especially prevalent in younger patients. Females are affected more often than males **(McConahey *et al.*, 1986)**.

On microscopic examination, the tumour is multicentric within the thyroid gland in at least 20% of cases. Round, laminated calcifications (psammoma bodies) are seen in approximately 25% of cases **(Solbiati *et al.*, 1998)**.

The major route of spread of papillary carcinoma is through the lymphatics to nearby cervical lymph nodes. In fact, it is not uncommon for a patient with papillary thyroid cancer to present with enlarged cervical nodes and a palpable normal thyroid gland. The presence of nodal metastasis in the neck does not, in general, appear to alter the prognosis for this malignancy. Distant metastases are very rare (2-3% of cases) and occur mostly in the mediastinum and lung. After 20 years, the cumulative mortality from papillary thyroid cancer is typically only 4-8% **(McConahey *et al.*, 1986)**.

Papillary carcinoma has peculiar histological features (fibrous capsule, micro-calcifications) and cytologic features "(ground glass) nuclei, cytoplasmic inclusions in the nucleus, and indentations of the nuclear membrane" which often allow a relatively easy pathologic diagnosis **(Pilotti and Pierotti, 1992)**.

In particular, micro-calcifications, which result from the deposition of calcium salts in the psammoma bodies, are present with a high incidence in both the primary tumour and the cervical lymph node metastases **(Solbiati, 1998)**.

Papillary "micro-carcinoma" is a non-encapsulated sclerosing tumour measuring 1 cm or less in diameter. In 80% of cases, the patients with enlarged cervical nodes and a palpably normal thyroid gland **(McConahey *et al.*, 1986)**.

Fig. (10) Calcified psammoma body from papillary carcinoma
(Solbiati et al., 1998).

- Follicular Carcinoma

It is the second subtype of well-differentiated thyroid cancer. It accounts for 5 to 15% of all cases of thyroid cancer, affecting females more often than males **(Pilotti and Pierotti, 1992).**

Pathologically, there are two variants of follicular carcinoma and they differ greatly in histology and clinical course **(Pilotti and Pierotti, 1992).**

The minimally invasive follicular carcinomas are encapsulated and only the histologic demonstration of focal invasion of capsular blood vessels of the fibrous capsule itself permits differentiation from follicular adenoma. The widely invasive follicular carcinomas are not well encapsulated, and invasion of the vessels and the adjacent thyroid is more easily demonstrated **(Pilotti and Pierotti, 1992).**

Both variants of follicular carcinoma tend to spread via the blood stream rather than via lymphatics, and distant metastases to bone, lung, brain and liver are more likely than metastases to cervical lymph nodes. The widely invasive variant metastasizes in about 20-40% of cases and the minimally invasive in only 5-10% of cases **(Pilotti and Pierotti, 1992)**.

Mortality due to follicular carcinoma is approximately 20-30% at 20 post-operative years **(McConahey *et al.*, 1986)**.

- *Anaplastic Thyroid Carcinoma*

It is typically a disease of the elderly, it represents one of the most lethal of solid tumours. Although it accounts for less than 5% of all thyroid cancers, it carries the worst prognosis, with a 5-year mortality rate of more than 95% **(Nel *et al.*, 1985)**.

The tumour typically presents as a rapidly enlarging mass extending beyond the gland and invading adjacent structures. It is often inoperable at the time of presentation **(Pilotti and Pierotti, 1992)**.

Anaplastic carcinomas may often be associated with papillary or follicular carcinomas, presumably representing a differentiation of the neoplasm. They tend not to spread via the lymphatics but instead are prone to aggressive local invasion of muscles and vessels **(Pilotti and Pierotti, 1992)**.

- *Medullary Carcinoma*

It accounts for only about 5% of all malignant thyroid disease. It is derived from the parafollicular cells, or C-cells, and typically secretes the hormone calcitonin, which can be a useful serum markers. This cancer is frequently familial (20%) and is an essential component of the multiple endocrine neoplasia (MEN) type II syndromes **(Solbiati *et al.*, 1998)**.

The disease is multicentric and/or bilateral in about 90% the familial cases. There is a high incidence of metastatic involvement of lymph nodes, and the prognosis for patients with medullary cancer is considered to be somewhat worse than that for follicular cancer **(Solbiati *et al.*, 1998)**.

- *Lymphoma*

Lymphoma accounts for approximately 4% of all thyroid malignancies. It is mostly of the non-Hodgkin's type and usually affects elder females. The typical clinical sign is a rapidly growing mass, which may cause symptoms of obstruction such as dyspnoea and dysphagia **(Hamburger *et al.*, 1983)**.

In 70 to 80% of cases, lymphoma arises from a pre-existing chronic lymphocytic thyroiditis (Hashimoto's disease) with subclinical or overt hypothyroidism. The prognosis is highly variable and depends on the stage of the disease. The 5–year survival rate may range from nearly 90% in early stage cases to less than 5% in advanced, disseminated disease **(Kasagi *et al.*, 1991)**.

- *Thyroid Metastasis*

Metastasis to the thyroid is very rare. The two most common primary tumours to metastasize to the thyroid gland are bronchogenic carcinoma and renal cell carcinoma multifocality is the rule. Haemorrhage is common with renal metastasis **(Yousem and Schefe, 1996)**.

5. Miscellaneous Lesions

a. *Congenital Anomalies*

Congenital (developmental anomalies) of the thyroid result from disturbance in the descent of thyroid anlage. Although rare, they are the most common cause of sporadic cretinism.

i. Thyroid Agenesis

Complete failure of the thyroid anlage to develop results in total absence of thyroid tissue. Children with thyroid agenesis are born as cretins. In hemiagenesis only one of the thyroid lobes develops.

ii. Ectopic Thyroid

An ectopic thyroid may be located anywhere along the route of descent, usually between the normal position and the base of the tongue but sometimes caudally in the mediastinum. The base of the tongue is the most common location such a lingual thyroid sometimes causes laryngeal or pharyngeal obstruction **(Kissane, 1990)**.

Total absence of thyroid tissue from its normal location occurs in about two thirds of cases with an ectopic thyroid. In patients with an ectopic thyroid, the presence and severity of hypothyroidism depend on the quantity of residual thyroid tissue.

Hypothyroidism may not develop until later in childhood or in adulthood **(Kissane, 1990)**.

iii. Thyroglossal Cyst

Remnants of the thyroglossal duct may give rise to cysts or sinuses. Thyroglossal cysts occur in the midline, most commonly in the region of the hyoid bone. They are lined with columnar or squamous epithelium, though this may lack because of inflammation. Follicles are sometimes present in the wall of the cyst. Cysts may communicate with pharynx at foramen caecum and form fistulas. If they are inflamed, they may rupture to the skin **(Kissane, 1990)**.

Table (1) Pathology of thyroid swellings **(Phelps, 1998).**

Disease	*Swelling (Focal or Diffuse)*	*Function (Hyper-, Hypo-)*	*Others*
Thyroglossal cyst	Focal	-	They create masses in the neck requiring differentiation from serious neoplasms, they may communicate with the skin to produce draining sinus
Diffuse non toxic goitre	Diffuse	-	Disfiguring painless swellings in the neck, feels soft, elastic with a smooth surface
Solitary nodular goiter	Focal	-	This discrete swelling has a complete capsule of fibrous tissue which may show calcification, dyspnoea occur when the nodule is over the trachea
Multinodular Goiter	Focal	±	Multiple nodules created by island of colloid filled acini, random irregular scarring, focal haemorrhage and haemosiderin depositions, may compress the trachea and oesophagus, liable for calcification, infection, malignant transformation
Hyperthyroidism	Diffuse	Increase	Marked irritability and nervousness, with increase sensitivity to heat and weight loss
Hashimoto's thyroiditis	Diffuse	±	Enlargement of the thyroid occasionally with pressure symptoms over the trachea and oesophagus

Table (1) [Contd.]

Disease	Swelling (Focal or Diffuse)	Function (Hyper-, Hypo-)	Others
Subacute thyroiditis (de Quervain's)	Focal or diffuse?	Normal or slight high	Enlarged gland, painful, elevated level of thyroid antibodies
Reidle thyroiditis	Multifocal	Increase	Extensive fibrosis of the gland
Thyroid adenoma	Focal	±	Well defined fibrous capsule, rarely cause significant symptoms
Papillary carcinoma	Solitary or multifocal	Increase	Slowly progressive, the younger the individual, the better the prognosis
Follicular cancer	Irregular lump	Increase or euthyroid	More rapid course with possible metastasis. Surgery, iodine ablation and hormones for treatment
Medullary carcinoma	Focal	Increase	Focal lesion with rapid course and high level of calcitonin
Anaplastic carcinoma	Focal	Increase	This highly malignant tumour cases death within 6 months, 2 years

CHAPTER (VII)
SONOGRAPHIC APPEARANCE OF DIFFERENT THYROID SWELLINGS

Simple Cyst

Sonographic Appearance

It is marked by area of hypoechogenicity with irregular cyst wall. Internal debris may be seen. Tissue rests can appear as hyperechoic areas within the lumen **(Fobbe, 1995).**

Colour Doppler

It appears to be completely avascular in contrast to the rare cystic papillary carcinoma, which exhibits papillary projection with colour flow signals **(Solbiati, 1998)**.

Hyperplasia and Goiter

Sonographically Appearance

Most hyperplastic or adenomatous nodules are isoechoic compared to normal thyroid tissue. As the size of the mass increases, it may become hyperechoic due to the numerous interfaces between cells and colloid substance. Less frequently, a hypoechoic sponge-like pattern is seen **(Kerr, 1994)**.

When the nodule is isoechoic or hyperechoic, a thin peripheral hypoechoic halo is commonly seen it is most likely due to perinodular blood vessels and mild oedema or compression of the adjacent normal parenchyma **(Solbiati *et al.*, 1985)**.

The degenerative changes of goitrous nodules correspond to their sonographic appearances purely anechoic areas are due to serous or colloid fluid. Echogenic fluid or moving fluid levels correspond to haemorrhage **(Solbiati *et al.*, 1985)**.

Bright echogenic foci with comet tail artifacts are likely to be due to the presence of dense colloid material **(Ahuja *et al.*, 1996)**.

Intracystic thin septations probably correspond to attenuated strands of thyroid tissue. On colour Doppler these septations are avascular **(Lagalla *et al.*, 1992)**.

Intracystic solid projections, or papillae with or without colour Doppler signals, are common, and this appearance can be similar to the rare cystic papillary thyroid carcinoma **(Lagalla *et al.*, 1992)**.

Colour Doppler Sonography

Most hyperplastic nodules, both cystic and solid, do not show internal flow signals on colour Doppler studies **(Fobbe *et al.*, 1989)**.

Perinodular blood vessels are sometimes detected with only low velocity signals 15-20 cm/sec. **(Solbiati *et al.*, 1992b).**

When single or multiple hyperplastic nodules have autonomous function (pretoxic or toxic phase) the pattern detected by colour flow mapping is totally different as it shows intense, grouped, internal (intranodular), or peripheral (perinodular) flow signals or a combination **(Funkunari *et al.*, 1990)**, with the highest peak velocities up to 160-220 cm/sec. detectable in the thyroid gland **(Solbiati *et al.*, 1992b)**.

Adenoma

Sonographically

Adenomas are usually solid masses that may be hyperechoic, isoechoic or hypoechoic. They often have a peripheral hypoechoic halo that is thick and smooth **(Lagalla *et al.*, 1993a)**.

Colour Doppler

The halo is due to the fibrous capsule and blood vessels, which can be readily seen. Often, vessels pass from the periphery to the central regions of the nodule, creating a "spoke and wheel like" appearance. Hyperfunctioning (autonomous) adenomas sometimes exhibit abundant blood flow, which may be peripheral and/or internally located **(Lagalla *et al.*, 1993a)**.

Inflammatory Lesions

There are no specific scintigraphic, sonographic, CT or MR appearances to differentiate one inflammatory process involving the thyroid gland from another. The most useful study may be the nuclear medicine thyroid scan, performed with ^{99m}Tc pertechnetate or radioactive iodine (^{123}I or ^{131}I), which will determine the functional activity of the thyroid gland. However, serology testing to distinguish the various causes of thyroid inflammatory disease is much more valuable than the imaging studies. On the other hand, if imaging is to be used as a map for surgical correction or resection of the thyroid gland, then MR and ultrasound are of particular benefit. One must be cautious regarding CT scanning and the administration of contrast enhanced iodinated compounds, since these agents will interfere with thyroid function tests for up to 6 weeks **(Mancuso and Dillon, 1989)**.

Sonographic Examination

The typical appearance of acute infection is enlargement of the gland, either focal or diffuse, and hypoechogenicity, presumably on the base of oedema **(Gooding, 1993)**.

Scintigraphy Examination

Radioiodine uptake values are generally normal, and scintigraphy demonstrates a normal gland for the most part, often with a focal defect at the site of the abscess “cold nodule” **(Gooding, 1993)**.

Subacute Granulomatous Thyroiditis

Sonographic Examination

The gland may appear enlarged and hypoechoic. Sonography can be used to assess the evaluation of the disease following the medical therapy **(Adams and Jones, 1990)**.

Colour Doppler

The gland usually shows normal or decreased vascularity due to diffuse oedema of the gland **(Adams and Jones, 1990)**.

Subacute De Quervain’s Thyroiditis

Scintigraphy Examination

Nuclear medicine studies show heterogeneous uptake that will vary in degree according to the stage of the disease **(Yousem and Scheff, 1996)**.

Sonographic Examination

Subacute thyroiditis is hypoechoic on ultrasound, and there may be atrophy of thyroid tissue with time **(Yousem and Scheff, 1996)**.

Hashimoto’s Thyroiditis

Scintigraphy Examination

The gland is enlarged and shows heterogeneous increased or decreased uptake of radiotracers. The thyroid gland is symmetrically enlarged but may have nodules within it. Although early in the disease there may be increased uptake of iodine on nuclear medicine studies, the usual response is diminished or normal thyroid uptake on imaging **(Yousem and Scheff, 1996)**.

Ultrasound Examination

The typical sonographic appearance of Hashimoto's thyroiditis is diffuse glandular enlargement with a homogeneous but coarsened parenchymal echo texture, generally more hypoechoic than a normal thyroid **(Yeh *et al.*, 1996)**.

Fibrotic septations may produce a pseudo-lobulated appearance of the parenchyma. Multiple, discrete hypoechoic micronodules from 1-6 mm in diameter have been described micronodulation is a highly sensitive sign of chronic thyroiditis with a positive predictive value of 94.7%. Histologically, they represent lobules of thyroid parenchyma, which have been infiltrated by lymphocytes and plasma cells and surrounded by echogenic fibrous strands **(Yeh *et al.*, 1996)**.

Both benign and malignant thyroid nodules may coexist with chronic lymphocytic thyroiditis, and FNA is often necessary to establish the final diagnosis **(Takashima *et al.*, 1992)**.

Commonly, cervical lymphadenopathy is present, especially affecting the delphian node above the thyroid isthmus.

The end stage of chronic thyroiditis is atrophy when the thyroid gland is small, with ill-defined margins and heterogeneous texture due to progressive increase of fibrosis. Occasionally, discrete nodules occur, and fine needle aspiration is needed to establish the diagnosis **(Takashima *et al.*, 1992)**.

