

# THYROID DISORDERS

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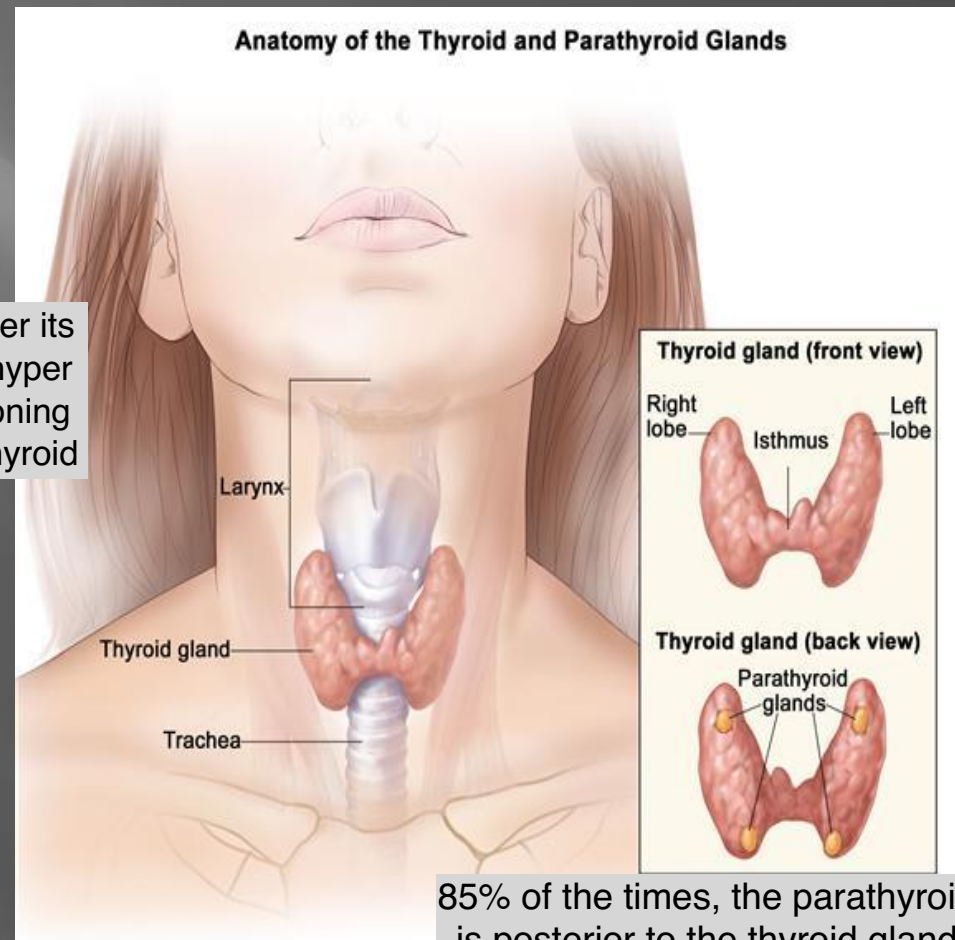
# Introduction

- The thyroid is one of the largest of the endocrine organs, weighing approximately 15 to 20 g.

It's way down in the neck, anterior to the 2nd tracheal ring

- It has a tremendous potential for growth → termed a *goiter*, can weigh many hundreds of grams.

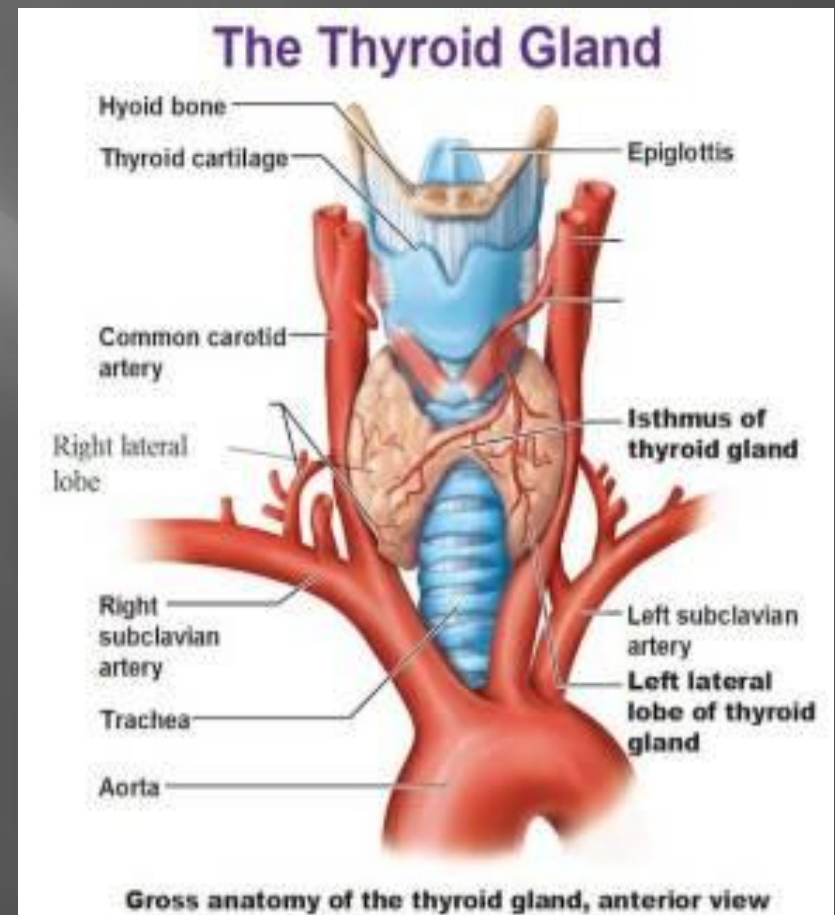
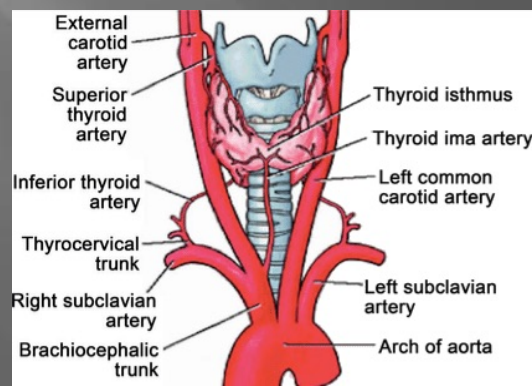
Whether its hypo/hyper functioning or euthyroid



85% of the times, the parathyroid is posterior to the thyroid gland

- The normal thyroid is made up of two lobes joined by a thin band of tissue, the isthmus.
- Two pairs of vessels constitute the major arterial blood supply, the superior thyroid artery, arising from the external carotid artery, and the inferior thyroid artery, arising from the subclavian artery.

Hyper vascular gland



- ▣ Estimates of thyroid blood flow range from 4 to 6 mL/min/g, well in excess of the blood flow to the kidney (3 mL/min/g). In diffuse toxic goiter due to Graves' disease, blood flow may exceed 1 L/min and be associated with an **audible bruit** or even a **palpable thrill**.

