دور الانبعاث البوزيترونى المقطعى فى تشخيص الأورام الخبيثة للغدة الدرقية

رسالة مقدمة توطئة للحصول على درجة الماجستير فى الأشعة التشخيصية

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Introduction and Aim of the Work

Thyroid cancer is the most common endocrine cancer, it constitutes ١٪ of all malignancies worldwide and are heterogenous in terms of histology, clinical presentation, treatment and prognosis. It is more common in females than males ***(Hayat et al., ٢٠٠٧).***

Different imaging modalities are used when evaluating cases of cancer thyroid including:

Ultrasound used mainly to show the presence of nodules, their size and if they are solid or cystic ***(Shetty et al., ٢٠٠٦).*** Radionuclide scanning is the second and most important modality used, radioactive iodine is taken orally or intravenously, this material concentrates in the thyroid gland, pictures are taken to determine cold nodules which may be benign or malignant or hot nodules which are typically benign ***(Wusy and Weiss, ٢٠٠٦).*** Fine needle aspiration is very important to determine the exact nature of the nodule whether benign or malignant ***(Izquierdo et al., ٢٠٠٦).*** Finally CT and MRI are currently used to detect the size of the tumor and if it has spread to lymph nodes in the neck or distant structures ***(Kraeher et al., ٢٠٠٦).***

Positron emission tomography (PET) using ١٨-F-labelled ٢ flouro-٢ deoxy-D-glucose (١٨ FDG) is a newly established

tool used in the diagnosis and follow up of cancer thyroid . The sensitvity of using FDG-PET in the detection of cancer thyroid is very high and more accurate than the other imaging modalities as it is purported to be capable of differentiating among tumors, scar, fibrosis and necrosis *(Leboullex et al. ٢٠٠٧).* Moreover can detect recurrent thyroid cancer in cases when radio- active iodine scans have proven to be unreliable or difficult to interpret as differentiated thyroid cancer cells may undergo a process of transformation thus losing some or all of their ability take up and retain ١٣١-iodine; Yet still they retain the ability to absorb FDG *(Hartado et al. ٢٠٠٧).*

If a PET scan is performed after a patient receives a tracer dose of FDG, the images could reveal abnormal areas of increased uptake that may indicate the thyroid cancer cells. Images from survey of the body could reveal abnormal areas of uptake indicating the spread of the thyroid cancer to lymph nodes, lungs, bones or central nervous system *(Quon et al. ٢٠٠٧).*

The aim of this work is to highlight the role of Positron Emission Tomography in the diagnosis of thyroid cancer.

Gross Anatomy

The thyroid is brownish-red highly vascular gland located anteriorly in the lower neck, extending from the level of the fifth vertebra down to the first thoracic vertebra. The gland varies from an H to a U shape. The thyroid gland consists of two symmetrical lobes united infront of the second, third and fourth tracheal rings by an isthmus. Apart from its own thin capsule it is enclosed by an envelope of pretracheal fascia.

Each lobe is pear-shaped with a narrow upper pole and a broader lower pole. It appears approximately triangular on cross section with lateral, medial and posterior surfaces.

The lateral (superficial) surface is covered by sterno-thyroid and sternohyoid muscles; the upper pole is tucked away beneath the upper end of the sternothyroid muscle which limits the extension of an enlarging lobe. The lower end of sternocleidomastoid overlaps the strap muscles.

The medial surface lies against the lateral side of the larynx and upper trachea, the lower pole extending along the side of the trachea as low as the sixth tracheal ring with the lower pharynx and upper oesophagus immediately behind. The cricothyroid muscles of the larynx and the inferior constrictor of the pharynx are medial muscular relations of this surface with the external and recurrent laryngeal nerves approaching it from above and down respectively.

The posterior surface overlaps the medial part of the carotid sheath (the sheath containing the carotid artery and the jugular vein). The parathyroid glands usually lie in contact with this surface between it and the fascial sheath.

The isthmus joins the anterior surfaces of the lobes towards their lower poles. The posterior surface of the isthmus is firmly adherent to the second, third and fourth tracheal rings and the pretracheal fascia is here fixed between them. This fixation and the investment of the whole gland by pretracheal fascia are responsible for the gland moving up and down with the larynx during swallowing.