Colour Doppler

The gland is usually hypovascular however, hypervascularity similar to the "thyroid inferno" of Graves' disease may occur. A recent study suggests that hypervascularity occurs when hypothyroidism develops **(Lagala *et al.*, 1993a)**. When the gland atrophies blood flow signals are absent **(Solbiati *et al.*, 1998)**.

Malignant Thyroid Lesions

Papillary Carcinoma

Ultrasound Examination

They are relatively distinctive in most cases, similar to the pathologic features. Hypoechogenicity (in 90% of cases) due to closely packed cell content, with minimal colloid substance. Microcalcifications that appear as tiny, punctate hyperechoic foci, either with or without acoustic shadows **(Brkljacic *et al.*, 1994)**.

Cervical lymph node metastasis, which may contain tiny, punctate echogenic foci due to microcalcifications. Occasionally, meastatic nodes may be cystic as a result of extensive degeneration **(Solbiati *et al.*, 1995b)**.

Cystic lymph node metastases in the neck occur almost exclusively in association with papillary thyroid carcinoma but occasionally may occur in nasopharyngeal carcinomas **(Solbiati *et al.*, 1995b)**.

Colour Doppler

Hypervascularity (in 90% of cases) with disorganized vascularity, mostly in well encapsulated forms is seen **(Solbiati *et al.*, 1995b)**.

Most well differentiated carcinomas are generally hypervascular, with irregular tortuous vessels and arteriovenous shunting **(Solbiati *et al.*, 1995b)**.

Quantitative analysis of the flow velocities is not accurate in differentiating benign from malignant **(Solbiati *et al.*, 1998)**.

Follicular Carcinoma

Sonographically

It resembles the picture of adenoma there are no unique sonographic features that allow differentiation of follicular carcinoma from adenoma, which is not surprising, given the cytologic and histologic similarities of these two tumours.

Features that suggest follicular carcinoma are irregular tumour margins and a thick, irregular halo **(Lagala *et al.*, 1992)**.

Colour Doppler

It shows tortuous or chaotic arrangement of internal blood vessels **(Lagata *et al.*, 1992)**.

Medullary Carcinoma

Sonographically

The findings are similar to that of papillary carcinoma. Local invasion and metastasis to cervical nodes occur more frequently in patients with medullary carcinoma than in patients with papillary carcinoma **(Solbiati *et al.*, 1998)**.

Bright, puctate, echogenic foci caused by nests of amyloid or calcification are detectable in 80 to 90% of medullary carcinomas. These foci can be seen not only in the primary tumour, but also in lymph node metastases and even in hepatic metastases **(Gorman *et al.*, 1987)**.

Anaplastic Thyroid Carcinoma

Sonographically

These carcinomas are usually hypoechoic. They are often seen to encase or invade blood vessels and invade neck muscles **(Solbiati *et al.*, 1995b)**.

Often these tumours can not be adequately examined by ultrasound because of their large size. Instead, a CT or MRI of the neck usually demonstrates more accurately the extent of the disease **(Pilotti and Pierotti, 1992)**.

Colour Doppler

Poorly differentiated anaplastic carcinomas are often hypovascular due to extensive necrosis associated with their rapid growth **(Solbiati *et al.*, 1995b)**.

Lymphoma

Sonographic Appearance

Lymphoma of the thyroid appears as a hypoechoic lobulated mass that is nearly avascular. Large areas of cystic necrosis, or encasement of adjacent neck vessels may occur **(Kasagi *et al.*, 1991)**.

The adjacent thyroid parenchyma may be heterogeneous due to associated chronic thyroiditis **(Takashima *et al.*, 1989)**.

Table (2) Ultrasonographic appearance of thyroid swellings **(Giomondo *et al.*, 1993)**.

Lesion	*Size*	*Nature*	*Echogenicity*	*Calcific*	*Cystic*	*Other Comments*
Cystic lesions: Thyroglossal cyst	Small	Focal	Increased echogenicity	-	++	Midline along migratory pathway of embryological thyroid gland
Simple cyst of thyroid	-	Focal	An echoic	-	++	- Fine needle aspiration to detect malignant - Bloody content › chocolate coloured fluid, or xanthocromatic fluid.

						- Not true epithelium cysts may be degeneration. Thyroid adenoma or colloid nodules
Acute thyroiditis	Increase	Focal/diffuse	Decrease	-	-	Pyriform sinus fistulous communication in infants produces left lobe thyroiditis
Hashimoto's thyroiditis	Increase	Diffuse	Decrease	-	-	Sometimes the gland is nodular may be associated with thyroid lymphoma, leukaemia and papillary carcinoma
Hyperthyroidism	Increase	Diffuse	Decrease	-	-	Gland hypervascularity (Doppler)
Hyeprplasia adenoma	Increase	Focal/diffuse	Decrease	+	+	May be surrounded by hypoechoic rim which is vascular. Cystic component develop from necrosis and haemorrhage
Papillary carcinoma	Increase		Hypoechoic 63%; isoechoic 26%	+		- Doppler › rim of vascularity defining tem. - Invasion of surrounding thyroid tissues, local invasion of normal tissue boundries. - Ipsilateral adenopathy
Thyroid lymphoma	Increase	Focal/diffuse	Decrease	+	-	Cervical adenopathy, mediastinal extension

CHAPTER (VIII)
CT FINDINGS
OF THE DIFFERENT THYROID SWELLINGS

Thyroglossal Cysts

Thyroglossal cyst arise from remnants of thyroglossal duct and are secondary to secretion from its epithelial lining. They may develop anywhere along the course of the duct from the foramen caecum of the tongue to the pyramidal lobe of the thyroid gland **(Lee *et al.*, 1989)**.

Are commons to occur in the neck, they account for approximately 70% of congenital neck masses **(Reede *et al.*, 1991)**.

They usually present in young patient as an asymptomatic mass in the anterior neck in the midline or slightly of midline **(Lee *et al.*, 1989).**

Sixty five per cent of these cysts are located below the hyoid bone, 20% suprahyoid, and 15% at the level of the hyoid. Infrahyoid thyroglossal cysts usually are embedded within the strap muscles **(Lee *et al.*, 1989)**.

Routine sectional imaging of thyroglossal duct cysts is not performed in children because the clinical presentation (a painless midline neck mass that moves on swallowing) is so typical **(Reede *et al.*, 1991)**. The diagnosis usually is apparent on clinical examination, but may be confusing in adults, especially if the cyst is lateral to the middle **(Lee *et al.*, 1989)**.

Ultrasound or radioisotope scanning may be performed to confirm a normal position to the thyroid before surgery.

CT is usually performed preoperatively in cases of suspected thyroglossal duct cyst in adult to confirm the diagnosis and to exclude other nodal masses. On contrast enhanced CT, a well circumscribed, low density mass is present. Peripheral rim enhancement or internal septation are occasionally seen. Inflammation can alter the density of cyst so that it approaches or equals that of soft tissue **(Reede *et al.*, 1985)**. Increased attenuation of the cyst usually is associated with increased protein content and coexistent or prior inflammation **(Lee *et al.*, 1989)**. Alterations in the adjacent soft tissue represent inflammatory changes in patient before surgery or post-surgical changes in recurrent disease **(Reede *et al.*, 1985)**.

Rarely, solid areas may be seen that represent a complicating papillary carcinoma **(Lee *et al.*, 1989)**.

Ectopic thyroid tissue can be found anywhere along the course of the thyroglossal cyst. They are commonly found above the hyoid bone in the region of the base of the tongue, they may or may not be associated with functional thyroid tissue in the lower neck. It is estimated that approximately 70 to 80% of patients with lingual thyroid tissue have no other thyroid tissues.

The main variants include:-

(1) The lingual thyroid, in which the normal thyroid is usually absent in 70-80%.

(2) Cervical ectopic thyroid, in which the normal thyroid and thyroglossal cyst may or may not be absent.

(Stark and Bradley, 1988)

Lingual thyroid tissue is more common if females presented clinically as a lobulated mass in the midline at the base of the tongue, plain film examination of this area may demonstrate a soft tissue mass in the region of the base of the tongue, this is a non specific finding, since a number of conditions such as carcinoma, lymphoma, and enlarged lingual tonsils may produce similar findings.

CT findings of lingual thyroid tissue are fairly specific, on a non contrast scan the tissue appears as high attenuation mass at the base of the tongue. This is a reflection of the high iodine content of the thyroid tissue. After intravenous contrast injection it will enhance to a greater degree because of the rich blood supply of the gland **(Reede, 1985)**.

Residual thyroid tissue located along the course of thyroglossal cyst other than the base of the tongue may also escape detection until it becomes enlarged. The CT appearance may resemble normal thyroid tissue or shows evidence of non homogeneous enhancement pattern with low density within it **(Reede, 1985)**.

Aberrant thyroid tissue can develop any of the abnormality of normally located tissue, including carcinoma **(Stark *et al.*, 1988)**.

Recently, a case of submandibular ectopic thyroid tissue has been associated with a true lingual thyroid **(Latimer *et al.*, 1995)**.

Very few cases of ectopic thyroid have been described. A case of ectopic thyroid tissue arise posterolateral to the upper thoracic oesophagus **(Salam, 1992)**.

Goiter

On CT intrathoracic goiter almost always is continuous with a cervical thyroid on serial images. Extension to the neck may not be present if there has been prior thyroid surgery, if the gland is ectopic, or if the connection between the cervical and mediastinal components in only a narrow fibrous or vascular pedicle **(Bashist *et al.*, 1983)**.

The goiter is usually located in the anterior mediastinum in front of the great vessels. Larger masses displace the mediastinal vessels anterolaterally. Interdigitation between the trachea and oesophagus and extension into the posterior mediastinum can also be seen. Intrathoracic goiters usually are well defined and often contain focal areas of coarse calcification and low attenuation areas of cystic degeneration. The attenuation of the intrathoracic component frequently is less than that of the cervical thyroid, but greater than that of muscle.

This appearance, however is highly variable and relates to the iodine content of the goiter. If the iodine content is very low, the CT density may be similar to that for surrounding soft tissue **(Glazer *et al.,* 1989)**.

Enhancement patterns may be either homogeneous or non homogeneous with well defined low density areas **(Bashist *et al.,* 1983)**. Contrast enhancement is marked but usually inhomogeneous **(Burgener and Kormano, 1996)**.

Prolonged enhancement, more than 2 min after infection, may also be seen and is believed to be related to iodine uptake by the gland **(Glazer *et al.,* 1982)**. Because of the multinodularity of intrathoracic goiters and their variable iodine content, the enhancement pattern is frequently inhomogeneous.

Occasionally amorphous collection or ring like calcification may be identified within the lesion. This finding has no correlation, either positive or negative, with malignancy because calcification is identified in approximately 25 to 50% of benign and malignant thyroid lesions.

CT is very useful in defining the inferior limit of a goiter, it also defines the relationship of the goiter to the great vessels and adjacent structures and, this is of considerable surgical significance, commonly as the left innominate vein crosses the anterior mediastinum. The vein acts as a barrier to the further downward extension of retrosternal goiter, frequently, however goiter may extend further inferiorly posterior to the great vessels, and introduce into the middle and posterior mediastinum. Occasionally, a goiter may extend inferiorly anterior to the greater vessels, the key CT findings that identify a mediastinal mass as thyroid in origin are as follows:-

(1) The superior portion of the lesion is usually intimately associated with the thyroid gland.

(2) The lesion has CT numbers greater than surrounding muscles on the pre-contrast scan as well as the post-contrast scan.

(3) The lesions enhance after administration of contrast material, other lesions commonly encountered in this area do not enhance, with exception of those that are vascular.

(4) Well defined borders.

(5) Punctate coarse or ring like calcifications, low attenuation areas of cystic degeneration.

(6) The lesion is usually either located in close proximity to or intimately associated with the trachea.

(Galzer *et al.*, 1982)

Benign Lesions of the Thyroid Gland

Cysts

About 20% of solitary thyroid nodules are cysts, thyroid cysts may be difficult to differentiate from parathyroid cysts on ultrasound or CT. Thyroid cysts are almost uniformly benign and result from either degeneration of goiter or colloid cysts and as such can be diagnosed by evaluation of the cyst content **(Thomas *et al.*, 1988)**.

Adenoma

Benign lesions such as adenoma are found on CT as isodense with the surrounding muscle tissue and stands out smoothly from the thyroid tissue. An increase of density is usually recognizable after administration of contrast medium although it is less than that of the normal thyroid tissue **(Wegner, 1983)**.

Thyroid adenoma may be seen as inhomogeneous well circumscribed mass within the thyroid gland and may contain coarse calcifications with irregular distribution or aligned along the periphery of the lesion. Toxic and nonfunctioning adenomas may occur. It may be single or multiple. Adenomas are also found in goiters **(Burgener and Kormano, 1996)**.

It is well capsulated and the trabeculae extend to divide the tumour into many loculi, the tumour is very liable to turn malignant to give papilliferous carcinoma **(Sobeih, 1982)**.

Malignant Lesions of the Thyroid Gland

Thyroid carcinoma usually occur in the 5th and 7th decade with female predilection. There are five types of thyroid carcinoma (papillary 60%; follicular 20%; anaplastic 15%; medullary 4% and Hürthle *cell* 1%) **(Burgener and Kormano, 1996)**.

CT can be useful in the evaluation of patients with thyroid malignancy, defining the extent of the neoplasm and identifying lymph node metastases. However, there are no reliable CT findings which indicate the malignant or benign nature of a thyroid mass. The presence of adenopathy, recurrent laryngeal palsy, and cartilage destruction tend to favour malignant changes, calcification is found in up to 35% of benign and malignant lesions **(Thomas *et al.*, 1988)**.

Thyroid adenomas and carcinomas are seen as soft tissue masses within the gland. Calcification and cyst formation is seen in both types of lesion and CT can not reliable distinguish benign from malignant thyroid masses unless metastatic disease, bone or cartilage destruction or neurological involvement is identified in the latter **(Phelps, 1998)**.

Thyroid carcinoma can be seen as unilateral intra-thyroidal mass with infiltrating margins obscuring adjacent soft-tissue planes or mass with well defined margins simulating benign lesion.

Punctate or linear calcifications at the periphery are seen in approximately half of all cases (psammomatous bodies), most commonly in papillary carcinomas **(Burgener and Kormano, 1996)**.

Lymphogenic spread to regional lymph nodes occurs early. Haematogenous spread more often to lung and bone **(Burgener and Kormano, 1996)**.

CT Appearance of Anaplastic Carcinoma

Anaplastic carcinoma usually occurs after 50 years of age, with no predilection for either sex. It is one of the most malignant of all carcinoma occurring in human. The lesion presents as a hard fixed mass with rapid growth into the surrounding neck structures and it usually causes death by compression and asphyxia due to invasion of the trachea.

It usually appears as large homogeneous mass that are isodense or hyperdense relative to skeletal muscles on CT calcification and necrosis are usually present and are often extensive. Thyroid anaplastic carcinoma may invade the carotid artery, internal jugular vein, larynx, trachea or oesophagus and regional lymph nodes. CT scan can detects tumour spread to the vascular structures and regional lymph nodes, it can defines the extent of the masses in the thyroid gland more exactly than physical examination does. It can discriminates between primary tumour and adjacent enlarged nodes. Also it is reported that 5% of metastatic nodes from cancer, head and neck can be detected by CT because they are deep or in area not accessible on physical examination such as retropharyngeal groups **(Takashima *et al.*, 1990)**.