Palpable murmur



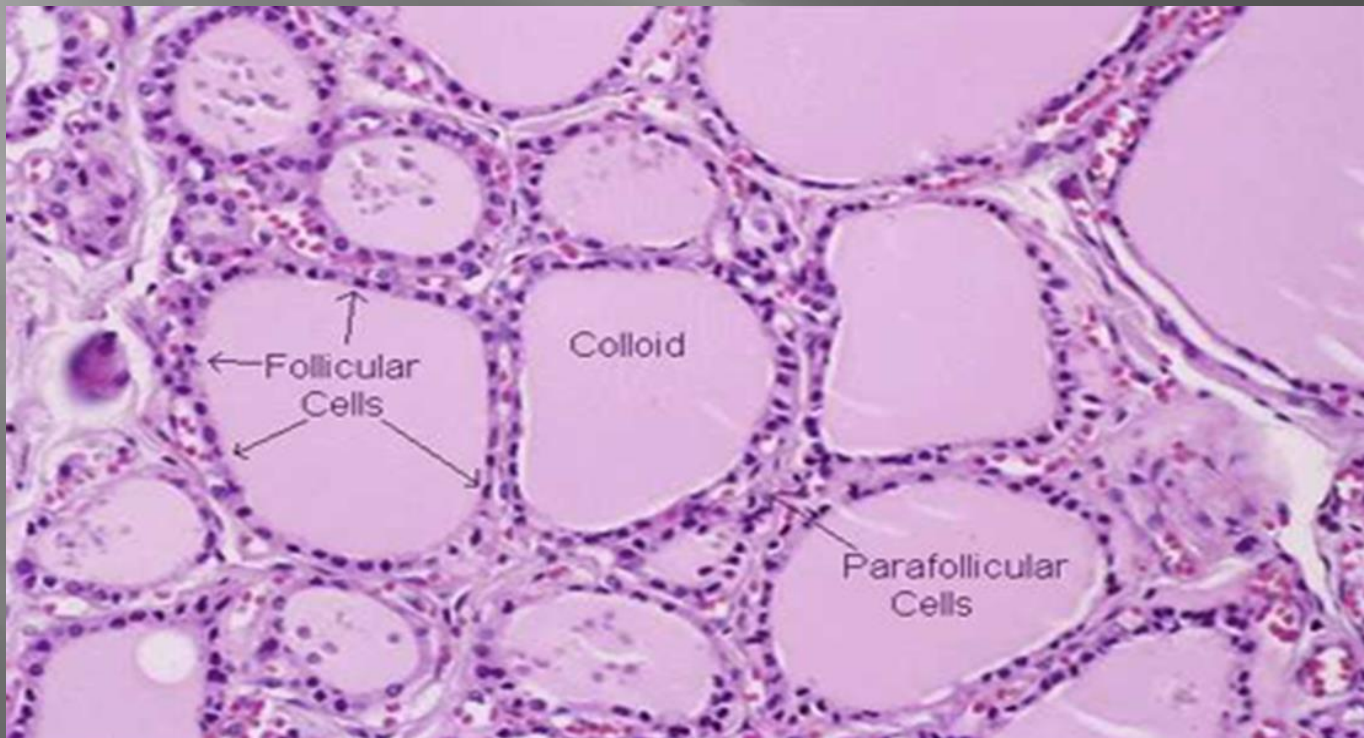
Double the  
blood flow to  
the kidney



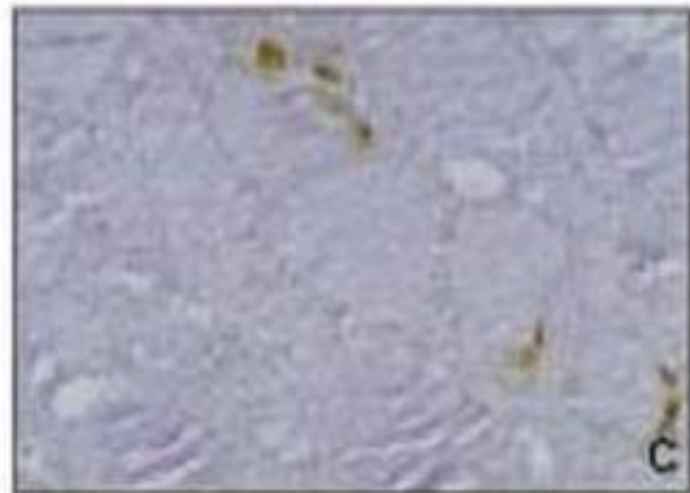
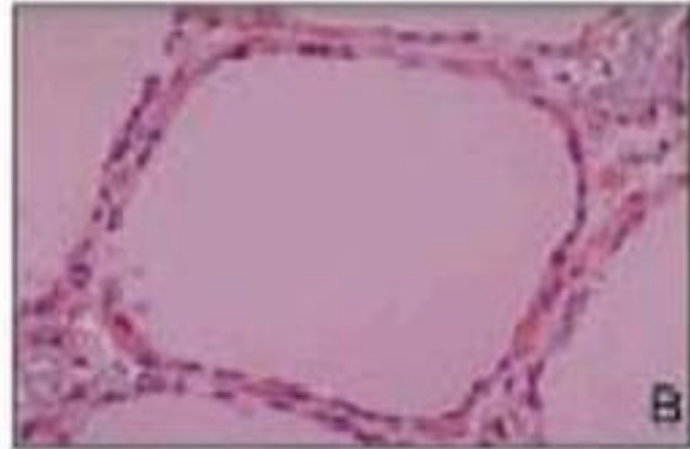
- ❑ The gland is composed of closely packed spherical units termed **follicles**, which are invested with a rich capillary network. The interior of the follicle is filled with the clear proteinaceous **colloid** that normally is the major constituent of the total thyroid mass.
- ❑ On cross section, thyroid tissue appears as closely packed ring-shaped structures consisting of a single layer of thyroid cells surrounding a lumen.



- ▣ The thyroid also contains para-follicular cells, or **C cells**, that are the source of **calcitonin**.
- ▣ The **C cells** undergo hyperplasia early in the syndrome of **familial medullary carcinoma** of the thyroid (MEN2) and give rise to this tumor in both its familial and its sporadic forms



Asymmetry of thyroid size is found in healthy subjects and the right lobes tend to be larger than the left lobes.



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(A) Normal thyroid gland. (B) Normal thyroid follicles. (C) Parafollicular cells. Calcitonin immunostain.



# Laboratory/Radiologic assessment of thyroid Status

- Goal is to assess the **functional and anatomic status**.
- Laboratory determinations will confirm whether there is an excess, normal, or insufficient supply of thyroid hormone to verify the inferences from the clinical history and physical examination.



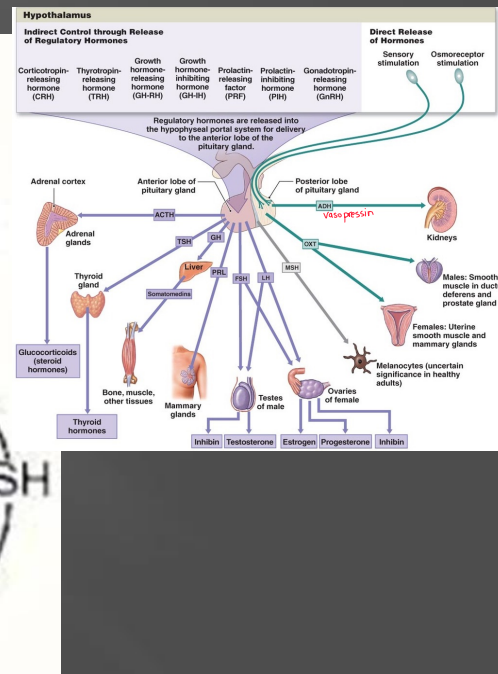
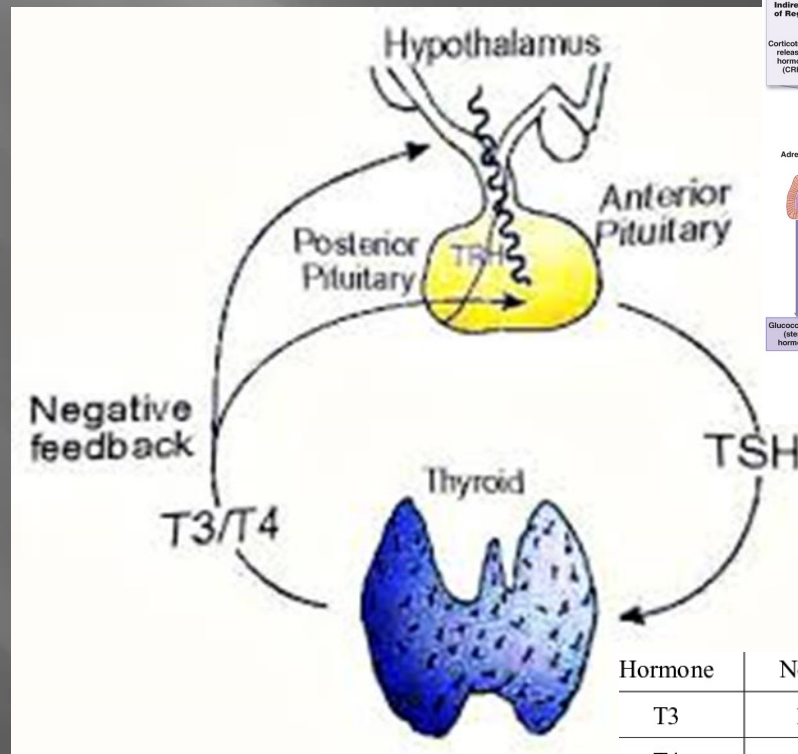


▣ Laboratory/radiologic tests can be divided into four major categories:

- (1) Those that assess the state of the hypothalamic-pituitary-thyroid axis.
- (2) Tests that reflect the impact of thyroid hormone on tissues.