A conical pyramidal lobe often ascends from the isthmus or the adjacent part of either lobe (more often the left) toward the hyoid bone to which it may be attached by a fibrous or fibromuscular band, the levator of the thyroid gland ***(Mcmin ١٩٩٤)***.

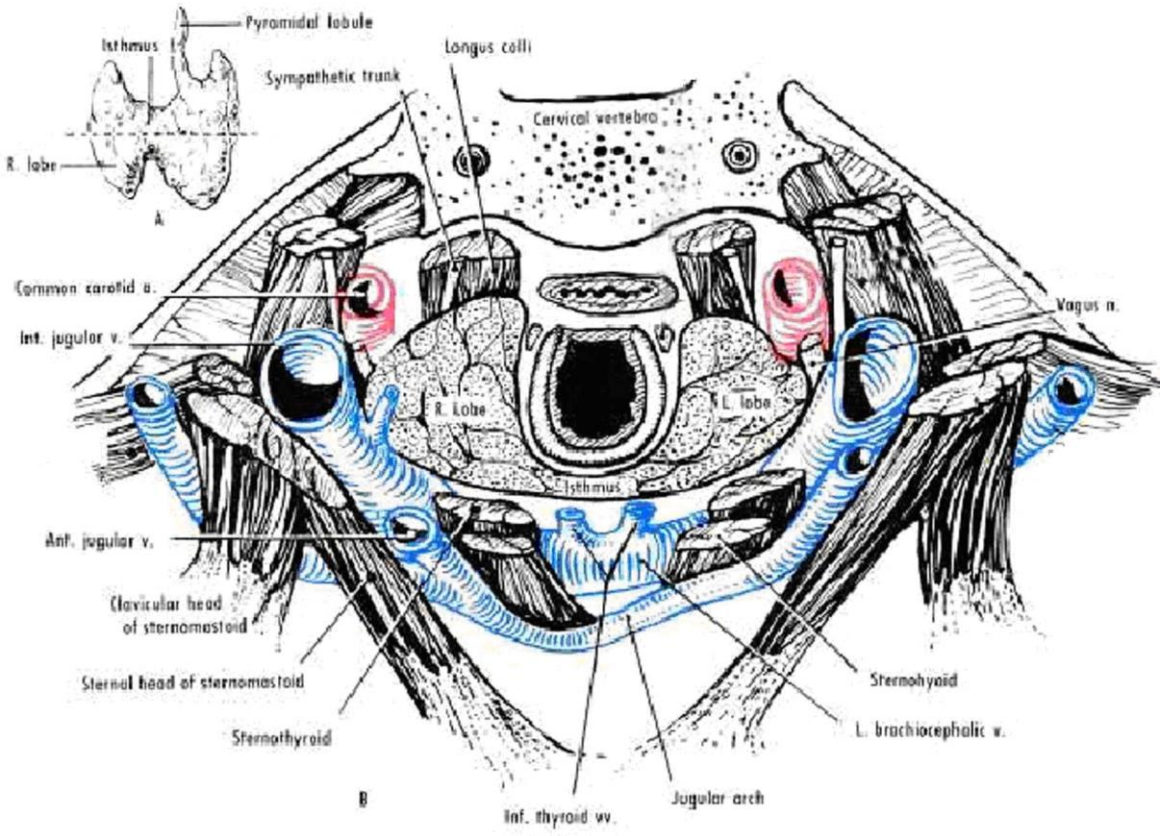

Figure (١): Aanatomy of thyroid gland ***(Quoted from Swenson et al., ٢٠٠٤).***

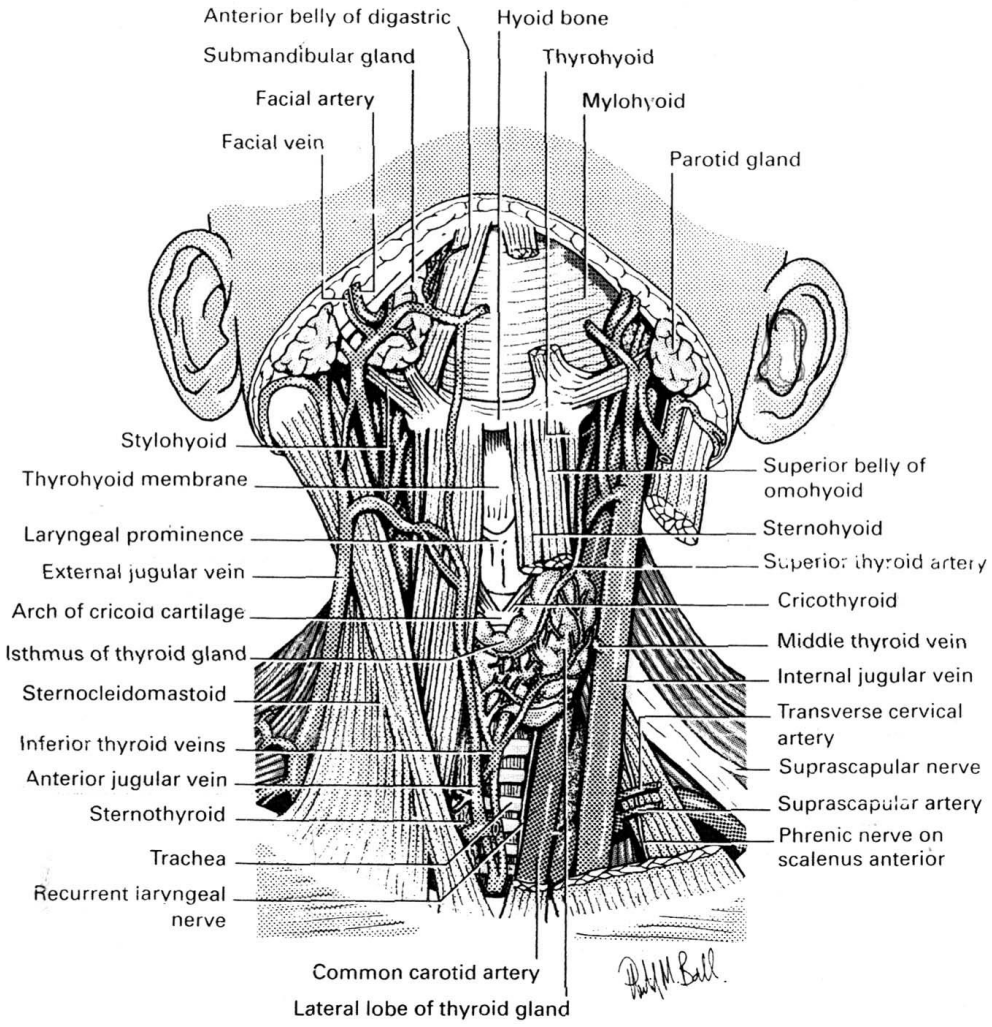

Figure (٢): Relations of thyroid gland ***(Quoted from Mcmin, ١٩٩٤).***

Arterial Supply:

The arterial supply to the thyroid gland comes from the superior and inferior thyroid arteries and, occasionally, the thyroidea ima. These arteries have abundant collateral

anastomoses with each other, both ipsilaterally and contralaterally. The thyroid ima is a single vessel, which originates, when present, from the aortic arch or the innominate artery and enters the thyroid gland at the inferior border of the isthmus.

Superior thyroid artery:

The superior thyroid artery is the first anterior branch of the external carotid artery. In rare cases, it may arise from the common carotid artery just before its bifurcation. The superior thyroid artery descends laterally to the larynx under the cover of the omohyoid and sternohyoid muscles. The artery runs superficially on the anterior border of the lateral lobe, sending a branch deep into the gland before curving toward the isthmus where it anastomoses with the contralateral artery.

Inferior thyroid artery:

The inferior thyroid artery arises from the thyrocervical trunk, a branch of the subclavian artery. It ascends vertically and then curves medially to enter the tracheoesophageal groove in a plane posterior to the carotid sheath. Most of its branches penetrate the posterior aspect of the lateral lobe ***(Lemaire et al., ٢٠٠٥).***

Venous Drainage:

Three pairs of veins provide venous drainage to the thyroid gland. The superior thyroid vein ascends along the superior thyroid artery and becomes a tributary of the internal jugular vein. The middle thyroid vein follows a direct course laterally to the internal jugular vein. The inferior thyroid veins

follow different paths on each side. The right passes anterior to the innominate artery to the right brachiocephalic vein or anterior to the trachea to the left brachiocephalic vein. On the left side, drainage is to the left brachiocephalic vein. Occasionally, both inferior veins form a common trunk called the thyroid ima vein, which empties into the left brachiocephalic vein ***(Rouviére ١٩٩١).***