Up to 25% of patients can present with cervical lymph node metastases from an occult thyroid carcinoma. Metastases from papillary adenocarcinoma may undergo cystic degeneration **(Glazer *et al.*, 1989)**.

With metastatic involvement of the lower deep cervical lymph nodes alone, the primary tumour is commonly located in the thyroid thorax or abdomen **(Burgener and Kormano, 1996)**.

Thyroid carcinoma is the most common neck tumour involves the juxta-visceral lymph nodes (prelaryngeal, paratracheal and paraesophageal lymph nodes **(Burgener and Kormano, 1996)**.

Lymph nodes 1.5 cm or greater in diameter are considered abnormal. A nodal mass of any size with central lucency and peripheral enhancement indicating central necrosis is also considered abnormal. Obliteration of fascial planes around enlarged lymph nodes in the non operated or non irradiated neck generally is indicative of extranodal spread of tumour or extension of tumour into adjacent soft tissues **(Lee *et al.*, 1989)**.

Diagnostic criteria based on CT findings have been established for staging the neck **(Table 3)**.

Table (3) Criteria for staging lymph node metastases in the neck **(Lee *et al.*, 1989)**.

No	Nodes less than 15 mm in size and of homogeneous density
N_1	Nodes 15-29 mm in size in largest diameter or node of any size with evidence of necrosis clearly demonstrated.
N_2	Single homolateral node 3-6 cm in size, more than one positive homolateral node 15 mm or greater or less than 15 mm with necrosis, conglomerate homolateral nodal mass 3-6 cm in size.
N_3	Homolateral nodal mass greater than 6 cm; bilateral nodes or contralateral nodes.

Medullary Carcinoma

Medullary carcinomas occur also in adolescence when associated with multiple endocrine neoplasia (MEN) syndrome:-

MEN 1: Pituitary and parathyroid adenoma, pancreatic island cell tumour.

MEN 2 : Parathyroid adenoma, medullary thyroid carcinoma, pheochromocytoma.

MEN 3 : Medullary thyroid carcinoma, pheochromocytoma, ganglioneuromatosis.

(Burgener and Kormano, 1996)

CT Appearance of Primary Malignant Lymphoma

Is a rare disorder, it accounts for 4% of all thyroid malignancies and secondary thyroid gland involvement is found incidentally in 15% of patients with systemic malignant lymphoma at autopsy **(Walfish, 1986)**.

There is strong association of malignant lymphoma with Hashimoto's thyroiditis **(Wright and Anscomb, 1985)**.

Nearly all patients with this disease have coexistent Hashimoto's thyroiditis, and a small percentage of patients with Hashimoto's thyroiditis develop malignant lymphoma of thyroid gland **(Takashima *et al.*, 1988)**.

Palpation of tumours is prevented in more than half of the patients with thyroid lymphoma due to coexistent Hashimoto's thyroiditis, which show a diffuse thyroid goiter with a firm consistency **(Takashima *et al.*, 1992)**. Primary thyroid lymphoma appear as homogeneous enlarged thyroid gland with reduced attenuation but no discrete or localized tumour can be detected. CT demonstrates low attenuation mass in the thyroid with additional features such as compression or infiltration of the surrounding structures, but little evidence of calcification and necrosis. Contrast enhancement is usually required to better detect the primary tumours because Hashimoto's thyroiditis is always present **(Takashima *et al.*, 1988)**. Thyroid carcinoma or lymphoma may be seen as an infiltrating soft tissue mass extending from the thyroid **(Sutton, 1993)**. The differentiation between the primary thyroid lymphoma and anaplastic carcinoma can be made if there is no evidence of Hashimoto's thyroiditis and if additional features such as calcification and necrosis are present then the most likely diagnosis is anaplastic carcinoma, but the final diagnosis, must depend on the result of biopsy **(Takashima *et al.*, 1988)**.

It is not possible to differentiate benign from malignant disease within the thyroid gland based only on CT characteristic of the lesions. The presence of ancillary findings such as lymph node enlargement and bone or cartilage destruction in association with thyroid lesion would suggest a diagnosis of malignancy.

Recurrent laryngeal nerve palsy in the presence of thyroid mass is also highly suggestive of malignancy since this rarely occurs with benign thyroid lesions **(Reede *et al.*, 1984)**.

Thyroid carcinoma with mediastinal extension may be indistinguishable from a goiter, but its margin with the mediastinal vessels and fat are usually obliterated, invasion of the adjacent structures may also be present in association with cervical mediastinal lymphadenopathy and pulmonary nodules **(Glazer *et al.*, 1982)**.

Table (4) Computed tomography appearance of thyroid swellings **(Yousem and Schefe, 1996)**.

Disease	*Focal or Diffuse*	*Density*	*Calcification*	*Cystic*	*Others*
Thyroglossal cyst	Focal	Well circumscribed low density lesion with peripheral rim of enhancement		+	Inflammatory changes may occur
Lingual thyroid tissue	-	High attenuation mass at the base of the tongue greater enhancement after IV contrast	-	-	May escape detection until it becomes enlarged
Multinodular goiter	Diffuse	Homogeneous or non homogeneous enhancement	Amorphous collections or ring like calcification	+	CT defines the inferior limit of goiter and relationship of goiter to the surrounding structures, goiter has well defined borders
Adenoma	Focal	Isodense or hyperdense	+		-
Carcinoma	Focal	Isodense or hyperdense large homogeneous mass	+++, necrosis		Compress the surrounding structures and asphyxia due to invasion of the trachea it can spread to the vascular structures and regional lymph nodes
Lymphoma	Diffuse	Homogeneous enlarged gland with reduced attenuation	+		Compress or infiltrates the surrounding structures

MATERIAL AND METHODS

This study was conducted on 56 patients with suspected thyroid swellings.

All patients were subjected to the following:-

(1) History was taken, stressing the following points:-

- Personal history: including age, sex and residence, it is including the complaint of the patient with its onset, course and duration with detailed description of any neck swellings, pressure manifestations, thyroiditis, hyperthyroid features and history of drug intake.
- Past history: regarding previous intake of thyroid extract or antithyroid drugs, previous operative interference, previous irradiation to the neck or previous radiographic studies with iodinated contrast media.
- Family history concerning similar or other thyroid diseases.

(2) Clinical examination: all cases were subjected to general and local examinations with emphasizing on the following data:-

a. General examination: as regarding hyper- or hypothyroid states, nervous manifestations, eye changes, gastrointestinal manifestations or skin changes.

b.Local examination: including careful inspection and palpation of the neck for:-

- Symmetrical and asymmetrical enlargement of the thyroid.
- Study of mobility of the gland during swallowing.
- If a thrill is present over the gland due to hypervascularity.
- Any palpable nodule or nodules within the substance of the thyroid gland to assess their size, location, borders, consistency and mobility.
- Any palpable lymph gland in the neck.

(3) Ultrasonographic and Doppler examinations of the gland: the procedure of ultrasonographic examination of the 56 cases of thyroid swelling is done by a simple scanning technique using (Philips SD 800) colour Doppler U/S with 7.5 MHz linear transducer.

An optimum image resolution was obtained especially by both technique procedure. This transducer had colour Doppler capability and low flow sensitivity. The velocities were set between 0.04 m/sec and 0.11 m/sec so as the internal carotid artery is completely filled with colour flow signal.

Grayscale and colour images were taken for the evaluation.

The examination was carried without any preparation of the patient. First we palpated the patient neck before beginning the scanning procedures. If the mass was palpable, determine its location and approximate size, with the patient lying in the supine position and a pillow behind his neck in-between his shoulders to allow adequate extension of the neck. Apply acoustic complaint to the neck. The higher viscosity complaint was preferred.

We placed the transducer directly on the skin surface, adjust the focal depth to the level of thyroid tissue, care must be taken not to obliterate the texture of the isthmus. It was applied in the midline to identify the trachea in a transverse scan (drawing a strong post acoustic shadow) due to the presence of air inside. Each lobe was examined carefully in a transverse scan from its upper pole to its lower pole.

In all these examinations, the transducer face was perpendicular to the patient neck to ensure a favourable angle of entry for the ultrasound beam. The transverse scan showed the upper, mid, and lower portions of the thyroid with a small field of view from a resolution.

Using the carotid artery and jugular vein as landmarks, they are just lateral to the thyroid gland, anterior in the neck and posterior to the strap muscles.

In the longitudinal scans: the mid and medial portions of the thyroid were demarcated. First we imaged the carotid artery, then carefully sliding the transducer medially to view the thyroid gland. Determining the nature of intrathyroid or extra-thyroid mass in the neck was a good first step towards sorting out its origin. Most extrathyroidal masses displace the carotid artery and jugular vein medially. Mark the site of and palpable mass or textural changes with calibers to draw attention to the changes when the films are reviewed later.

The fundamental features of evaluation of a thyroid nodule on high-resolution sonography were:-

-*Consistency:* A nodule that had a significant cystic component was usually a benign adenomatous (colloid) nodule that had undergone degeneration or haemorrhage. However, papillary carcinomas may undergo cystic changes and appear almost indistinguishable from benign cystic nodules.

-*Echogenicity:* thyroid cancers were usually hypoechoic relative to the adjacent normal thyroid parenchyma. Unfortunately, many benign thyroid nodules were also hypoechoic. A predominantly hyperechoic nodule was more likely to be benign. The isoechoic nodule had an intermediate risk of malignancy.

-*Margin:* benign thyroid nodules tened to have sharp, well-defined margins, whereas malignant lesions tened to have irregular or poorly defined margins.

-*Calcification*: when calcifications were large and coarse, the nodule was more likely to be benign. When the calcifications were fine and punctate, malignancy was more likely.

-*Peripheral halo*: a peripheral sonolucent halo that completely or incompletely surrounds a thyroid nodule may be present in 60 to 80% of benign nodules and only 15% of thyroid cancers.

-*Comet tail artifact*: Comet-tail artifacts were frequently encountered in cystic thyroid nodules and they were likely to be related to the presence of colloid substance. All cases that had this artifact were benign.

-*Colour Doppler*: The vascularity of the nodule was classified according to **Solbiatti *et al.*, (1988)** into type (I): avascular nodules, type (II): nodules with perinodular vessels only and type (III): nodules with intranodular and perinodular vessels.

(4) Scintigraphic examination:

Ablation of iodine containing drugs or antithyroid treatment was ensured in all patients for a period from 1-3weeks prior to imaging. All cases were evaluated scintigraphically. Calculation of the percentage of thyroid uptake of the tracer was performed to every case.

All patients were scanned by a large field of view of gamma-camera with a pin-hole collimator attached to the camera head.

Images were taken 20 minutes after intravenous injection of 5 mci ^{99m}Tc pertechnetate, the patient was lying supine with hyperextension of the neck. A 10 cm neck to collimator distance was respected and initially an anterior scan was performed, the time taken was recorded for a total count of 500,000 in each for anterior image. Radioactive markers (cobalt 57) were used and placed on the suprasternal notch to identify it and for localization of the nodules if needed.

Following this, a repeated right and left oblique images were taken at 30-45° angulation, respecting the same collimator to neck distance and image acquisition time (if needed).

If a part of the gland was not visualized as in case of hyperfunctionning thyroid nodules, the hot nodule was covered by lead shield and then re-imaging with increase time was performed in order to better visualize the rest of the gland.

- *Hot nodule:* was considered when apart of gland showed more activity than the rest of thyroid tissue.
- *Cold nodule:* was considered when apart of the gland showed no or very minimal tracer accumulation.
- *Warm nodule:* was considered when apart of the gland showed tracer uptake of similar intensity as the rest of thyroid tissue.

(5) Computed tomography of the thyroid gland: our study was done on (General Electric Cystic Plus) whole body computed tomography scanner.

The examination was carried without any preparation, the patient lied supine, the neck extended and the trachea was parallel to the table top and he was asked not to swallow during the examination. The axial cuts were taken every 5 mm with slice thickness 3 mm and the cut began from the base of the tongue down to the level of C_7 vertebrae with dynamic injection of 60 ml of urographic nonionic water soluble contrast media.

In normal individuals the thyroid started to appear in the cuts passing by $C_{5,6,7}$ vertebrae, it was seen in front of the trachea with no invasion or extension into the surrounding structures.

The body of the thyroid gland lied lateral to the cricoid cartilage and trachea, and anterior and medial to the carotid artery and jugular vein.

(6) Histopathological Diagnosis: their histopathological diagnosis was obtained in 50 cases surgically removed nodules and 6 cases by fine needle aspiration.

STATISTICAL ANALYSIS

X : "Mean" is the measure of central tendency of a group of data.

S.D. : "Standard deviation" is the measure of distribution of data around their mean.

X^2 : Chi square to test the presence of significant relation between two variables.

F : Analysis of variance (A NOVA) to test presence of significant difference between more than two means (more than 2 groups).

RESULTS

This study included 56 patients with a clinical diagnosis of thyroid swelling. The age of these patients ranged between 16-59 years old.

All of these patients were subjected to thorough clinical examination, radionuclide scanning; ultrasound scanning; Doppler ultrasonography and computed tomography.

Radionuclide scanning was applied for informations regarding the site of the gland, the radioactivity accumulation in the lesion whether cold or hot, the distribution of activity in the gland whether homogeneous or heterogeneous, the nodularity of the lesion whether solitary or multiple, and the retrosternal extension.

Ultrasound scanning was applied to comment on the site, size of the lesion (or the sized gland itself) number, its echogenicity, cystic changes, classification, margin, hypoechoic halo, and presence of cervical lymph nodes enlargement.

Doppler ultrasonography has been proposed as a promising technique for the evaluation of various thyroid disorders including thyroid hyperfunction because it can depict thyroid blood flow changes that are related to the course of thyroid disease. Flow information can be displayed in a non invasive way and can therefore add a new dimension in thyroid diagnosis.

Computed tomography was done after intravenous contrast injection for some cases for evaluating the size, and shape of the gland, nodular lesion (focal or diffuse), density, calcification, cystic changes, displacement or infiltration of surrounding structures, presence of significant pathologic cervical lymph nodes or retrosternal extension.

Table (5) Distribution of cases according to sex, age and diagnosis.

Diagnosis	*No. of Case*	*Sex*		*Age in Years*
		Females	*Males*	*Mean ± S.D.*
Adenoma	8(14.5%)	6	2	40 ± 9.76
Autonomous nodule	4(7.1%)	2	2	53 ± 8.49
Colloid nodular goitre	20(35.8%)	16	4	361 ± 12
Colloid carcinoma	4(7.1%)	4	0	18 ± 2.83
Follicular carcinoma	2(3.5%)	0	2	30 ± 0
Papillary carcinoma	2(3.5%)	2	0	44 ± 0
Anaplastic carcinoma	2(3.5%)	2	0	50 ± 0
Toxic goitre	14(2.5%)	12	2	37.57 ± 10.16
Total	**56**	**44 (78.6%)**	**12 (21.4%)**	

Test of significance

$X^2 = 3.01$ $P > 0.05$

$F = 2.08$ $P > 0.05$

The study included 56 patients [44(78.6%) females and 12(21.4%) males] with mean age 35.73 ± 12.11, 43.83 ± 9.07 years respectively. Range of age of the affected group was (16.59 years). Females were affected more than males in all studied diseases except autonomous nodules and follicular carcinoma but with no significant statistical difference. There was no significant difference also in age between cases of different diseases.