When we're thinking of thyroid disorder we don't order only T4 alone or TSH alone  
 We order TSH, T4 +/- T3 (full axis)  
 But if asymptomatic > only TSH

No need to test TRH

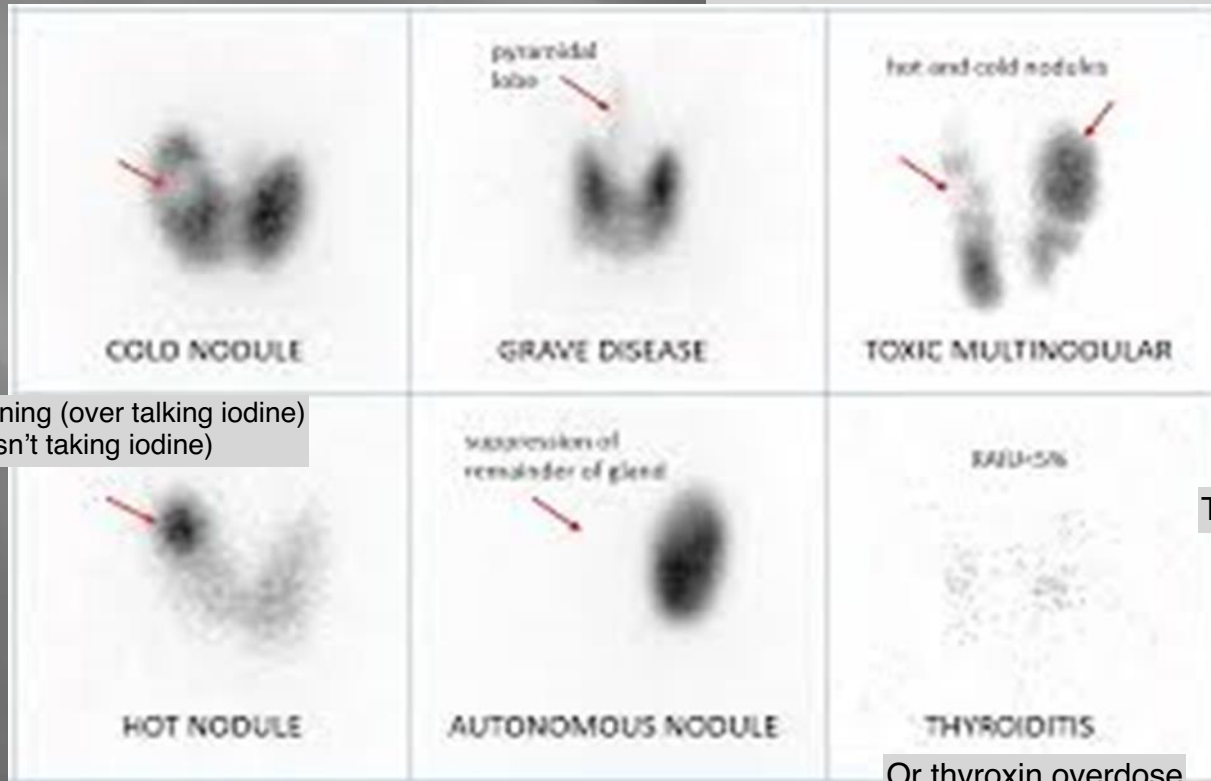


Hormone	Normal range	Unit
T3	12.23-3.50	Nano mole per liter
T4	54-174	Nano mole per liter
TSH	0.3-5.0	Milli internatio. unit/ liter

(3) Tests for the presence of autoimmune thyroid disease. **Antibodies status is important**

(4) Tests that provide information about thyroidal iodine metabolism. The use of iodine and other isotopes for scintiscanning.

Radio active I131 uptake studies:  
Increased uptake 'hot' nodule > graves + nodular goiter  
Decreased uptake 'cold' nodule > adenoma + carcinoma



Hot nodule > hyper-functioning (over taking iodine)  
Cold > not active (isn't taking iodine)

Thyroid is destroyed

Or thyroxin overdose

Physiologic state	Serum TSH	Serum Free T4	Serum T3	24-h radioiodine uptake
Hyperthyroidism, untreated	Low	High	High	High
Hyperthyroidism, T3 toxicosis	Low	Normal	High	Normal or High
Primary Hypothyroidism, untreated	High	Low	Low or Normal	Low or Normal
Hypothyroidism secondary to pituitary disease	Low or Normal	Low	Low or Normal	Low or Normal
Euthyroid, on exogenous thyroid hormone	Normal	Normal on T4, Low on T3	High on T3, Normal on T4	Low

# THYROTOXICOSIS







# Causes of Thyrotoxicosis

- ▣ **Disorders with increased Iodine uptake:**
  1. Graves' disease
  2. Toxic MNG/adenoma *→ multi-nodular goiter*
  3. Inherited non-immune hyperthyroidism
  4. Hyperthyroidism due to thyrotropin secretion (TSH-oma).
  5. HCG-induced hyperthyroidism – Associated with pregnancy or Trophoblastic Tumors