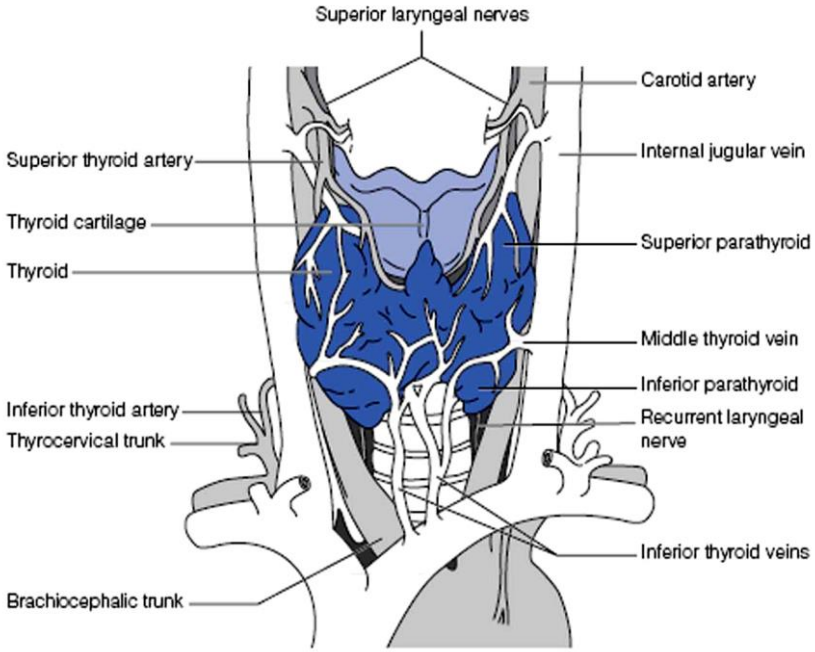

Figure (٣): Blood supply of thyroid gland ***(Quoted from Anne, ١٩٩١).***

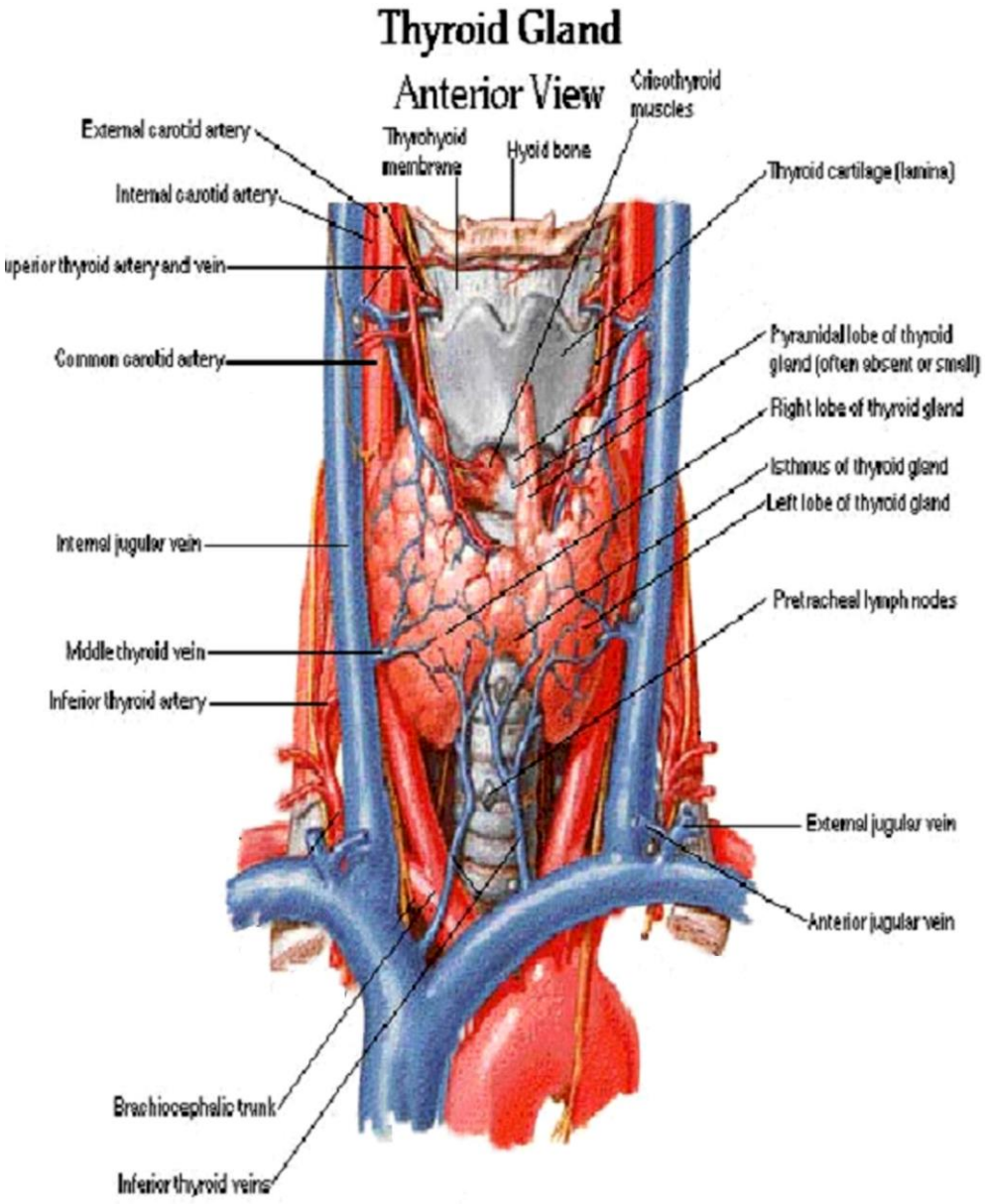

Figure (٤): distribution of thyroid arteries and veins
(Quoted from Netter Atlas, ٢٠٠٧).

Lymphatic Drainage:

Lymphatic drainage of the thyroid gland is extensive and flows multidirectionally. Immediate lymphatic drainage courses to the periglandular nodes, to the prelaryngeal (Delphian), pretracheal, and paratracheal nodes along the recurrent laryngeal nerve, and then to mediastinal lymph nodes. Regional metastases of thyroid carcinoma can also be found laterally, higher in the neck along the internal jugular vein. This can be explained by tumor invasion of the pretracheal and paratracheal nodes causing an obstruction of normal lymph flow ***(Lemaire et al., ٢٠٠٥).***