Table (6) Results of echo-pattern for case with different diagnosis

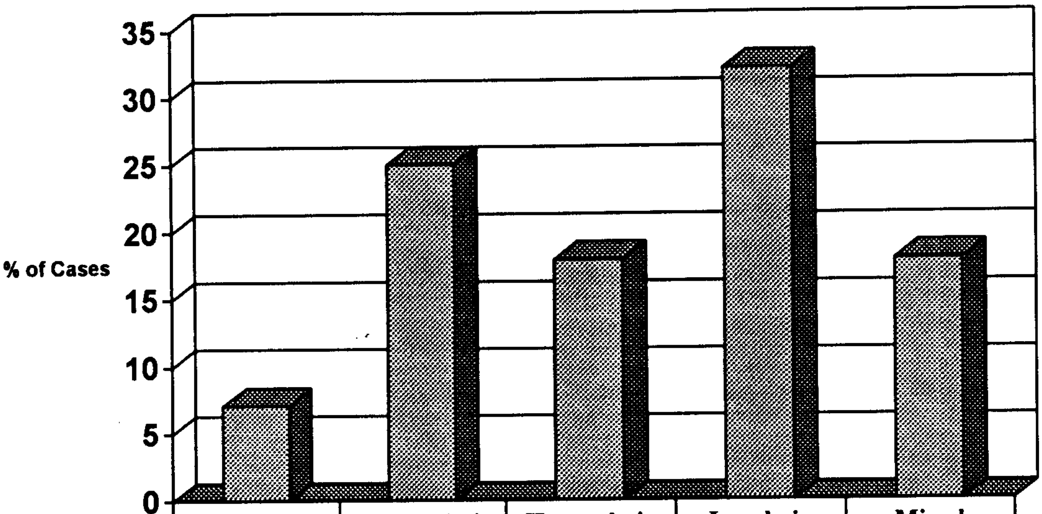
Diagnosis	*No.*	*Anechoic*	*Hyper-*	*Hypo-*	*Iso-*	*Mixed*
Adenoma	8	0	2	0	4	2
Autonomous	4	0	2	0	2	0
Colloid nodules	20	0	4	0	12	4
Colloid carcinoma	4	4	0	0	0	0
Follicular carcinoma	2	0	0	2	0	0
Papillary carcinoma	2	0	1	1	0	0
Anaplastic carcinoma	2	0	0	2	0	0
Toxic goitre	14	0	4	6	0	4
Total	**56**	**4 (7.1%)**	**13 (23.2%)**	**11 (19.7%)**	**18 (32.1%)**	**10 (17.9%)**

Test of significance:-

$X^2 = 50.67$ $P < 0.0001$

There were high significant differences in echo-pattern results among cases with different diagnosis.

Most of thyroid cases were isoechoic 18 cases (32.1%) followed by hyperechoic 13 cases (23.2%). The least was anechoic (7.1%).



	Anechoic	Hyperechoic	Hypoechoic	Isoechoic	Mixed
(%)	7.1	25	17.9	32.1	17.9

Table (7) Cystic changes among different thyroid swellings.

Diagnosis	*Total Of Cases*	*Negative Cystic Changes*		*Positive Cystic Changes*	
		No	*(%)*	*No*	*(%)*
Adenoma	8	2	8.3	6	18.7
Autonomous nodule	4	2	8.3	2	6.3
Colloid nodular	20	6	25	14	43.7
Colloid carcinoma	4	4	16.8	0	0
Follicular carcinoma	2	0	0	2	6.3
Papillary carcinoma	2	2	8.3	0	0
Anaplastic carcinoma	2	0	0	2	6.3
Toxic goitre	14	8	33.3	6	18.7
Total	**56**	**24**	**42.9**	**32**	**57.1**

Test of significance:

$X^2 = 5.28$ $P>0.05$

Most of cases (57.1%) had cystic changes. There was no significant relation between cystic changes and diagnosis of thyroid enlargement.

The highest percentages of cases who had cystic changes was detected among colloidal nodular goitre follow by adenoma and toxic goitre.

Table (8) Calcification change among different thyroid swelling.

Diagnosis	*No. Of Cases*	*No Calcification*		*Egg Shell*		*Micro-Calcification*	
		No.	*(%)*	*No*	*(%)*	*No*	*(%)*
Adenoma	8	6	75	2	25	0	0
Autonomous	4	4	100	0	0	0	0
Colloid nodular goitre	20	14	70	4	20	2	10
Colloid carcinoma	4	4	100	0	0	0	0
Follicular carcinoma	2	0	0	0	0	2	100
Papillary carcinoma	2	0	0	0	0	2	100
Anaplastic carcinoma	2	0	0	0	0	2	100
Toxic goitre	14	12	85.7	2	14.3	0	0
Total	56	40	71.4	8	14.3	8	14.3

Test of significance:-

$X^2 = 22.06$ $P < 0.05$

There was significant difference between cases of different diagnosis and type of calcification.

Table (9) Distribution of cases according to diagnosis and ultrasound findings (margin, Halo).

Diagnosis	*No. Of Cases*	*Margin Well Defined*	*Margin Ill-Defined*	*Halo*	
				-ve	*+ve*
Adenoma	8	8	0	2	6
Autonomous	4	4	0	0	4
Colloid nodular goitre	20	20	0	8	12
Colloid carcinoma	4	4	0	4	0
Follicular carcinoma	2	0	2	2	0
Papillary carcinoma	2	2	0	2	0
Anaplastic carcinoma	2	0	2	2	0
Toxic goitre	14	14	0	8	6
Total	**56**	**52 (92.9%)**	**4 (7.1%)**	**28 (50%)**	**28 (50%)**

Test of significance:-

$X^2 = 28.01$ $P < 0.001$

$X^2 = 8.54$ $P > 0.05$

Most of benign cases showed well defined margin and positive halo sign while most of malignant cases showed ill-defined margin and negative halo sign with significant statistical difference.

Table (10) Results of Doppler as regard number of nodules; grade and mean velocity.

Diagnosis	*No. Of Cases*	*No. Of Nodules*	*Grade*			*Velocity Mean ± S.D.*
			I	*II*	*III*	
Adenoma	8	8	0	6	2	60.75 ± 8.66
Autonomous	4	4	0	4	0	48.5 ± 7.78
Colloid nodular goitre	20	46	0	38	8	36.6 ± 11.98
Colloid carcinoma	4	4	4	0	0	26 ± 5.66
Follicular carcinoma	2	2	0	0	2	52 ± 0
Papillary carcinoma	2	2	0	0	2	4.5 ± 0
Anaplastic carcinoma	2	2	0	0	2	60 ± 0
Toxic goitre (Rt)	14	14	0	0	14	108 ± 44.69
(Lt.)						113.14 ± 54.71
Total	**56**	**82**	**4**	**48**	**30**	

Test of significance:-

$X^2 = 35.89$ $P<0.001$

$F = 6.29$ $P<0.001$

There was significant difference in Doppler grade of thyroid nodules. The most common grade was grade II and III among colloid nodular goitre, and adenoma. Toxic goitre cases were of grade IV and III.

There was significant difference in velocity among different thyroid diseases. Toxic goitre cases had the highest velocity followed by carcinoma and adenoma.

- Type (I) = absent vascularization.
- Type (II) = peripheral vascularization.
- Type (III) = peri- and intranodular vascularization.

Table (11) Isotope scan results for different cases of thyroid enlargement.

Diagnosis	*No. Of Cases*	*Cold Nodule*	*Hot Nodule*	*Heterogeneous*	*Diffuse ↑*	*Diffuse ↓*
Adenoma	8	6	0	2	0	0
Colloid nodular	20	2	0	18	0	0
Cold cyst	4	4	0	0	0	0
Follicular carcinoma	2	2	0	0	0	0
Papillary carcinoma	2	2	0	0	0	0
Anaplastic carcinoma	2	0	0	0	0	2
Toxic goitre	14	0	0	2	12	0
Autonomous	4	0	4	0	0	0
Total	**56**	**16 (28.6%)**	**4 (7.1%)**	**22 (39.3%)**	**12 (21.4%)**	**2 (3.6%)**

Test of significance

$X^2 = 19.09$ $P < 0.001$

Table (12) Difference between cases of different diagnosis in CT texture (pattern).

Diagnosis	No. Of Cases	CT Pattern: Cyst	Diffuse Enlargement	Focal Hyperdense	Focal Isodense	Heterogeneous	Homogeneous
Adenoma	8	0	0	2	6	0	0
Autonomous	4	0	0	2	2	0	0
Colloidnodular	20	0	0	0	0	18	2
Colloid cyst	4	4	0	0	0	0	0
Follicular carcinoma	2	0	0	0	2	0	0
Papillary carcinoma	2	0	0	2	0	0	0
Anaplastic carcinoma	2	0	0	0	0	2	0
Toxic goitre	14	0	14	0	0	0	0
Total	**56**	**4** (7.1%)	**14** (25%)	**6** (10.7%)	**10** (17.9%)	**20** (35.7%)	**2** (3.6%)

Test of significance:-

$X^2 = 113.87$ $P < 0.0001$

There was highly significant difference in CT pattern for different cases of thyroid enlargement.

All cases of toxic goitre showed diffuse enlargement pattern CT. Ninety per cent of cases of colloid goitre showed heterogeneous pattern.

Table (13) Distribution of cases with thyroid enlargement according to CT texture (calcification and cystic changes).

Diagnosis	No. Of Cases	Calcification		Cystic Changes	
		-ve	+ve	-ve	+ve
Adenoma	8	6	2	2	6
Autonomous	4	4	0	2	2
Colloid nodular	20	14	6	4	16
Colloid cyst	4	4	0	0	4
Follicular carcinoma	2	0	2	2	0
Papillary carcinoma	2	0	2	0	2
Anaplastic carcinoma	2	0	2	0	2
Toxic goitre	14	12	2	8	6
Total	**56**	**40 (71.4%)**	**16 (28.6%)**	**18 (32.1%)**	**38 (76.9%)**

Test of Significance:-

$X^2 = 8.6$ $P > 0.05$

$X^2 = 3.62$ $P > 0.05$

There was no statistical significant relation between cystic changes and calcification detected by CT among different diagnosis of thyroid enlargement.

Table (14) Changes detected by CT among cases with thyroid enlargement (invasion, lymph nodes, retrosternal extension).

Diagnosis	*No. Of Cases*	*Invasive Goitre*		*Lymph Node Involvement*		*Retrosternal Extension*	
		No.	*%*	*No.*	*%*	*No.*	*%*
Adenoma	8	0	0	0	0	0	0
Autonomous	4	0	0	0	0	0	0
Colloid nodular	20	0	0	0	0	4	20
Coloyd carcinoma	4	0	0	0	0	0	0
Follicular carcinoma	2	0	0	0	0	0	0
Papillary carcinoma	2	0	0	2	0	0	0
Anaplastic carcinoma	2	2	0	2	0	0	0
Toxic goitre	14	0	0	0	0	2	14.3
Total	**56**	**2**	**3.6**	**4**	**7.1**	**6**	**10.7**

The only two cases that showed invasive goitre were recurrent anaplastic carcinomas which showed also lymph node involvement.

Twenty per cent of colloid nodular goitre showed retrosternal extension together with one case of toxic goitre.

All other cases in different diagnosis were free.

CASE PRESENTATION

Case (1)

Female patient, 40 years old, presented with anterior neck swelling. There was also tachycardia, palpitation and nervousness, sometimes dyspnea and dysphagia.

Laboratory Findings

High level of T_3 and T_4.

Scintigraphic Examination

Mild diffuse enlargement of the gland with smooth outline and homogeneous increased uptake.

Ultrasonography

Mild symmetrical enlargement of the gland with smooth outline and homogeneous echotexture.

Well defined margin, no cystic changes or abnormal calcification.

Doppler Ultrasonography

Marked increased parenchymal vascularity all over the gland (type IV).

Computed Tomography

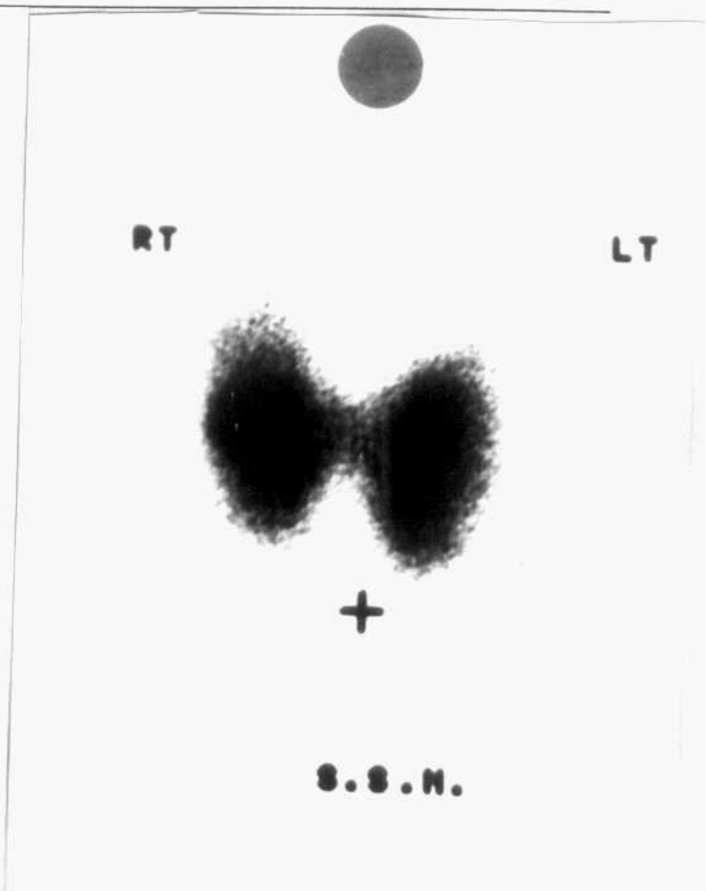
-Bilateral mild symmetrical enlargement of the gland with normal homogeneous density.

-Central trachea.

-No cervical lymphadenopathy.

Diagnosis

Diffuse toxic goiter.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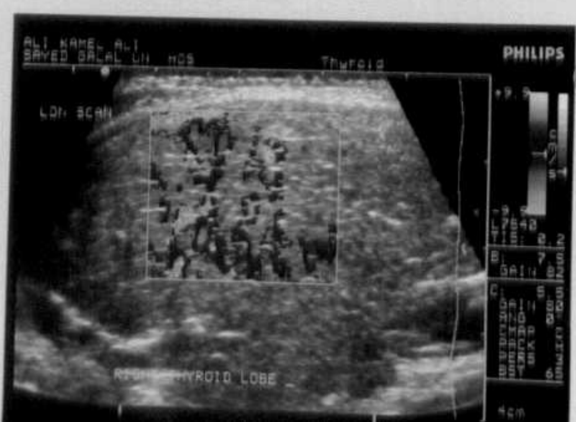
PHILIPS
Thyroid


PHILIPS
Thyroid

Case (2)

Female patient, 53 years old, presented with swelling in the front of her lower neck that is gradually increasing in size.

Scintigraphic Examination

Larger right lobe cold nodule.

Ultrasonography

It is large hypo- to anechoic cyst with hyperechoic septae and hyperechoic foci. Well defined margin, absent halo sign and no calcification.