**DO NOT DO THYROID UPTAKE AND SCAN DURING PREGNANCY.**



## ▣ Disorders with decreased Iodine uptake:

1. Sub-acute thyroiditis.
2. Iatrogenic thyrotoxicosis
3. Strauma ovarii
4. Metastatic thyroid carcinoma





COLD NODULE

pyramidal  
lobe



GRAVE DISEASE

hot and cold nodules



TOXIC MULTINODULAR



HOT NODULE

suppression of  
remainder of gland



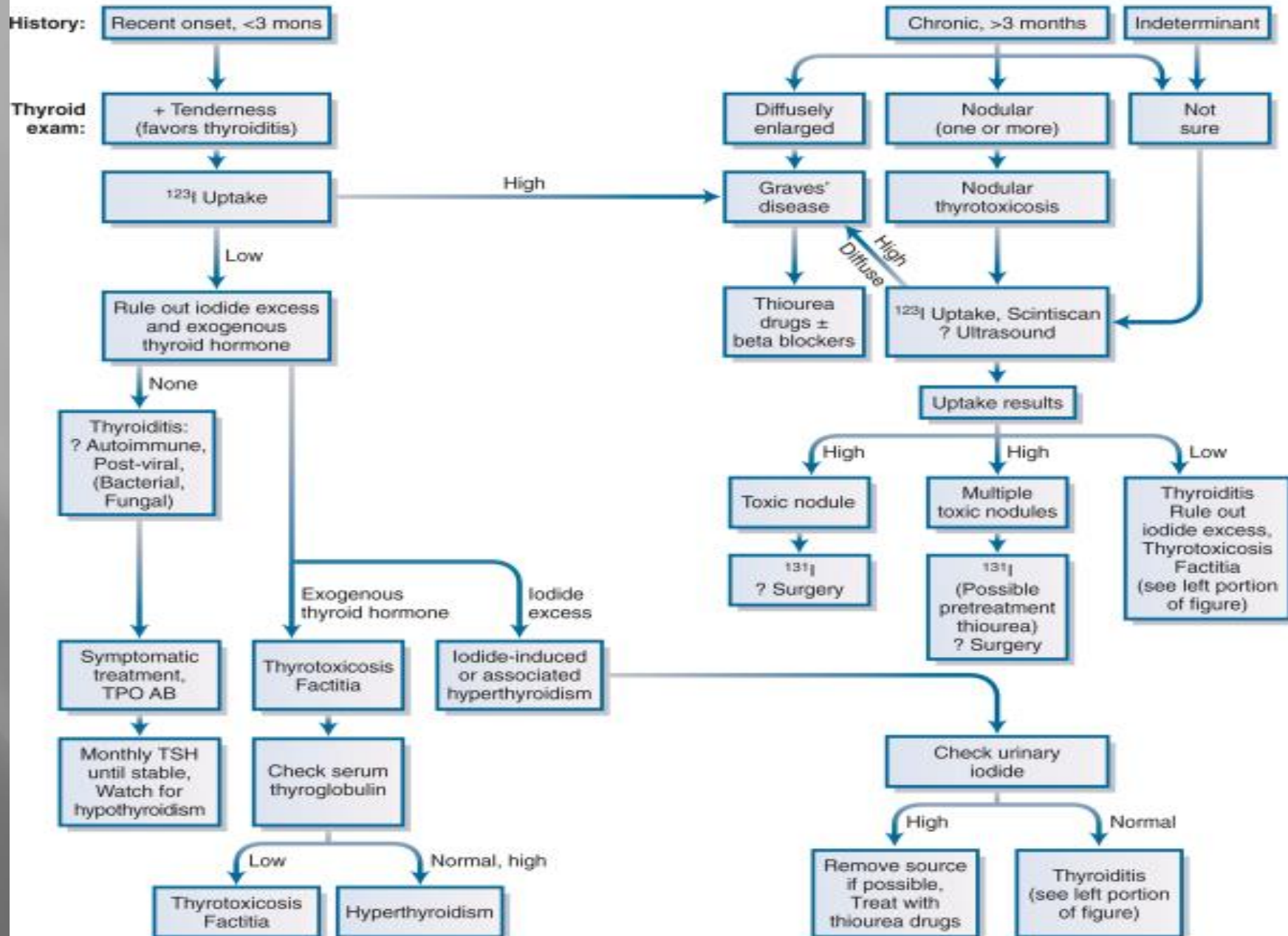
AUTONOMOUS NODULE

RAIU=5%



THYROIDITIS

**Patient with symptoms and signs suggesting thyrotoxicosis, no amiodarone;  
serum TSH <0.2 mU/L, free T<sub>4</sub> or T<sub>3</sub> elevated**



# Treatment?

- ▣ **In cases of Graves' disease, toxic MNG or adenoma:**
  1. Anti-thyroid medications, i.e carbimazole
  2. I131 treatment
  3. Surgery
  4. Temporary beta blockers for symptoms control.
- ▣ **In cases of subacute thyroiditis** → Temporary beta blockers, NSAID's and/or steroids for symptoms control.

# THYROID STORM/THYROID CRISES

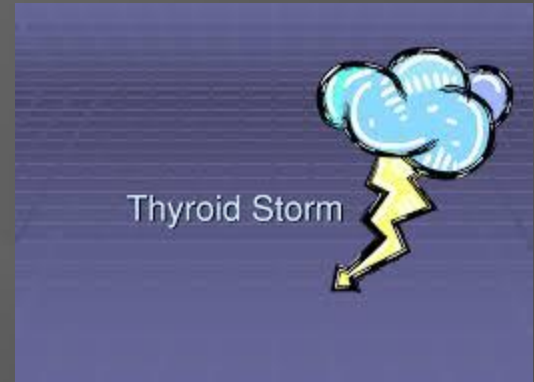
- An acute, life-threatening, hypermetabolic state induced by excessive release of thyroid hormones.

When they don't have a history, check for goiter/ eye symptoms

- Presentation: **Fever**, **tachycardia**, **HTN**, and **neurological** and **GI abnormalities**.

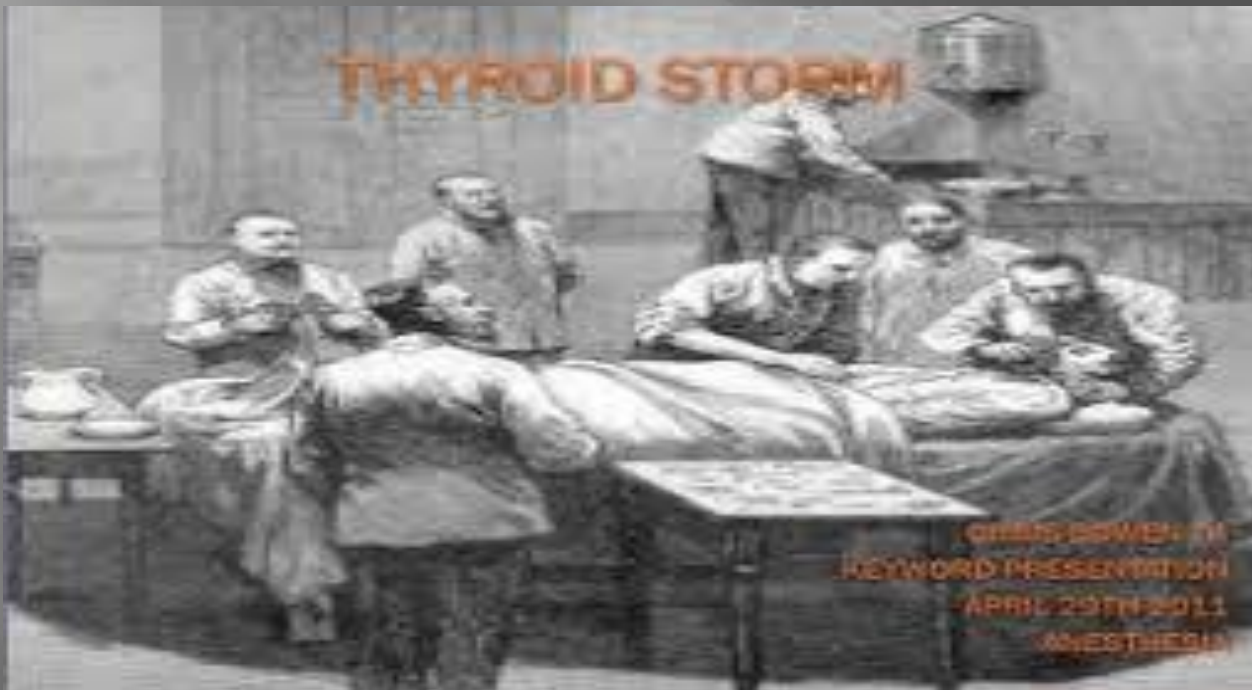
Clinical diagnosis

Exophthalmos

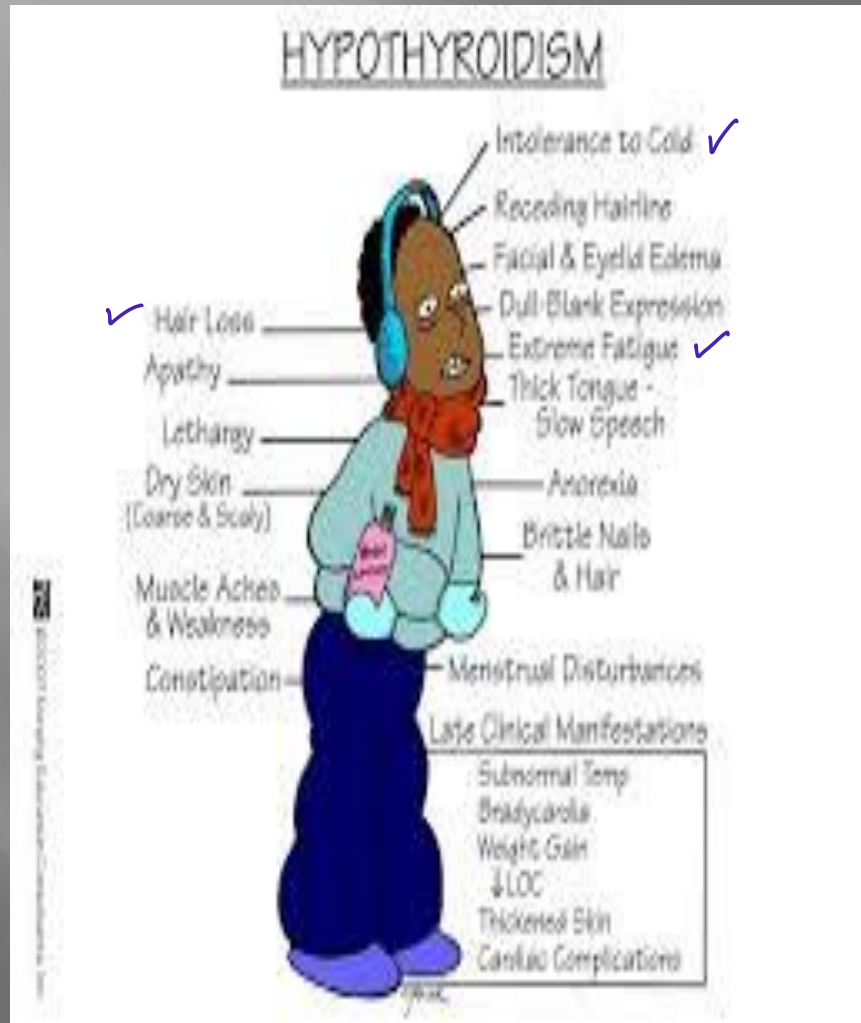




- ❑ Rapid diagnosis and aggressive treatment are critical.
- ❑ Diagnosis is primarily clinical
- ❑ Management: Supportive measures, IV fluids
- ❑ Propylthiouracil and Beta blockers. + Corticosteroids