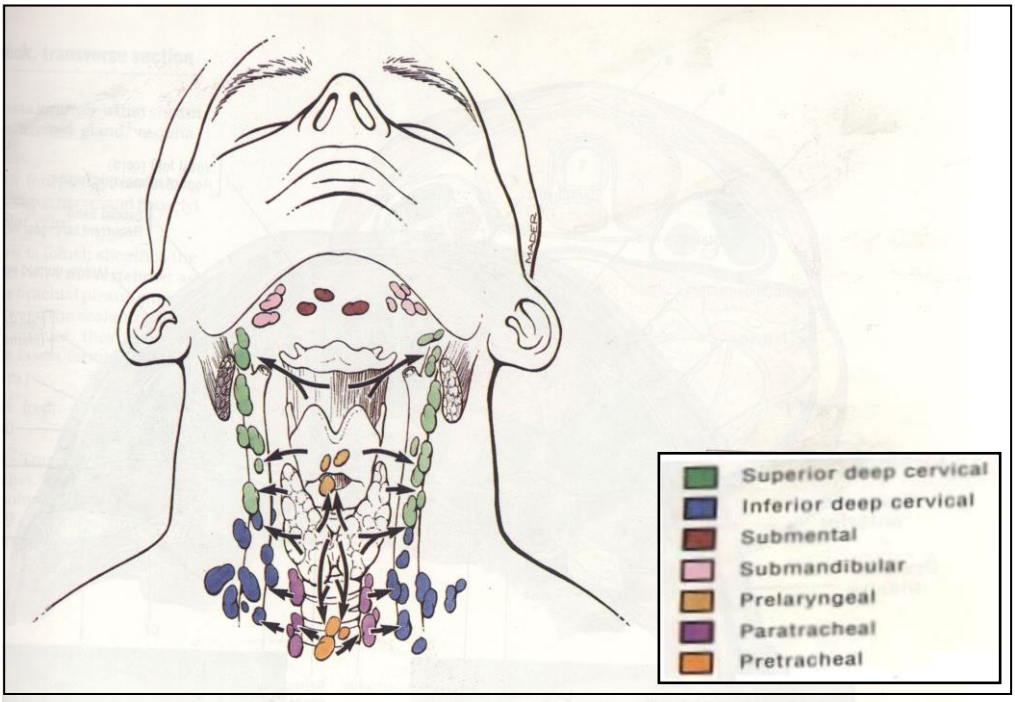

Figure (٥): Lymphatic drainage of thyroid gland ***(Quoted from Anne, ١٩٩١).***

Normal Scintigraphic Pattern of Thyroid Gland:

The right and left lobes are approximately equal in size; although a minor degree of asymmetry is acceptable. Each lobe measures up to ٧ cm in craniocaudal length, and up to ٣ cm in width. Uptake of the tracer is uniform , and at least equal or slightly more than uptake in the parotid and submandibular glands. The thyroid gland should have smooth contours .Relatively less activity is present at the periphery of the lobes where the gland is thinner as a result of its pyramidal shape ***(Joel, ٢٠٠٤).***

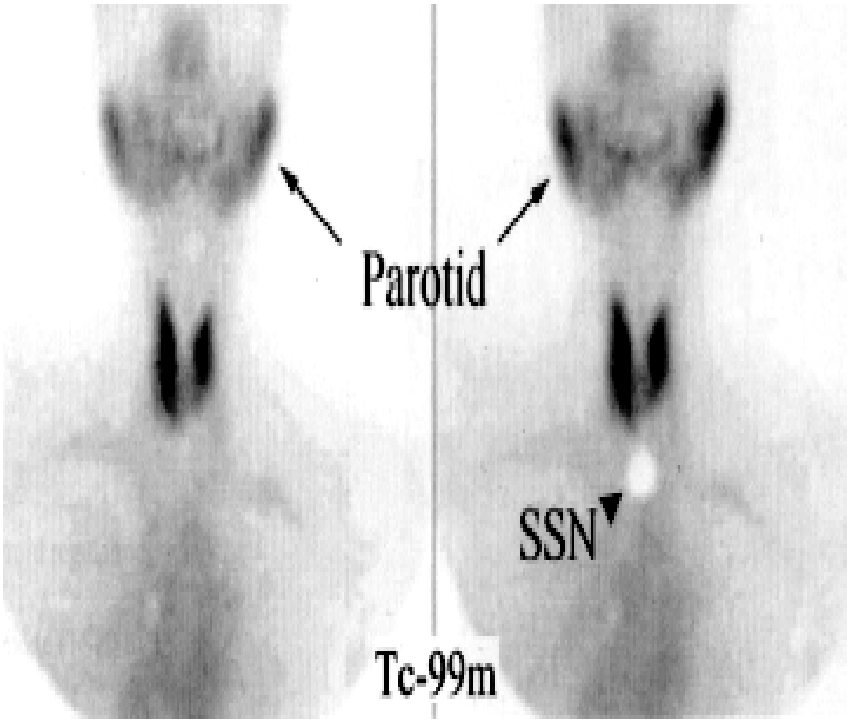

Figure (٦): Pattern of normal localization (**SSN:** suprasternal notch)
(Quoted from Joel, ٢٠٠٤).

Pathology of Thyroid Cancer

Incidence:

Thyroid cancer is the most common endocrine cancer, it constitutes ١٪ of all malignancies worldwide and are heterogenous in terms of histology, clinical presentation, treatment and prognosis. It is more common in females than males ***(Hayat et al., ٢٠٠٧).***

Risk factors:

Radiation: One proven risk factor for papillary thyroid cancer is a history of head or neck radiation treatments in childhood. In the past, children were sometimes treated with radiation for acne, fungus infections of the scalp, an enlarged thymus gland, or to shrink tonsils or adenoids. Years later, studies linked these treatments to an increased risk of thyroid cancer. Radiation exposure as an adult carries little risk of thyroid cancer.Therapeutic radiation for a cancer such as Hodgkin disease is another risk factor in children. This may be increasing as doses of radiation have been lowered. Although this avoids many of the side effects of radiation therapy, lower radiation doses can increase the risk for thyroid cancer ***(American Cancer Society, ٢٠٠٧)***.