Colour Doppler

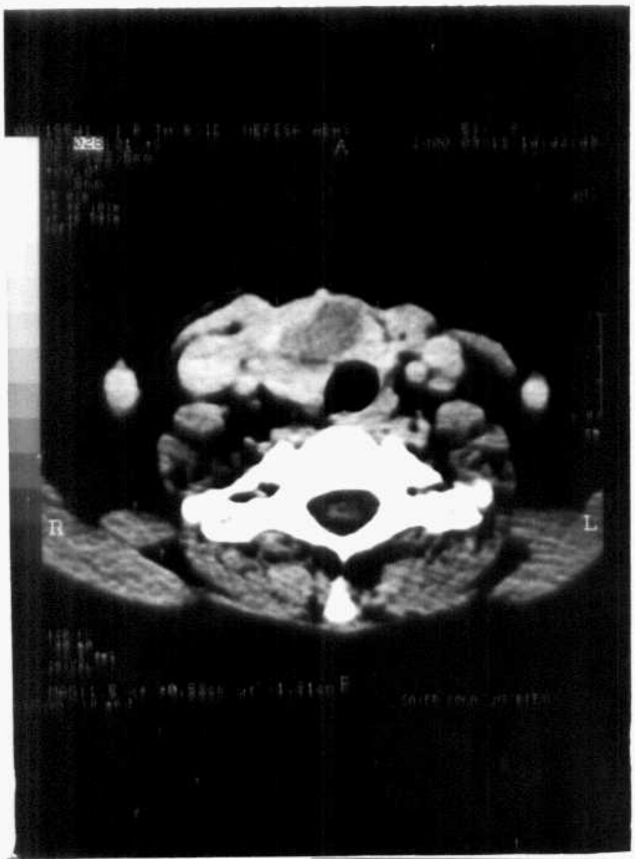
The nodule shows no vascularity (type 1).

Computed Tomography

- There is large well defined hypodense focal lesion involving the right lobe with normal left lobe and isthmus.
- Central trachea
- No cervical lymphadenopathy.

Pathological Finding

The nodule was found to be a large colloid cyst.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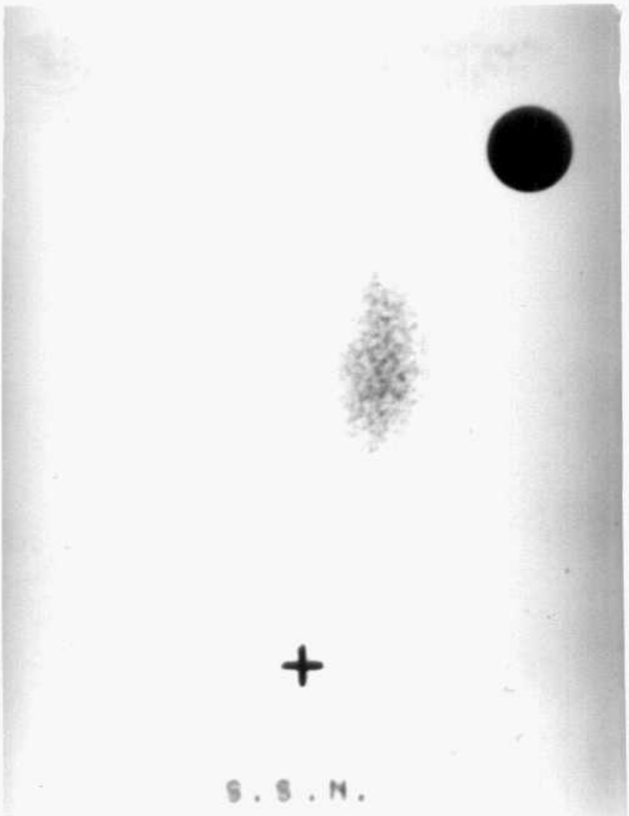
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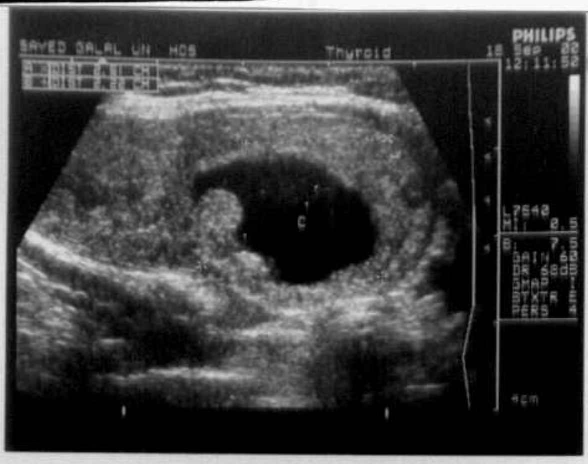
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Thyroid
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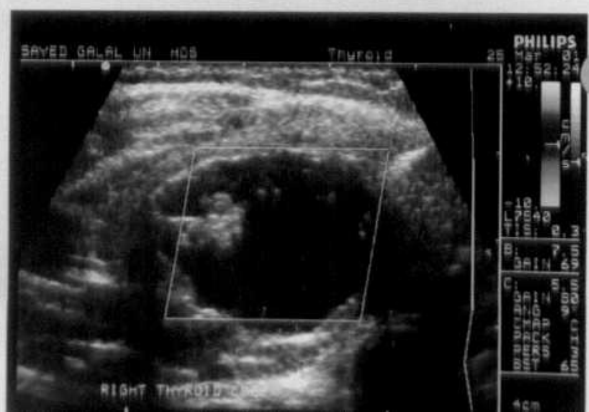
SAYED GALAL UN HOS
Thyroid
PHILIPS

Case (3)

Female patient, 48 years old, presented with swelling in the lower aspect of the neck, it is progressively increasing in size.

Scintigraphic Examination

- Large right lobe cold nodule.

Ultrasonography

A large right lobe well defined nodule with mixed echogenicity mainly isoechoic with areas of hypoechogenicity. Peripheral complete thin hypoechoic rim is present with no enlarged cervical lymph nodes.

Doppler Ultrasonography

The nodule shows both peripheral and internal vascularity (type III).

Computed Tomography

- The right lobe of the gland is enlarged and shows small isodense and hypodense nodules.
- No cervical lymphadenopathy.
- No area of abnormal calcification.
- Trachea is central in position.

Pathological Findings

The nodule was found to be adenomatous hyperplastic nodule.


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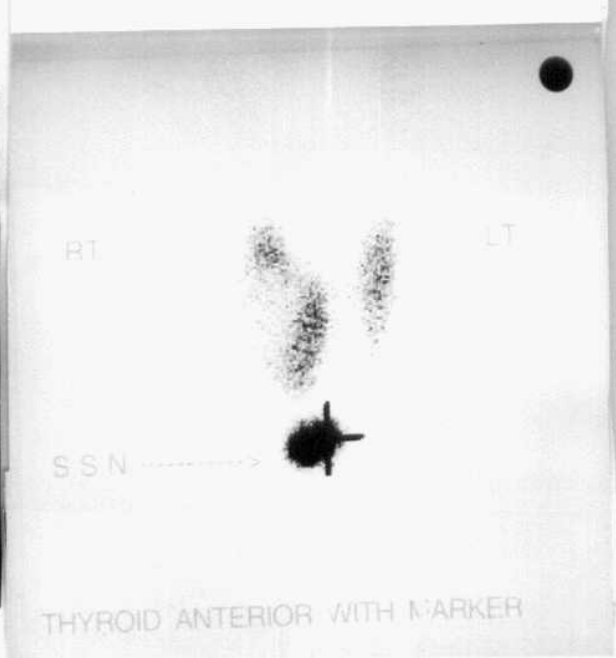
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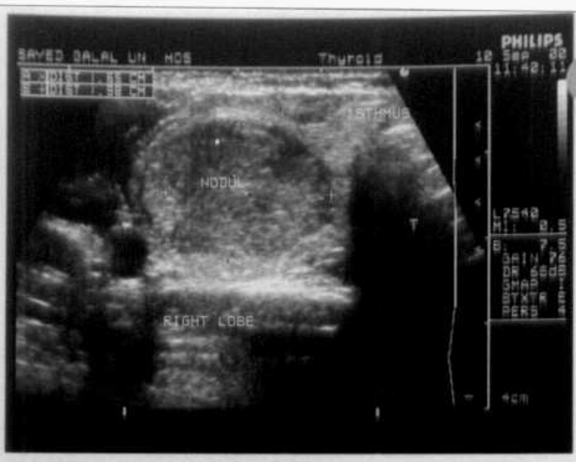
THYROID ANTERIOR WITH MARKER


PHILIPS
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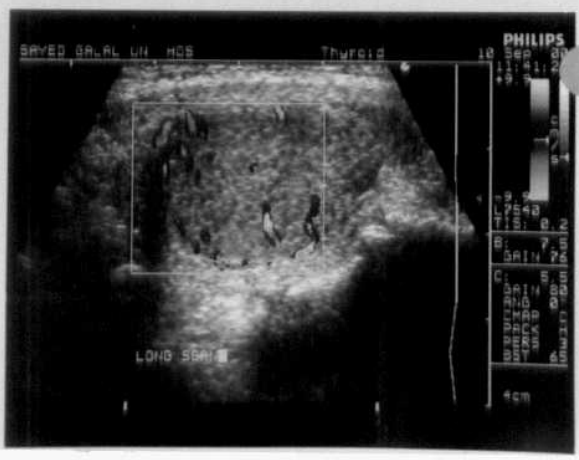
ISTHMUS
NODUL
RIGHT LOBE


PHILIPS
Thyroid
LONG SCAN

Case (4)

Female patient, 37 years old, complains from neck swelling which moves up and down with deglutition. There is also tachycardia, palpitation and nervousness, sometimes dyspnoea and dysphagia.

Laboratory Findings

High level of T_3 and T_4.

T_3 : 3 ng/ml (normal = 0.8 – 2.1).

T_4: 30 µg % (normal = 4.2 – 12.0).

Isotope Scan

Mild diffuse enlargement of the gland with homogeneous uptake.

Ultrasonography

-Mild symmetrical enlargement of the gland with smooth outline and homogeneous echo-texture.

-Picture suggestive of toxic goiter.

Doppler Ultrasonography

Marked increased parenchymal vascularity all over the gland (type IV).

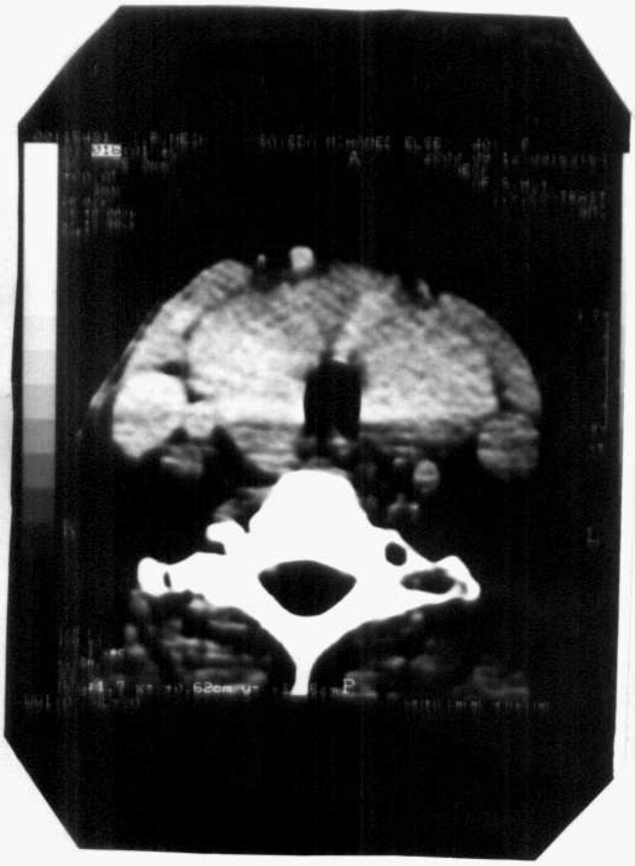
Computed Tomography

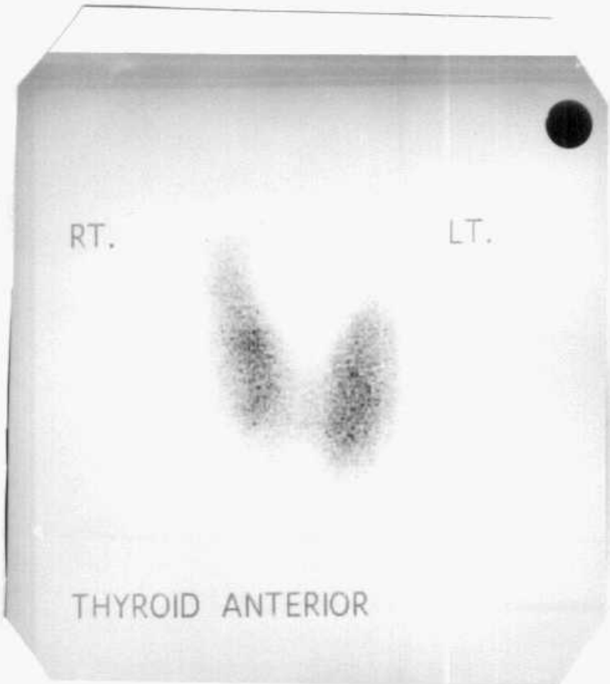
-Mild symmetrical enlargement of the gland with normal homogeneous density.

-Lateral displacement of the common carotid artery and internal jugular vein bilaterally.

-Picture suggestive of diffuse toxic goiter.

Diagnosis: Diffuse thyrotoxic goitre (Graves disease).




RT.
LT.
THYROID ANTERIOR


PHILIPS
Thyroid
ISTHMUS
RIGHT LOBE
LEFT LOBE


PHILIPS
Thyroid

Case (5)

Male patient, 48 years old, complains from neck swelling which moves up and down with deglutition. There is some pressure symptoms.

Isotope Scanning

A large right lobe cold nodule.

Ultrasonography

-Right lobe of thyroid gland is enlarged and shows large area of heterogeneous echogenicity with area of cystic degeneration and internal solid component.

-Left lobe of thyroid and isthmus are normal.

-Picture consistent with carcinoma.

Doppler Ultrasonography

The nodule shows both peripheral and internal vascularity (type III).

Computed Tomography

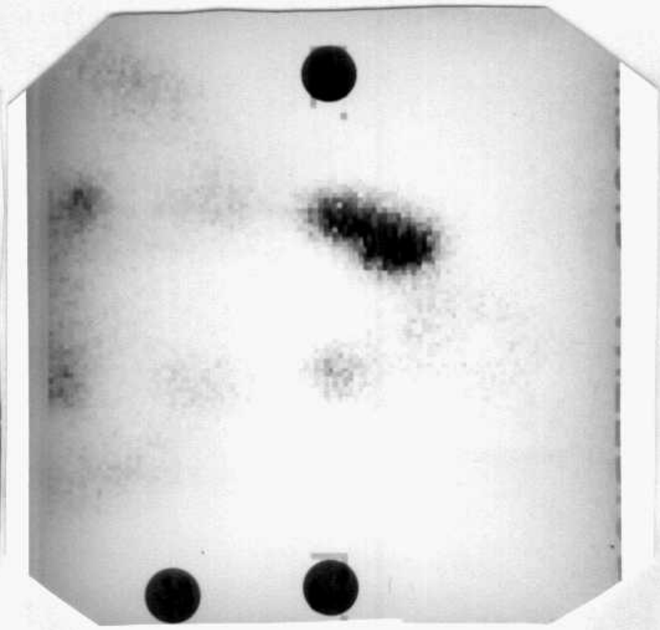
- Right lobe of thyroid gland is enlarged and shows large hypodense area of breaking down, with internal solid component.