# Hypothyroidism





Loss of outer 1/3 of eyebrows hair  
Periorbital edema

**Typical appearance with moderately severe primary hypothyroidism or myxedema**

# Causes of hypothyroidism

1. **Hashimoto's thyroiditis.** Most common cause in developed countries / Jordan
2. Post total thyroidectomy.
3. Post I131 treatment
4. Congenital, i.e Thyroid agenesis or dysplasia,
5. Medications, i.e Lithium and Amiodarone.
6. **Iodine deficiency** Most common cause in developing countries
7. Central hypothyroidism
8. Thyroid infiltration, i.e Riedel's struma, amyloidosis, and hemochromatosis



Physiologic state	Serum TSH	Serum Free T4	Serum T3	24-h radioiodine uptake
Hyperthyroidism, untreated	Low	High	High	High
Hyperthyroidism, T3 toxicosis	Low	Normal	High	Normal or High
Primary Hypothyroidism, untreated	High	Low	Low or Normal	Low or Normal
Hypothyroidism secondary to pituitary disease	Low or Normal	Low	Low or Normal	Low or Normal
Euthyroid, on exogenous thyroid hormone	Normal	Normal on T4, Low on T3	High on T3, Normal on T4	Low

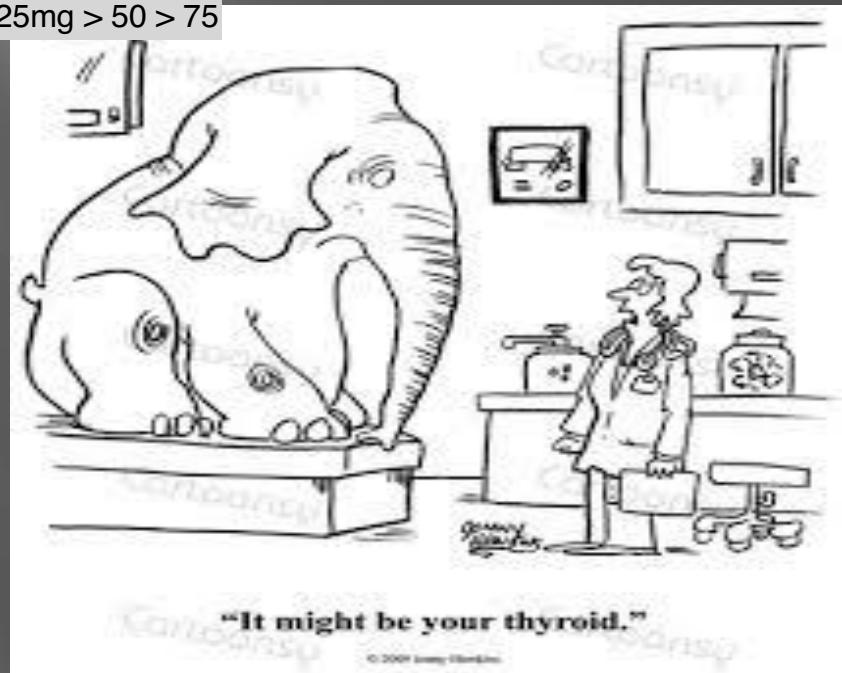
more common ←

# Treatment

- ▣ Levothyroxine replacement.
- ▣ No need for additional T3 replacement.
- ▣ In older people with history of CAD, start with a low dose and then titrate dose up slowly.

Starting 25mg > 50 > 75

In younger patients we don't get scared from giving the patient full dose (they're healthier and can tolerate the full dose)



# Myxedema coma/Myxedema crises

- ▣ An uncommon but a life-threatening form of untreated hypothyroidism with physiological decompensation.
- ▣ The condition occurs in patients with long-standing, untreated hypothyroidism and is usually precipitated by a secondary insult, such as climate-induced hypothermia, infection, or another systemic condition, or drug therapy.

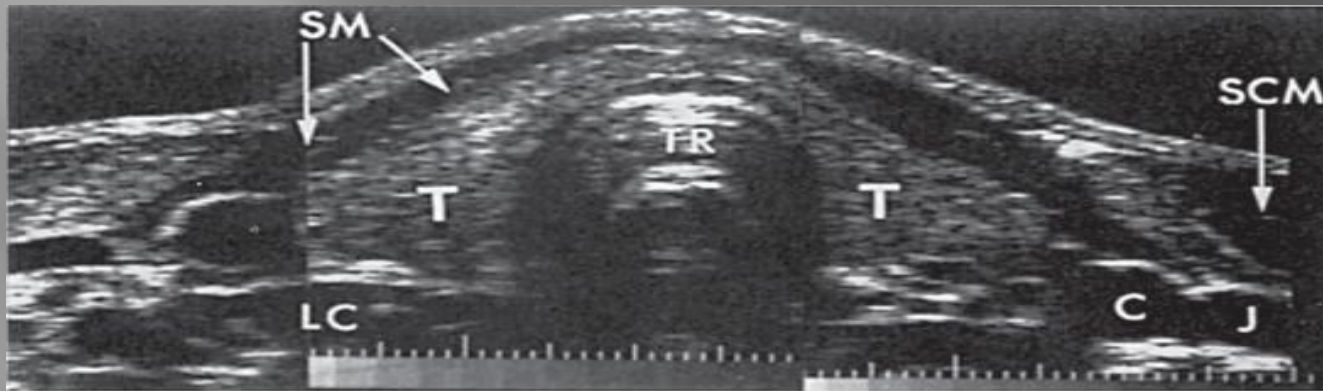
In hashimoto thyroiditis we think of other autoimmune diseases (Addison) so we give corticosteroids

- ▣ Patients with myxedema coma have changes in their mental status, including lethargy, stupor, delirium, or coma.
- ▣ Treatment:
  - Supportive measures
  - IV levothyroxine
  - In light of the possibility of adrenal insufficiency, stress steroid replacement *after* a cortisol level is obtained.