Diet low in iodine: Follicular thyroid cancers are more common in areas of the world where people's diets are low in iodine. A diet low in iodine may also increase the rate of

papillary cancer if there is exposure to radioactivity ***(Luigi et al., ٢٠٠٥)***.

Heriditary conditions: About ٢٠٪ of medullary thyroid carcinomas (MTCs) result from inheriting an abnormal gene. These cases are known as familial medullary thyroid carcinoma (FMTC). The combination of FMTC and tumors of other endocrine glands is called type ٢ multiple endocrine neoplasia (MEN ٢). People with certain inherited medical conditions are also at higher risk of thyroid cancer. Higher rates of the disease occur among people with conditions called *Gardner syndrome* and *familial polyposis* ***(Luigi et al., ٢٠٠٥)***.

Sex: For unclear reasons, benign thyroid nodules and thyroid cancers occur almost ٣ times more often in women than in men.

Age: Most cases of papillary and follicular thyroid cancer are found in people between the ages of ٢٠ and ٦٠ years. Benign thyroid nodules and thyroid cancers can occur in people of all ages ***(American Cancer Society, ٢٠٠٧)***.

Clinical Features:

A lump in the front of the neck that, sometimes growing rapidly.

- Hoarseness or difficulty speaking in a normal voice.
- Swollen lymph nodes, especially in the neck.
- Difficulty swallowing or breathing.

- Pain in the throat or neck.

(American Cancer, Society).

Types of Thyroid Carcinoma:

There are four types of thyroid carcinoma : papillary (٨٠٪), follicular (١٠-٢٠٪), medullary (٥٪) and anaplastic (rare).

Papillary carcinoma: represents ٨٠٪ of thyroid cancers.

Gross picture: solid, white, firm, often multifocal (٢٠٪), encapsulated (١٠٪), or infiltrative, variable cysts, fibrosis and calcification.

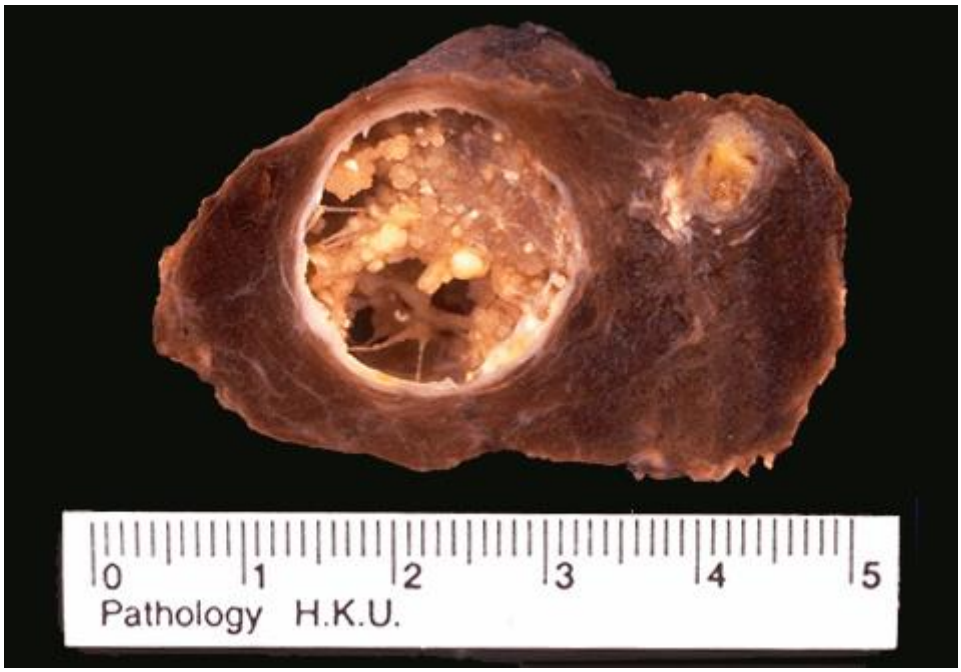

Figure (٧): Sectioning through a lobe of excised thyroid gland reveals papillary carcinoma, it is multifocal . The largest mass is cystic and contains excresences ***(Quoted from www.library med.utah.edu)***.