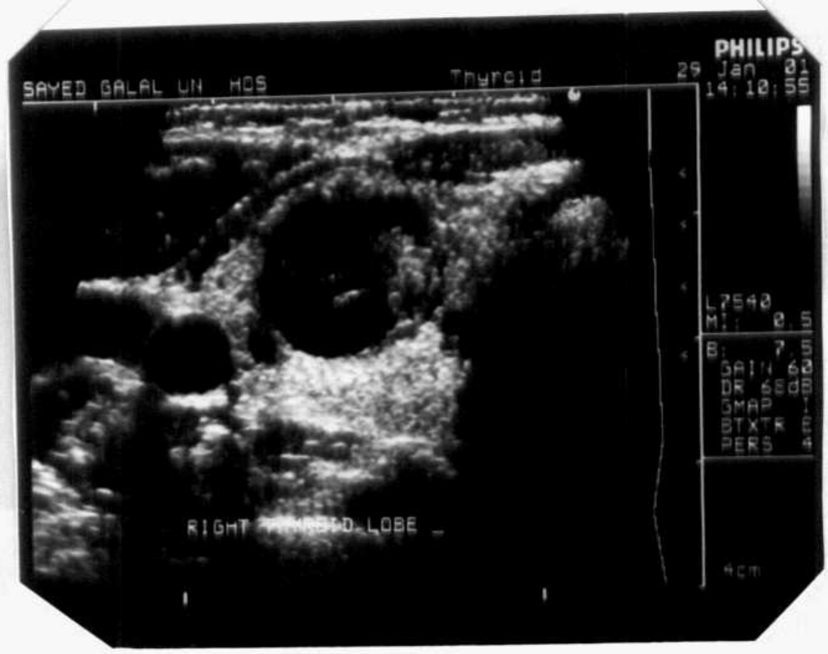
-Left lobe and isthmus are normal in size and of homogeneous density

-Trachea is compressed and deviated to the left side.

-No retrosternal extension or lymphadenopathy.

Pathologic Diagnosis: Papillary carcinoma of the thyroid.




PHILIPS
SAYED GALAL UN HOS
Thyroid
29 Jan 01
14:10:55
L7540
4cm

Case (6)

Female patient, 30 years old, presented with dyspnoea and swelling in front of the neck.

Scintigraphic Examination

A single right lobe cold nodule.

Ultrasonography

A large isoechoic nodule involving the right lobe with anechoic area (large cystic component). The cystic area showing wall irregularity and sedient inside. Positive halo sign, absent calcification and no enlarged cervical lymphadenopathy.

Doppler Ultrasonography

The cystic area showed no vascularity (type I).

Computed Tomography

-The right thyroid lobe is enlarged and showing large well defined homogeneous non enhancing nodule with no internal calcification.

-No retrosternal extension, no cervical lymphadenopathy.

Pathological Findings

The nodule was found to be adenomatous nodule with cystic degeneration.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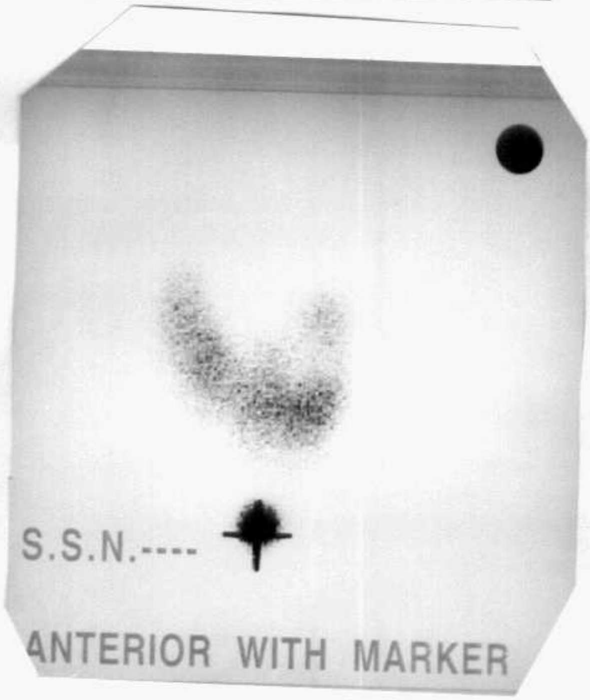
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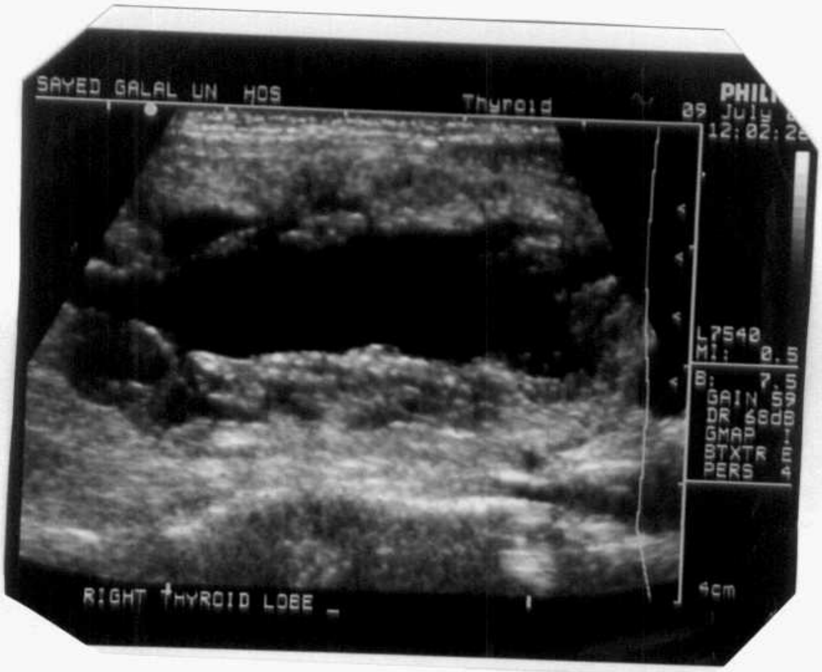
ANTERIOR WITH MARKER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Thyroid
L7540
MI: 0.5
GAIN
DR 68dB
GMAP
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PERS
4cm
RIGHT THYROID LOBE

Case (7)

Female patient, 40 years old, presented with anterior neck swelling and toxic manifestations.

Laboratory Findings

High level of T_3 and T_4.

Isotope Scanning

Enlargement of the gland with heterogeneous distribution of the tracer.

Ultrasonography

Multiple well-defined thyroid nodules with heterogeneous echo-pattern involving mainly the right lobe and isthmus, positive halo sign, with calcification nor cervical lymphadenopathy.

Doppler Ultrasonography

The nodule shows increased peripheral and internal vascularity (type III).

Computed Tomography

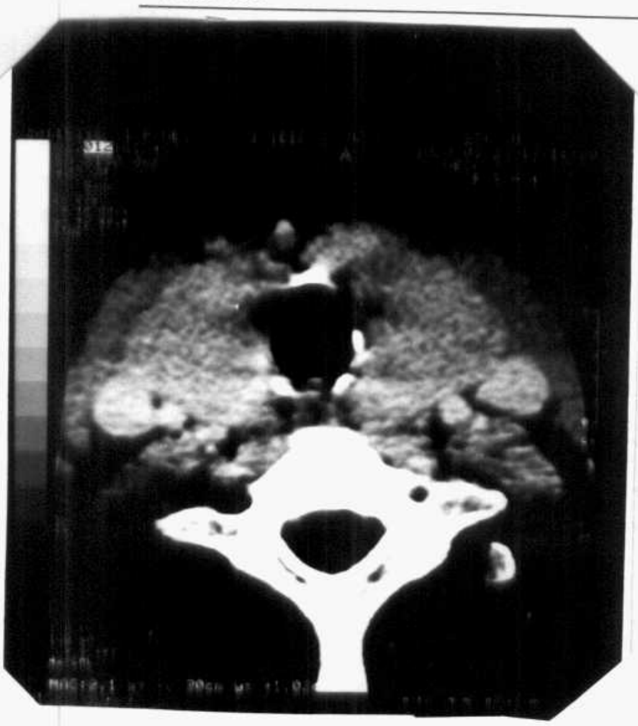
-There is diffuse enlargement of both thyroid lobes and isthmus with heterogeneous density and lobulated outline.

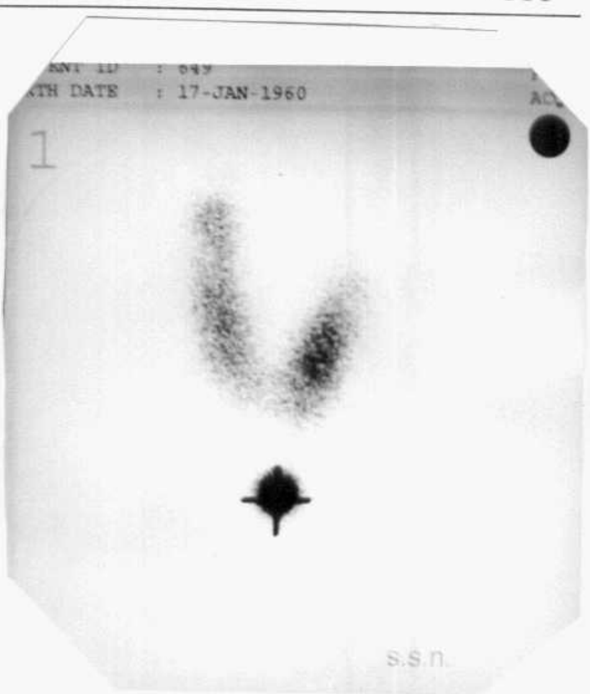
-No retrosternal extension.

-No cervical lymphadenopathy.

Pathological Findings

Toxic nodular goiter.

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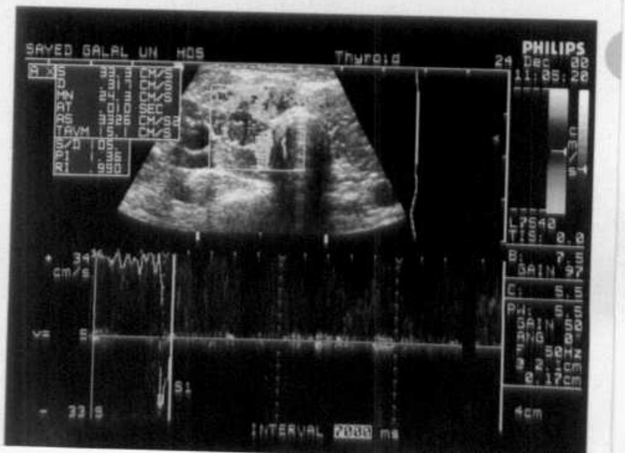
Thyroid
PHILIPS
RIGHT THYROID LOBE
LEFT LOBE


SAYED GALAL UN HOS
Thyroid
PHILIPS
INTERVAL

Case (8)

Female patient, 33 years old, presented with dyspnoea.

Scintigraphic Examination

Mild enlargement of both thyroid lobes with homogeneous uptake small area of decreased uptake on the lower pole of right lobe.

Ultrasonography

Small well-defined isoechoic nodule involving the lower part of the right lobe with positive halo sign.

No retrosternal extension nor cervical lymphadenopathy.

Doppler Ultrasonography

The nodule showed both peripheral and internal vascularity (type III). With characteristic spoke and wheel appearance.

Computed Tomography

- -Mild enlarged of the right lobe with small isodense well defined rounded nodule involving mainly the lower part of right lobe.
- -The left lobe and isthmus are free.

Pathological Findings

Thyroid adenoma.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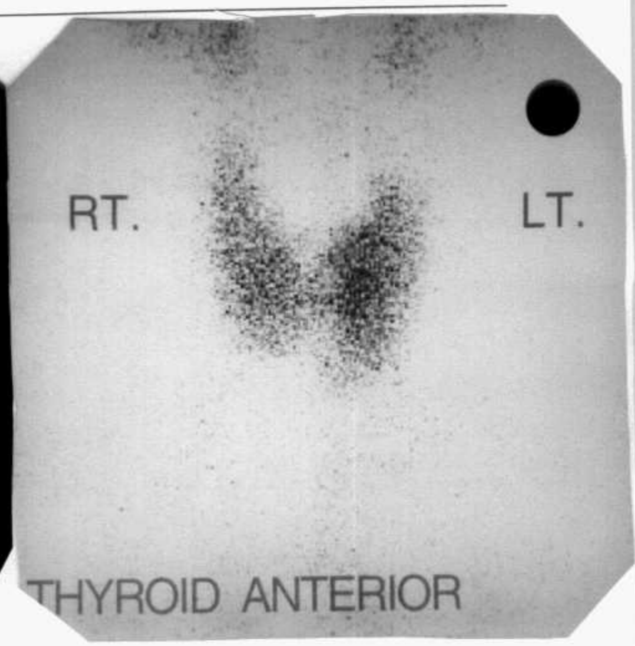
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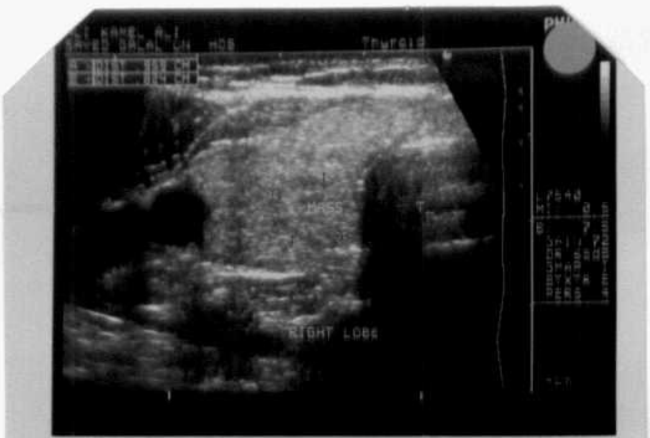
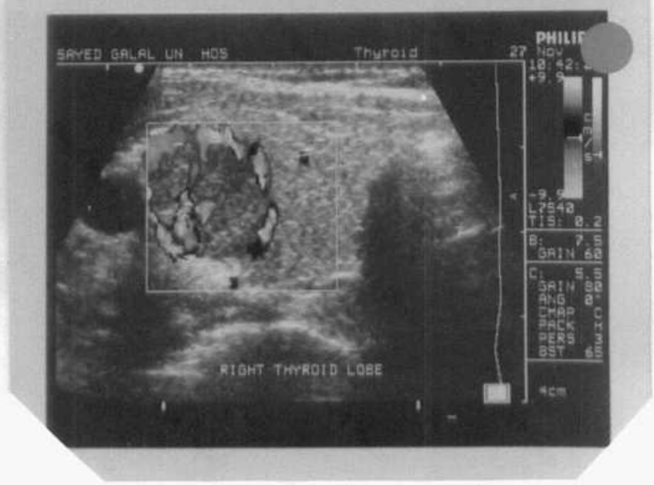
THYROID ANTERIOR


Thyroid
RIGHT LOBE


SAYED GALAL UN HOS
Thyroid
RIGHT THYROID LOBE

Case (9)

Female patient, 40 years old, complains of anterior neck swelling moderate in size, of gradual onset and progressive course, associated with pressure symptoms.