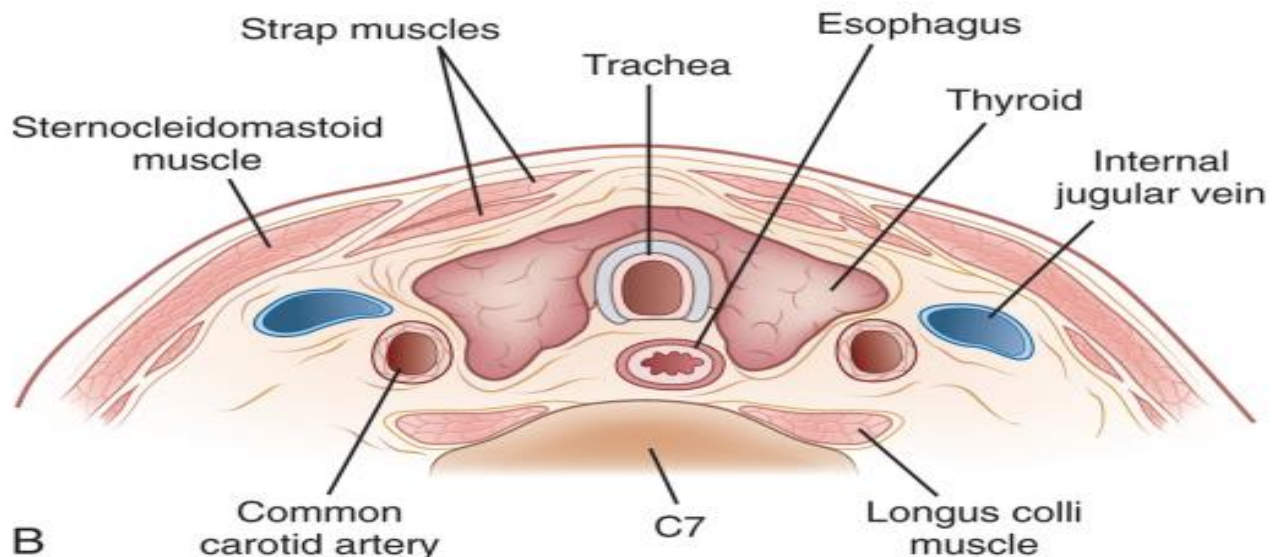


Addison

# NONTOXIC DIFFUSE AND NODULAR GOITER AND THYROID NEOPLASIA



A



B



# NONTOXIC GOITER: DIFFUSE AND NODULAR

- ▣ Nontoxic goiter may be defined as any thyroid enlargement characterized by uniform or selective growth of thyroid tissue that is not associated with overt hyperthyroidism or hypothyroidism and that does not result from inflammation or neoplasia.
- ▣ A thyroid nodule is defined as a discrete lesion within the thyroid gland that is due to an abnormal focal growth of thyroid cells.

- ▣ **Risk factors:**

- Familial
- Iodine deficiency
- Smoking
- Alcohol
- Older age
- Female sex
- Hx of uterine fibroids

Most common  
cause seen in  
the clinic: familial

noncancerous growths of the uterus that  
often appear during childbearing years



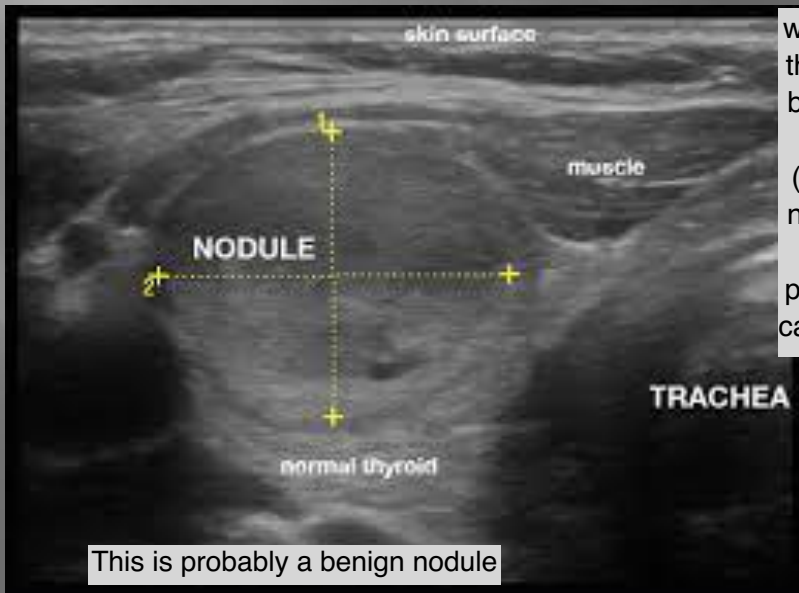


A little enlarged, it's darker and its heterogeneous

Chronic thyroiditis

Ultrasound wont help me in thyrotoxicosis to differentiate between the causes, because this picture can be seen in graves, subacute thyroiditis or hashitosis

So we'll use uptake scan But the U/S can be used to rule out nodules



we describe the nodules by the size, margins (smooth or not, regular or not), presence of calcifications

This is probably a benign nodule



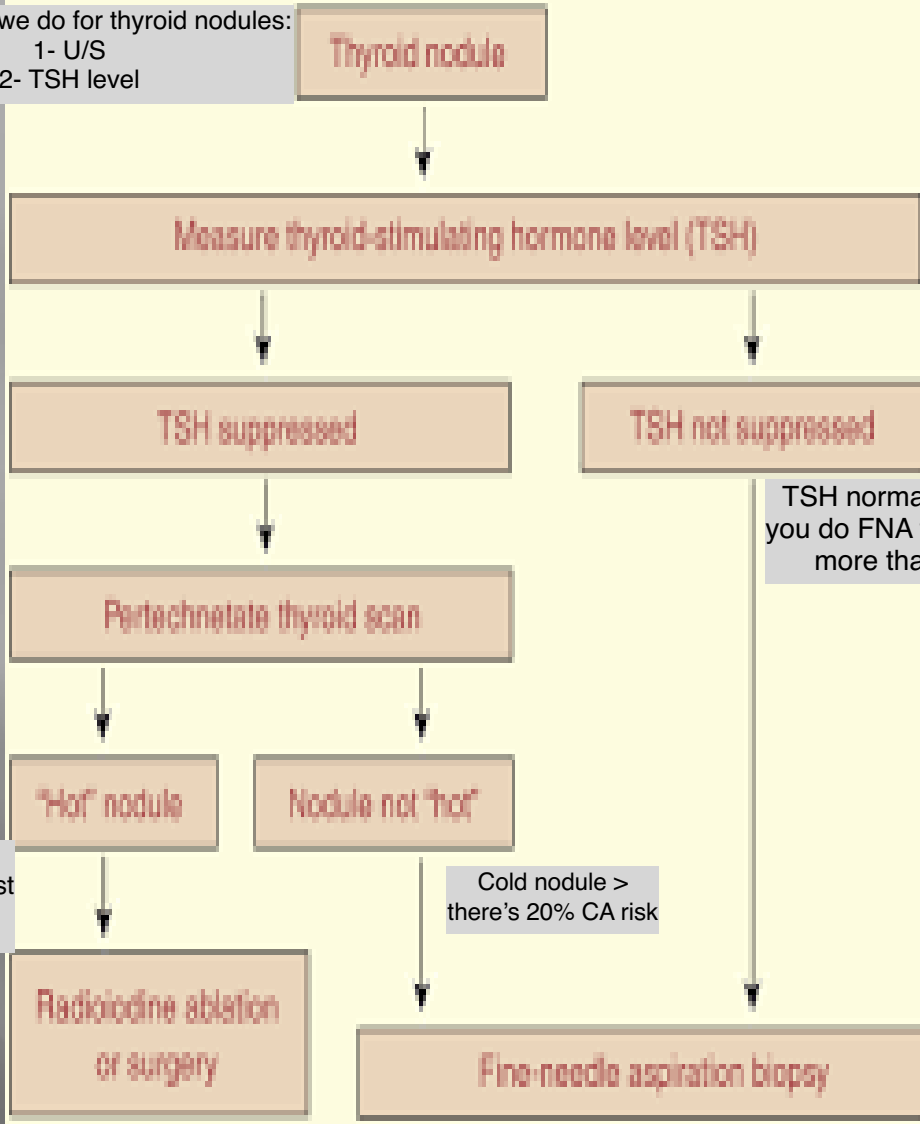
This is a suspicious nodule Papillary thyroid CA

# IMPORTANT !

In Ultrasound guided FNA, we use lidocaine

The work-up we do for thyroid nodules:

- 1- U/S
- 2- TSH level

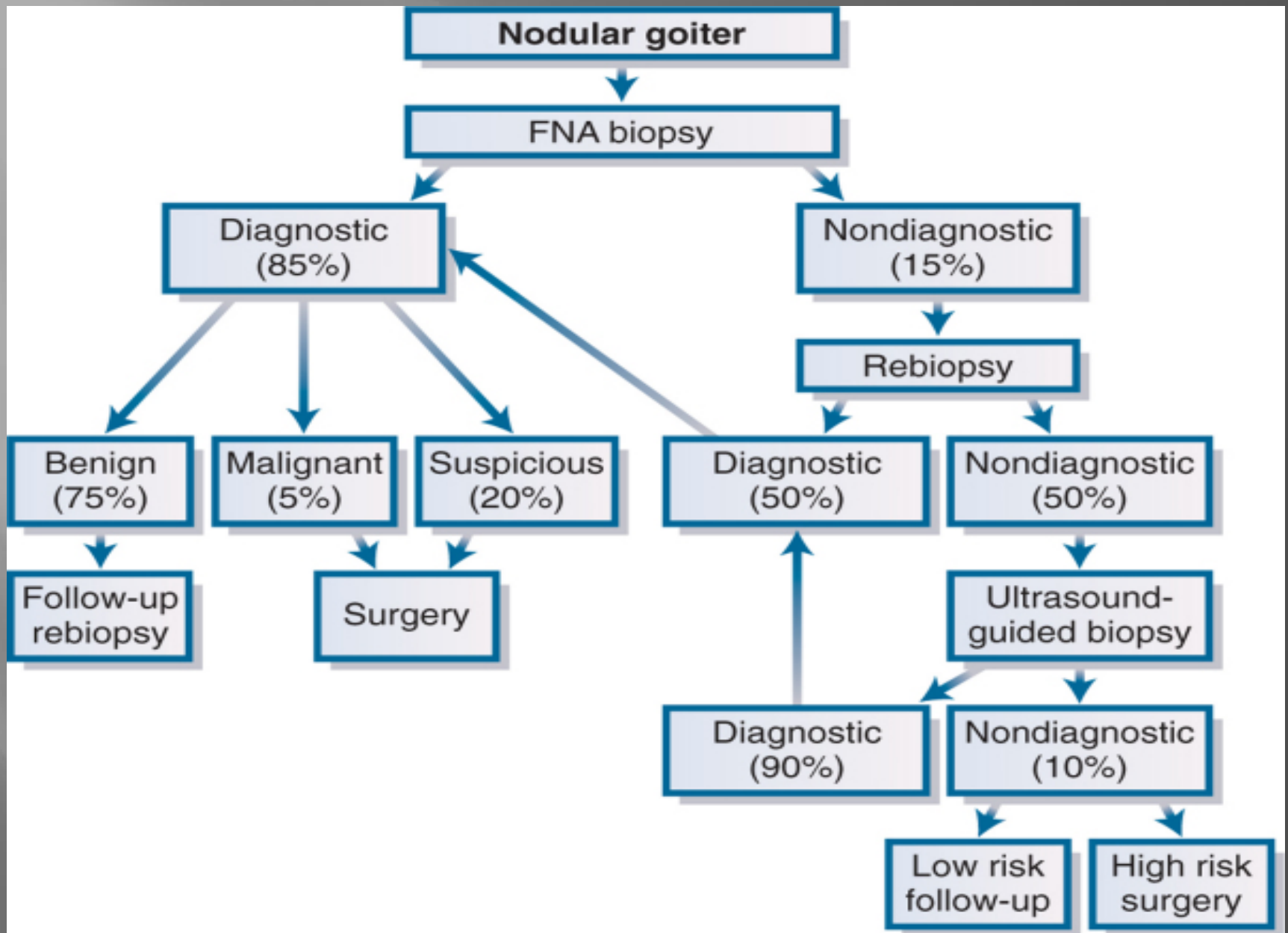


If its hot nodule, almost never CA

Cold nodule > there's 20% CA risk

TSH normal or high > you do FNA for nodules more than 1 cm





# Indications for thyroid surgery

- ❑ Malignancy
- ❑ Indeterminate and/or repeatedly nondiagnostic FNA results
- ❑ Cosmetic, mostly in females
- ❑ Obstructive symptoms

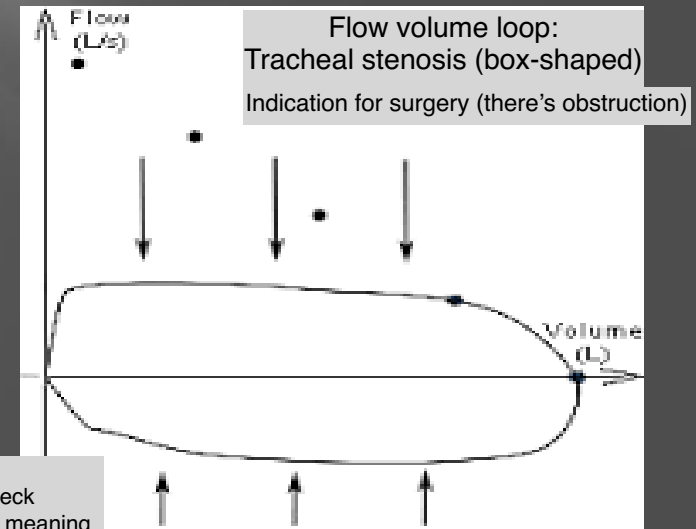
Dysphasia, dysphonia, dyspnea

FNA > malignant we have to remove it  
FNA > benign, if it's cosmetic or there's obstructive symptoms, or if the size is large or not



Pemberton sign

SVC obstruction because of presence of a mass inside the neck  
We ask the patient to raise his hands, and if the face becomes red meaning there's congestion and a mass that causes obstruction affecting venous return



If the patient was old or they have CAD we don't do it



# Does levothyroxine treatment help in non-toxic diffuse or nodular goiter?

It doesn't reuse the size except in 30%



- ▣ The efficacy of thyroid hormone suppressive therapy in euthyroid patients with solitary benign thyroid nodules or sporadic nontoxic multinodular goiters is **controversial**.
- ▣ Most studies have shown that few thyroid nodules regress in patients taking thyroid hormone. However, suppressive therapy does appear to interfere with goitrogenesis in many patients.
- ▣ The American Thyroid Association does not recommend suppression therapy of benign thyroid nodules in iodine sufficient populations

# Thyroid cancer

- ▣ The National Cancer Institute indicates that **thyroid cancer is the most common type of endocrine-related cancer** and estimates 60,220 new cases in 2013.
- ▣ Thyroid cancer represents approximately 3.6% of all new cancer cases.



- Although a diagnosis of thyroid or any type of cancer is frightening, the vast majority of thyroid cancers is highly treatable and in most cases curable with surgery and other treatments.



- Thyroid cancer is generally first suspected by a lump or nodule in the thyroid gland.



**Table 1. Relative Frequencies and Mortality Rates of the Various Histological Types of Thyroid Cancer**

Histological Type	Relative Frequency (%)	Cause-Specific Mortality Rates 20 Years (%)
Papillary	70 - 80	5 - 10
Follicular	15 - 25	25 - 30
Hürthle cell	2 - 5	20 - 35
Medullary	5 - 8	20 - 25
Anaplastic	4 - 10	> 95