Isotope Scanning

-Heterogeneous tracer distribution over an enlarged thyroid gland.

-There is retrosternal extension.

Ultrasonography

Both thyroid lobes and isthmus are enlarged. They show multiple well defined isoechoic nodules, with peripheral complete thin hypoechoic rims is present. Some of these nodules show cystic degeneration. No cervical lymph node enlargement

Doppler Ultrasonography

The nodule shows peripheral vascularity (type II).

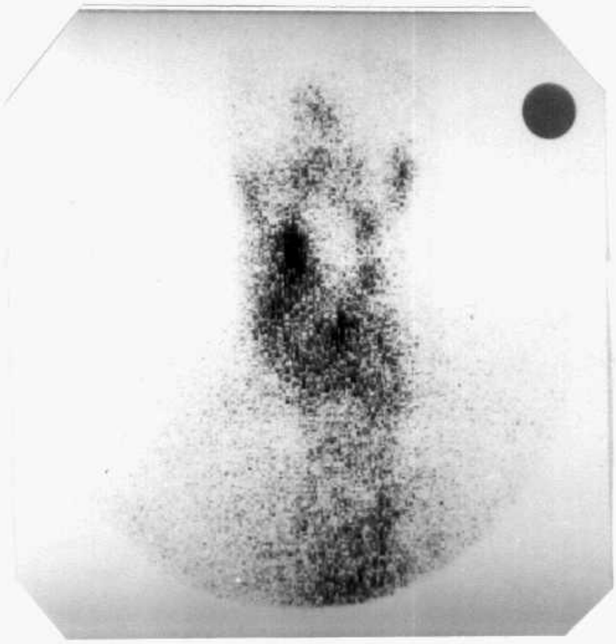
Computed Tomography

-Both lobes and isthmus of the gland are enlarged and show isodense and hypodense nodules, with lobulation of outline of the gland and multiple areas of cystic changes are seen representing degenerating nodule with dots of calcification.

-There is also retrosternal extension.

Pathological Diagnosis

Multinodular goitre with retrosternal extension.




PHILIPS
SAYED GALAL UN HOS
Thyroid
RIGHT THYROID LOBE


PHILIPS
FATMA AHMED
SAYED GALAL UN HOS
Thyroid

Case (10)

Female patient, 42 years old, presented with swelling in the front of her lower neck.

Scintigraphic Examination

A single large left lobe cold nodule.

Ultrasonography

Large heterogeneous solid texture with hypoechoic areas inside, ill-defined margin, absent halo sign, absent calcification large anechoic cystic component is present.

Doppler Ultrasonography

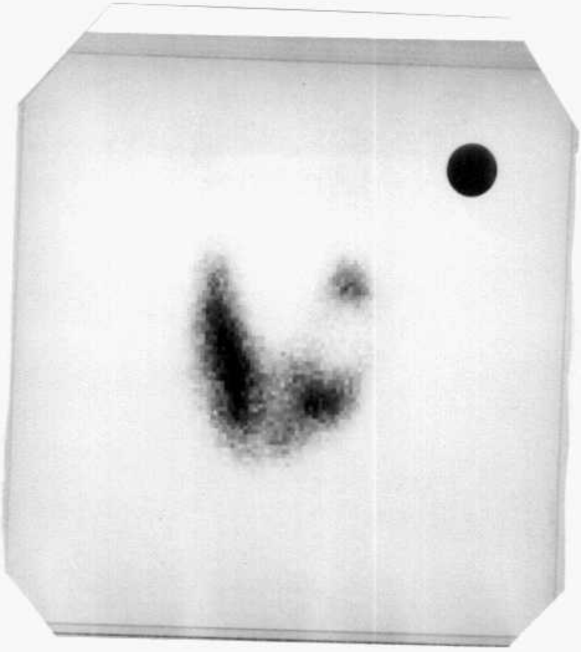
The nodule showed both peripheral and internal vascularity (type III).

Computed Tomography

The left thyroid lobe shows irregular hypodense areas with small areas of breaking down and spots of microcalcifications associated with mild displacement of the trachea and vessels to the opposite side.

Pathological Diagnosis

It was found to be a nodule of follicular carcinoma.




Thyroid
long scan
LEFT THYROID LOBE
4cm


Thyroid
PHILIPS
LEFT THYROID LOBE
4cm

DISCUSSION

Thyroid nodules are a common finding in the general population living in iodine sufficient areas, their prevalence dramatically increasing in areas of iodine deficiency **(Belfiore *et al.*, 1995)**.

Once a thyroid nodule has been detected, the fundamental problem is to determine if it is benign or malignant several methods for nodule characterization are in common use, including radionuclide imaging, sonography, Doppler and CT, each of these techniques has its advantages and limitations **(Solbiati *et al.*, 1998)**.

At present, ultrasound is the first choice in the evaluation of the morphology of the thyroid gland because the sensitivity of detection of small thyroid lesions is superior to that of scintigraphy. Scintigraphy is still the standard for thyroid functional assessment, although hyperfunction of the thyroid gland can be suspected on the basis of marked increased vascular flow seen on colour Doppler examination **(Ralls *et al.*, 1990)**.

Among several ultrasound patterns, hypoechogenicity of the thyroid nodules, microcalcification and absence of halo sign, were reported to be useful in prediction of thyroid malignancy **(Rago *et al.*, 1998)**.

The fundamental anatomic features of a thyroid nodules on high-resolution sonography are:-

-Internal consistency (solid, cystic, mixed).

-Echogenicity relative to the adjacent thyroid parenchyma.

-Margin.

-Presence and pattern of calcification.

-Peripheral sonolucent halo.

-Presence and distribution of comet tail artifacts.

(Ahaja *et al.*, 1996)

Our study comprises of 56 patients with different thyroid pathologies; 44 patients of them were females (78.6%) while 12 patients were males (21.4%).

The age of patients is ranging from 16-59 years with the mean age for females is 35.73 years and 43.83 years for males (Table 4).

The result appears to be coincides with that the most of the thyroid diseases whether benign or malignant are more common in females than in males and in those aging between 30-50 years **(Solbiati *et al.*, 1995)**.

Giomondo (1993) said that, different types of thyroid pathologies (whether focal or diffuse) show variable echogenic patterns which may be anechoic (liquid), isoechoic, hypoechoic, hyperechoic or mixed (prevalently solid or prevalently liquid).

The most typical hyperplastic nodule is isoechoic to the normal thyroid tissues. However, it may be hyperechoic (20-25% which is highly suggestive of a benign lesion) hypoechogenic in 5-7% which may suggest a surgical disease (adenoma or carcinoma) or heterogeneous in 25% of the cases **(Solbiati *et al.*, 1995)**.

Our study revealed twenty six cases with hyperplastic nodules most of them were isoechoic (46%) while the remaining were hyperechoic in (30%), mixed in 16% and hypoechoic in 8% (Table 5).

According to **(Müller, 1985)**, the echo-texture of the toxic goitre (Graresor Basedow's diseases) may be less homogeneous and the parenchyma is diffusely hypoechoic. Such echographic pattern is not peculiar as it may be also occur in Hashimoto's thyroiditis (but it is not as low as that of Hashimoto's thyroiditis) **(Bruneton, 1987)**.

In our study eight cases had primary toxic goitre show diffuse hypoechoic pattern. On the other hand six cases presented by secondary toxic goitre show heterogeneous echo-pattern which may be due to previously long standing nodular goitre with recent development of toxicity.

According to **Solbiate *et al.*, (1995)** thyroid adenoma may be follicular (50% isoechoic) or non follicular (mostly hypoechoic) and considered suspected for malignancy.

Adenoma in our study were eight cases four of them were hypoechoic, two cases were hyperechoic and the remaining two cases were mixed echo-pattern.

Although thyroid nodules are common, less than 5% provide to be malignant as stated by **Woeber, (1995)**. In our study malignant thyroid nodules represented 10% of the total (six cases).

Papillary and follicular carcinomas are mostly hypoechoic (90%) **(Solbiati *et al.,* 1995)**, and anaplastic carcinoma is dominantly hypoechoic **(Hatabu, 1992)**.

Six cases with malignant nodules were involved in our study most of them were hypoechoic (two cases with follicular carcinoma, two cases with anaplastic carcinoma and one case with papillary carcinoma).

According to **Solbiati *et al.,* (1995)**, in hyperplastic disease, 25% of cases may have mixed pattern, owing to likely extensive colloid cystic or haemorrhagic changes. Such cystic changes (especially if large) may suggest a benign lesion.

Hay (1990) stated that, completely anechoic nodules are benign in 100% of the cases.

However, cystic papillary carcinoma usually presents as a mixed nodule with one or more solid components which have central arterial blood supply and may show microcalcifications **(Solbiati *et al.*, 1995)**.

In our work, cystic changes were evident in thirty-two cases of the study (57.1%) (Table 6), most of them were benign. An associated solid component, was evident in twelve cases, however, no microcalcification or blood flow signals (using colour Doppler) could be seen within, so cystic changes are a common feature associated with different thyroid pathologies (mostly benign). The application of colour Doppler study at an associated solid component is important to exclude an underlying malignancy.

According to **Solbiati (1995)** two types of significant calcifications are existent in the thyroid gland, eye shell calcifications and microcalcification. The former is considered as the only indicative of benign pathology.

Egg shell calcification was found in eight cases in our work all of them were benign lesions (Table 7).

Microcalcification is a highly specific sign of malignancy. It is found in 80-90% of papillary carcinoma, 20% of nodular goiters, 3-4% of adenomas **(Solbiati *et al.*, 1995)** and in 80-90% of medullary carcinoma **(Gorman, 1987)**.

In our study eight cases presented with microcalcification, six of them were malignant lesions (two papillary carcinoma, two with follicular carcinoma and two with anaplastic carcinoma). The other two cases were colloid nodular goiter.

Peripheral hypoechoic halo of regular thickness may be fine (with hyperplastic nodule) or thick (with adenoma) with no signs of invasion of the adjacent anatomical structures **(Cuk, 1994)**.

The peripheral hypoechoic halo with uniform thickness was seen with twenty-eight cases, all of them were benign, and it was absent in twenty-eight cases (only six of them proved to be malignant) (Table 5).

Papillary carcinoma on the other side, may show irregular and ill-defined margins (invasive forms and microcarcinomas) or regular margins with peripheral hypoechoic halo **(Salbiati *et al.*, 1992)**.

Our work presented well defined nodules with regular margins at fifty-two cases. Only two of them were malignant. Ill defined margins were evident at four cases, all of them were malignant (2 with follicular carcinoma and the others with anaplastic carcinoma).

According to **Argalia (1995),** using colour Doppler ultrasound, three patterns of nodular vascularization are considered, not apparent or type I, peripheral or type II and finally peri- and intra-nodular or type III.

Kerr shows stated that, in hyperplastic nodules colour Doppler shows complete absence of flow signals in 10-15% of cases (type I) or exclusively perinodular arterial flow signals (type II) with no intra-nodular component. The peak velocity ranging between 15-20 cm/sec **(Kerr *et al.*, 1999)**.

Fobbe and his co-workers stated that, the majority of the adenomas and almost all autonomous adenomas show increased perfusion most apparent at the periphery of the nodule when the nodules exceeds the size of 2 cm, increased blood flow is also noted in the inferior of the lesion. Hypervascularity is also a feature of thyroid intrinsic malignancies. The increased perfusion tends to be more diffuse in carcinomas and not confined to the surface as in small autonomous adenomas. The perfusion pattern is helpful only for distinguishing the normal blood flow of a benign nodular goitre from the increased blood flow of an autonomous adenoma or malignant tumour **(Fobbe *et al.*, 1989)**.

In our study 15.6% of benign cases were avascular (type I). 46.6% showed peripheral rim of vascularity (type II) and 37.8% of the cases showed both peripheral and internal hypervascularity (type III).

Twenty cases with colloid nodular goitres containing 46 nodules were evaluated, 38 nodules presented with type II flow pattern and 8 nodules presented with type III flow pattern.

Only 8 nodules showed peak velocity above 40 cm/sec up to 130 cm/sec (only in gravies disease).

When a hyperplastic nodule become autonomous 40-50% of cases the colour flow pattern changes to type III and the systolic flow velocity often exceed 30-40 cm/sec. **(Solbiati *et al.*, 1995)**.

In our study four cases presented with an autonomous nodule and show type II flow pattern with peak systolic velocity of 48.5 cm/sec.

Most adenomas (80-90%) show predominantly perinodular blood flow signals with possible control branches **(Lagalla, 1993)**, they show peak systolic velocity more than 50 cm/sec **(Argalia, 1995)**.

In our study eight cases with adenoma were included six cases presented with type II flow pattern and two cases presented with type III flow pattern. Three cases showed peak systolic velocities above (50 cm/sec).

Most thyroid malignancies show type III flow pattern **(Lagalla, 1993)**.

According to **Solbiati *et al.* (1998)** intra-nodular flow signals with peak systolic velocities more than 50 cm/sec are suggestive of a malignant nature especially if associated with microcalcification, such association has greatly improved the values of sensitivity (85.5%) in the differentiation between malignant and benign lesions.

Six cases with malignant thyroid nodules were involved in this study (two cases with papillary carcinoma, two cases with follicular carcinoma and two cases with anaplastic carcinoma). All of them showed type III flow pattern and all were accompanied by micro-calcification. With intra-nodular arterial flow having peak systolic velocities about 50 cm/sec. All the malignant cases in our study showed type III vascularity with marked intra- and peri-nodular vascularity. Only two cases with benign pathology (adenoma) revealed simultaneous type III flow pattern. However, it had a hyperechoic texture which is highly suggestive of benign lesion.

Another type of vascularization in the thyroid gland was described by **Lagalla *et al.*, (1993)** as type IV flow pattern which is characterized by diffuse increased parenchymal vascularization seen in toxic goitre.

In our study eight cases with toxic goitre presented with type IV flow pattern.

Quantitative analysis of flow velocities is not accurate in differentiating benign from malignant swelling **(Solbiati *et al.*, 1991)**. Normally, peak systolic velocities reach 20-40 cm/sec in major thyroid arteries and 15-30 cm/sec in intraparenchymal arteries. It should be noted that these are the highest velocities in vessels supplying superficial organs **(Solbiati *et al.*, 1998)**.

In our study quantitative analysis of flow velocity revealed that regarding the peak systolic velocity, we found that the mean value for malignant cases was significantly higher in malignant cases than in benign cases. However, many benign cases with large nodules of adenomatous hyperplasia were found to have high peak systolic velocity. On the other side there were malignant cases with low peak systolic velocity. So it can not be used for reliable differentiation between benign or malignant cases but only arouse the suspicion of malignancy if high (above 40 cm/sec) in a small nodule with marked tortuous intranodular vessels.

Regarding the end diastolic velocity and resistive index we found that both revealed no significantly reliable data as regarding the differentiation of benign and malignant nodules, as both showed nearly the same values for both benign and malignant cases.

However, colour Doppler flow patterns of thyroid nodules can be used in conjunction with other B-mode ultrasound criteria, in detection of suspicious nodules among other nodules of the same gland in multinodular goitre, and less number of nodules will be submitted to fine needle biopsy.

Radionuclide scanning of the thyroid gland has been the most widely used imaging modality for evaluating palpable thyroid swellings **(Ascheraft, 1981)**.

Although the main indication for radionuclide scanning is evaluation of clinically palpable thyroid nodules, it is also used for evaluation of thyroid gland enlargement; detection and evaluation of other thyroid nodules regarding location and number; evaluation of different grades of thyroiditis and in the follow up of post-surgical cases especially in those with cancer thyroid **(Hoffer, 1979)**.

In our study, the primary diagnosis by radionuclide scanning was sixteen cases with solitary cold nodules, twenty-two cases with heterogeneous distribution, twelve cases with diffuse increased uptake, four cases with hot nodules (autonomous) and two cases with diffuse decreased uptake.

Most of the hot nodules were benign almost always representing hyperfunctioning adenomas of which up to 50% were autonomous **(Ascheraft, 1981).** Radionuclide scanning was very useful in the diagnosis of the cases with the autonomous nodules. Through T_3 suppression test (patient is given 25 microgram of T_3 (4 times)/day for 7 day. This repeat the scan if remain hot means autonomous activity and if uptake suppressed means not autonomous).

A non functioning thyroid nodules are essentially a non specific finding and may be due to any of numerous pathologies including hyperplasia 70-75%, carcinoma 15-25%. Focal area of thyroiditis, abscess, colloid cyst, lymphoma and rarely metastases **(Mettler, 1988)**.

Recent studies have shown that 70% of nodules considered solitary on scintigraphy or physical examination are actually multiple when assessed with high frequency ultrasound **(Brander, 1989)**.

The majority of cold nodules demonstrated a peripheral rim of colour flow and no internal flow (type II pattern) with colour Doppler sonography, with a large number of hot nodules demonstrated internal colour flow (type III) **(Clark, 1995)**.

Solitary cold nodules were sixteen cases in our study seven cases were provided to have multiple nodules on ultrasound and most of them (twelve cases) presented with type II flow pattern on colour Doppler study. With the other four cases presented with type III pattern, two of them were adenoma and other were papillary carcinoma.

Multinodular goitre typically present on radionuclide scanning as an enlarged gland with heterogeneous uptake and multiple cold, warm and/or hot areas which give the gland a course patchy appearance and they represent thyroid hyperplasia ranging from hyperfunctioning to cystic or degenerative nodules **(Ascheraft, 1981)**.

Isotope scanning is very useful in evaluation of retrosternal extension of the thyroid swelling. Four cases in our study show retrosternal extension on radionuclide scanning which probably due to the use of ^{99m}Tc which is not sensitive as I^{131} or I^{127} in detection of retrosternal extension which can be provided by CT **(Mettler, 1988)**.

CT offers an excellent resolution of the thyroid gland relative to other soft tissue structures in the lower neck and the entire neck and chest can readily be seen allowing differentiation of neck swelling whether thyroid in origin or not **(Carter, 1985)**.

Although thyroid cancer could be clinically diagnosed, yet CT is useful for detecting metastatic nodes and whether or not they compress or invade the internal jugular vein (although diagnosis is easier and faster with ultrasound) **(Bruneton, 1987)**.

In the present work, CT was accurate in localizing the gland and its enlargement, but it showed extent of enlargement being either focal or diffuse in a similar accuracy as the ultrasound. However, proper delineation of the relation to surrounding structures especially in malignant thyroid swellings as well as evidence of infiltration of the surrounding structures are detected mainly by CT.

Reede ***et al.*****, (1984)** stated that it is not possible to differentiate benign from malignant disease in the thyroid gland basing on CT characteristics of the lesions.

Both **Silverman** ***et al.*****, (1984); Solbiati** ***et al.*****, (1998)** stated that, the value of CT for thyroid pathologies is currently dominated by two indications: pre- and post-operative evaluation of thyroid cancer (especially anaplastic) as well as investigation of large goitres developing into the mediastinum.

In large goitres, high frequency ultrasound can not be employed owing to the depth of the field of view and moreover, because the possible mediastinal extension can not be assessed in these circumstances, CT studies are mandatory **(Solbiati** ***et al.*****, 1995)**.

In the present work the density and enhancement of the thyroid was heterogeneous with areas of breaking down or cystic degeneration which may simulate malignant tumours and can not be differentiated on CT bases.

SUMMARY AND CONCLUSION

Summary

Nodular thyroid disease is extremely common (5-10%). Lifetime risk exists for developing a palpable thyroid nodule.

Once thyroid nodule has been detected, the fundamental problem is to determine if it is benign or malignant. Surgical excision and pathological examination of the excised nodule gives the final definite diagnosis as regarding its nature. However, most of thyroid lesions are benign and thyroid malignancy is rare.

In this study fifty-six cases of the clinically suspected thyroid swelling were examined. Several methods for nodular characterization are in common use, including radionuclide imaging, sonography, Doppler ultrasound and computed tomography, each of this techniques has its advantages and limitations.

Radioisotope scanning of the thyroid gland is likely employed in clinical practice as it use as chief method of investigating thyroid disorders. This is because the scintiscan provides useful informations regarding thyroid functions and morphology.

Ultrasonography is generally safe method of examination which permits excellent visualization of the thyroid parenchyma and anatomy. It is widely used for evaluation of thyroid nodules, it also can define the exact number and the nature of nodule whether cystic or solid.

Colour Doppler findings were categorized in 3 groups:-

-Avascular nodules (type I).

-Nodules with perinodular vascularity (type II).

-Nodules with intranodular and perinodular vessels (type III).

Computed tomography offers excellent resolution of the thyroid relative to other soft tissue structures in the lower neck. It can readily show retrosternal extension of a goitre, airway compression and displacement of trachea, lymph node enlargement and infiltration of the surrounding structures in cases of malignant tumours can also be detected.

Conclusions

Once a thyroid nodule is discovered scintigraphic examination can give information about the function of the nodule whether it is hyperfunctioning (hot nodule), hypofunctioning (cold nodule), or normal function (warm nodule). However, it can not accurately detect its exact size, nature or number of nodules.

Currently, no single sonographic criterion distinguishes benign thyroid nodules from malignant nodules with complete reliability. However, certain sonographic features have been described that are seen more commonly with benign lesions more than with malignant ones and vise versa.

Ultrasonography of the thyroid gland is a sensitive non invasive mean of evaluating thyroid morphology and can define the number and nature nodules being solid or cystic. It allows detection of small nodules < 1 cm in diameter.

The development of colour Doppler sonography gave us the chance to recognize the vascularity of the nodules. Most hyperplastic nodules are hypovascular lesions and are less vascular than normal thyroid parenchyma. On the contrary, most well-differentiated thyroid carcinomas are generally hypervascular, with irregular tortuous vessels and arteriovenous-shunting. So the nature of the nodule could be suggested on the basis of hypo- or hypervascularity.

The two main categories of vessels distribution are noted: nodules with peripheral vascularity and nodules with internal vascularity (with or without a peripheral component). Benign lesions mostly show peripheral vascularity while most thyroid, malignancies display internal vascularity, with or without a peripheral component.

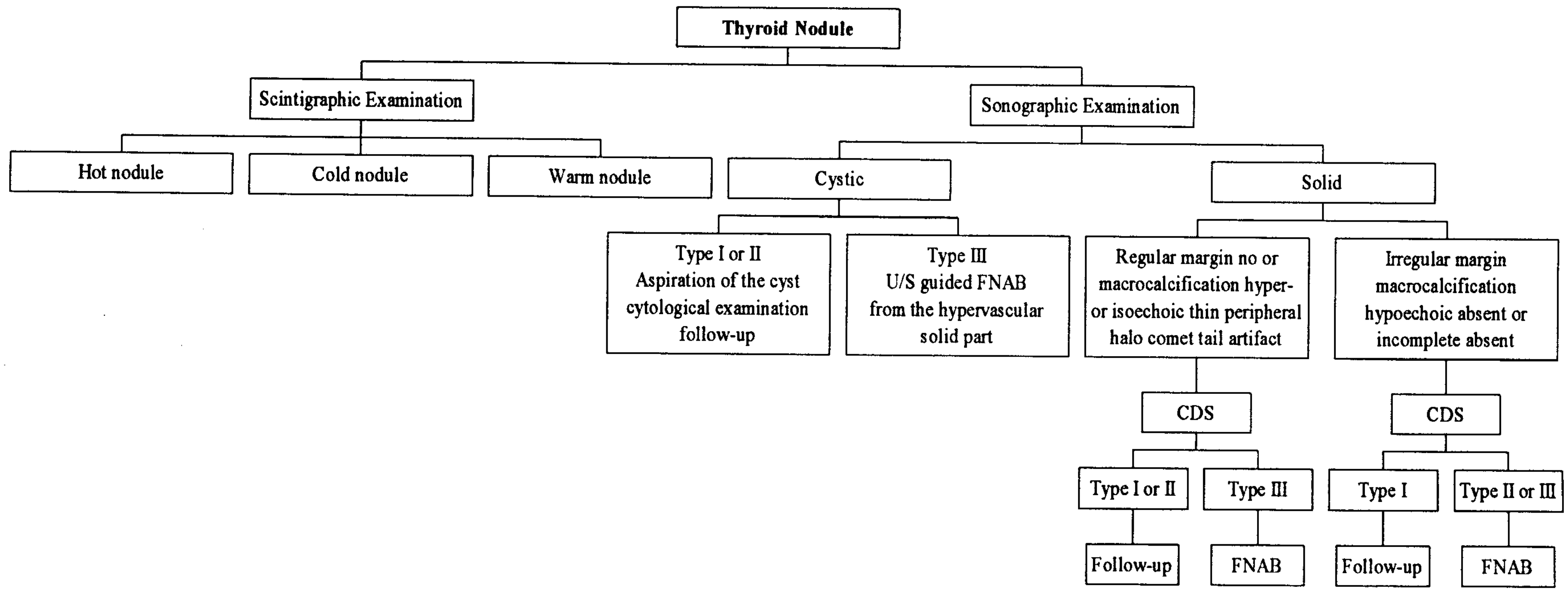
Colour Doppler sonography can play an important role in differentiation between a benign adenomatous (colloid) nodule that has undergone cystic degeneration or haemorrhage, which appears to be either completely avascular or show peripheral vascularity and cystic papillary carcinoma, which shows internal vascularity.

It also plays an important role in detection of isoechoic nodules on the basis of peripheral vascularity of compressed thyroid vessels around it.

It can also give an idea about the function of the nodule on the basis of hyper- or hypovascularity.

The major use of computed tomography is investigating malignant thyroid swelling with detection of retrosternal extension, compression, displacement or invasion of the surrounding structures, calcification and lymph node enlargement.

SCHEMATIC RECOMMENDATIONS



Type (I) Absent vascularization.

Type (II) Perinodular vascularization.

Type (III) Peri- and intra-nodular vascularization.

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الملخص العربي

- يعتبر تضخم الغدة الدرقية من الأمراض واسعة الانتشار .إذ يصيب ما بين خمسة إلي عشرة بالمائة من الأشخاص فى المراحل السنية المختلفة .
- وتنقسم الأمراض التي تصيب الغدة الدرقية إلي تضخم بسيط و تضخم مصحوب بتعدد العقد وتضخم مصحوب بزيادة أو نقص إفرازات الهرمونات عن المعدل الطبيعي كذلك و التهابات الغدة الدرقية و أورام الغدة الدرقية سواء حميدة أو خبيثة .
- ويثير ظهور اورام الغدة الدرقية التساؤل عما إذا كان ورما حميدا أم خبيثا ويعتبر الاستئصال الجراحي متبوعا بالتحليل المعملي (الباثولوجي) للورم هو الوسيلة الأكيدة لمعرفة طبيعة هذا الورم حيث إن معظم اورام الغدة الدرقية من النوع الحميد لذلك يستحسن التنبؤ بطبيعة الورم قبل إجراء العملية الجراحية بوسائل مختلفة مثل استخدام النظائر المشعة لتحديد نشاط الورم و الأشعة التلفزيونية الدبلر الملون والأشعة المقطيعة .ولكل هذه الوسائل مميزاتها و عيوبها .
- والغرض من هذا البحث هو مقارنة استخدام النظائر المشعة والموجات الصوتية والدبلر الملون والأشعة المقطعية فى تشخيص حالات تضخم الغدة الدرقية ومع إيضاح المميزات والعيوب المختلفة لكل منهم .
- وقد اشتمل البحث على فحص ستة وخمسون مريضا يعانون من تضخم الغدة الدرقية . تراوحت أعمارهم بين ١٦ - ٥٩ سنة حيث خضعت كل حالة لفحص بالنظائر المشعة . الموجات فوق الصوتية . الدبلر الملون والأشعة المقطعية .

• ونستطيع أن نستخلص نتائج هذا البحث فى الأتي :

١ – النظائر المشعة لها القدرة على تشخيص مكان الغدة وعدد العقد بها وكذلك نشاط العقد أو الغدة ذاتها كما إنها تأتي فى المرتبة الأولي فى فحص الآفات البؤرية للغدة الدرقية ولكنها غير قادرة على اكتشاف العقد اقل من ١ سنتيمتر .

٢ – الفحص بالموجات فوق الصوتية له القدرة على تحديد حجم الغدة وعدد العقد بها بما يفوق الفحص الإكلينيكي وفى حالة ثبوت عقدة غير نشطة بالنظائر المشعة فانه يلعب دورا هاما فى تحديد نوع العقدة إذا كانت صلبة أو متكيسة .

٣–الدوبلر الملون له القدرة على تقسيم أورام الغدة الدرقية ألي ثلاث أنواع وهى : ١ – النوع الأول : أورام لبس بها أوعية دموية

٢ – النوع الثاني : أورام بها أوعية دموية حول الورم فقط

٣– النوع الثالث : أورام بها أوعية دموية داخل الورم وحوله

وهذا التقسيم يساعد على استبعاد احتمال الأورام السرطانية خاصة فى حاله وجود حويصلات بالغدة الدرقية وحويصلة بداخلها ورم ولبس بها أوعية دموية (فى النوع الأول) مما يتطلب متابعة الحالة على فترات. كما انه يساعد فى توجيه الانتباه إلى أورام النوع الثالث والتي تحمل أعلي احتمالات وجود نشاط سرطاني ومن ثم تتطلب سحب عينة بواسطة ابره دقيقة أو اخذ عينة جراحيا وفحصها باثولوجيا .أما حالات النوع الثاني فيجب متابعتها على فترات متقاربة .

٤- الفحص بالأشعة المقطعية بالكمبيوتر له القدرة على تقييم أورام الغدة الدرقية من حيث علاقتهما بالأعضاء المجاورة وانتشارها وتضخم الغدة الليمفاوية المجاورة لها .

واخيرا فان المسح الذرى والموجات الصوتية والدوبلر الملون والأشعة المقطعية ماهى إلا فحوص مكملة لبعضها من اجل الوصول إلى تشخيص أدق لامراض الغدة الدرقية لذلك لا يغنى إجراء فحص معين عن إجراء بقية الفحوص الأخرى بالإضافة إلى قياس نسبة الهرمونات وا لتحليل الباثولوجي للوصول للتشخيص النهائي حتى يمكن إعطاء العلا ج الصحيح لكل حالة على حدة سواء كان العلاج طبيا أو جراحيا أو إشعاعيا.

جامعة الأزهر
كلية الطب - بنين
قسم الأشعة التشخيصية

دور الأشعة التلفزيونية المزدوجة والنظائر المشعة والأشعة المقطعية فى تقييم تضخم الغدة الدرقية

رسالة

توطئة للحصول على درجة الماجستير فى الأشعة التشخيصية

مقدمة من

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