Papillary is popular

→ least common but more aggressive



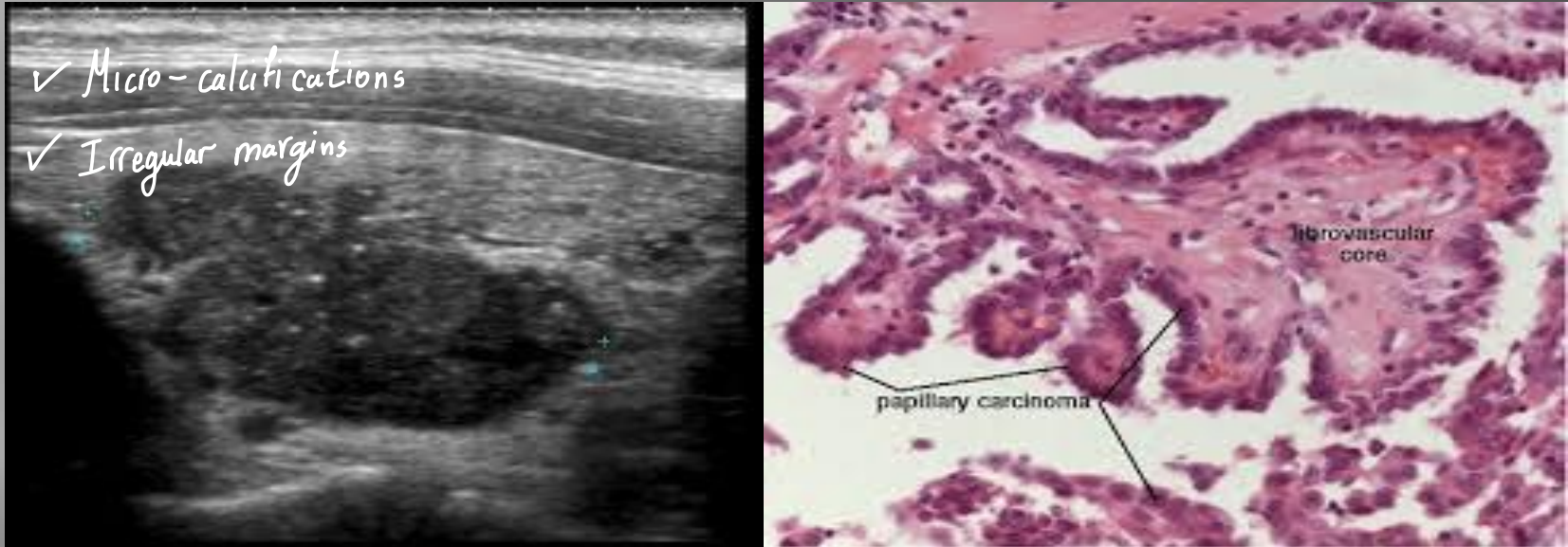
# 1. Papillary Thyroid Cancer

- ▣ Most common type of thyroid cancer: 70% to 80% of all thyroid cancers are papillary thyroid cancer
- ▣ Commonly diagnosed between the ages of 30 and 50
- ▣ Females are affected 3 times more often than males
- ▣ Usually not aggressive
- ▣ May spread, but usually not beyond the neck

cervical LNs

Papillary, Popular, Prognosis (good).  
Palpable LNs, Psammoma bodies (histology) on  
Positive I<sup>131</sup> uptake.

- Papillary cells resemble finger-like projections



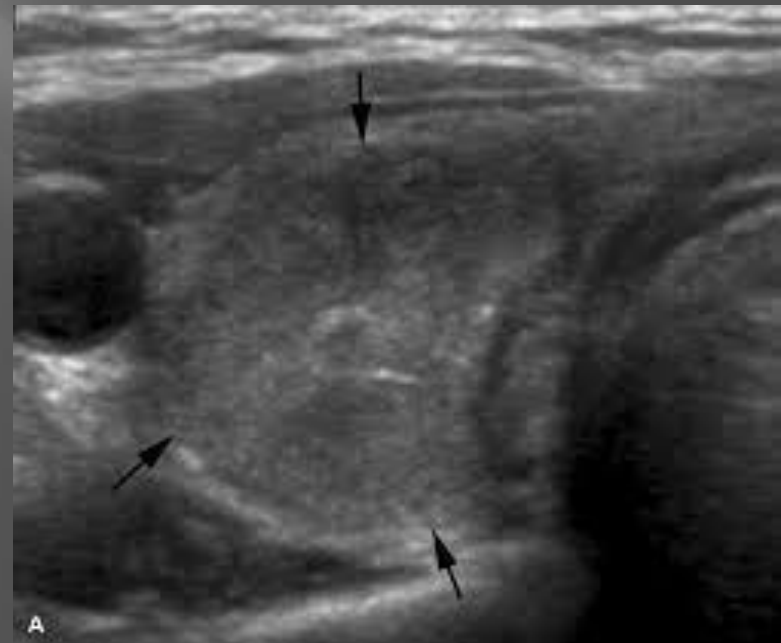
- Tumor development can be related to radiation exposure, such as radiation treatments for acne or **adenoid problems** as a child

## 2. Follicular Thyroid Cancer

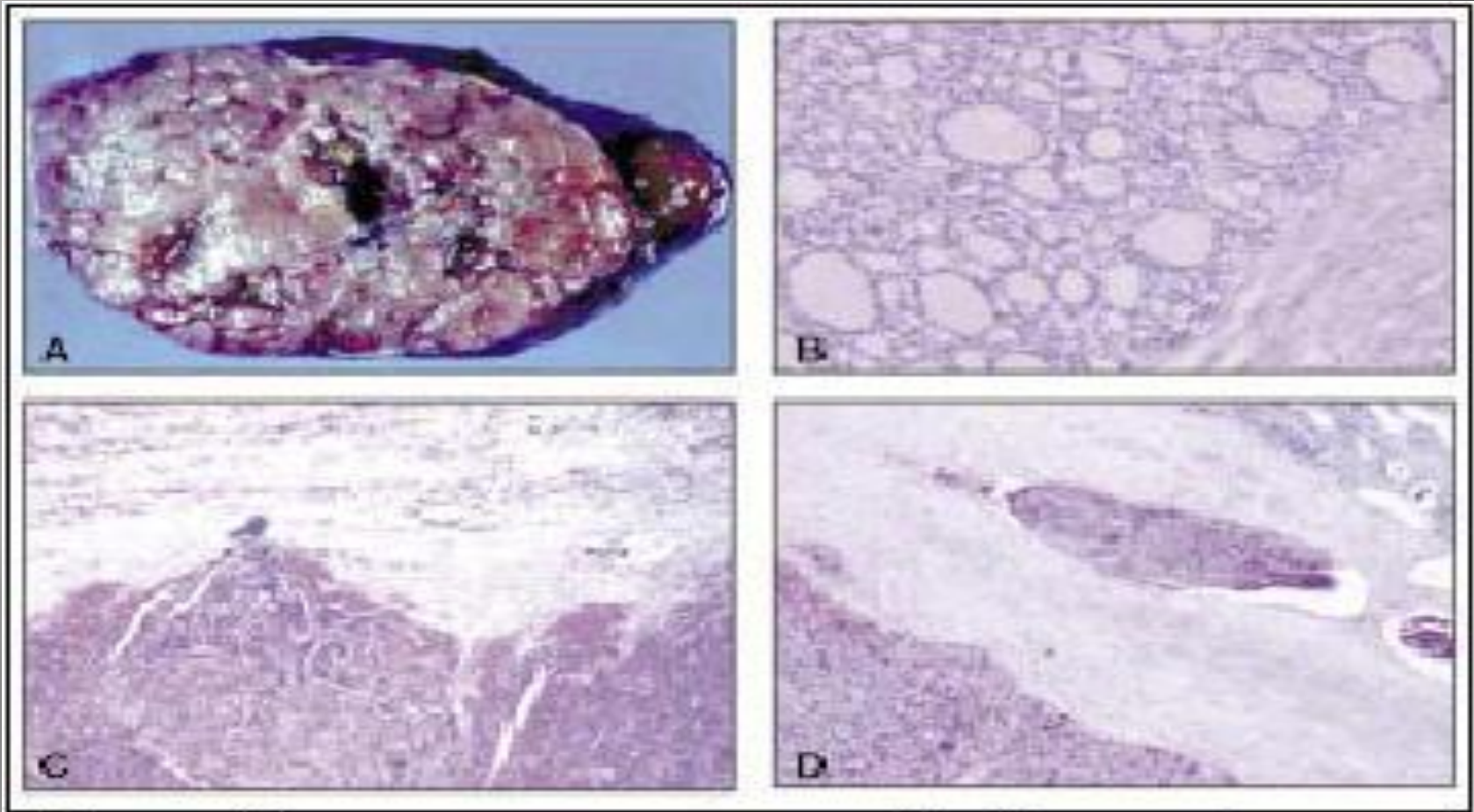
It's considered follicular neoplasm until you prove that there's a vascular invasion > you do a hemithyroidectomy > to the pathologist (either follicular adenoma or carcinoma)

- ▣ Makes up about **10% to 15% of all thyroid cancers**
- ▣ Often diagnosed between the ages of **40 and 60**
- ▣ **Females are affected 3 times more often than males**
- ▣ Cancer cells may **invade blood vessels** and **travel to other body parts such as bone or lung tissues**

Mets generally occurs hematogenously



▣ Follicular cells are sphere-shaped



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(A) Follicular adenoma with variegated gross appearance. (B) Follicular adenoma. The periphery of the tumor is surrounded by a fibrous capsule. (C) Follicular adenoma with indentation of the inner aspect of the tumor capsule. (D) Follicular carcinoma with vascular invasion with tumor attachment to the endothelium.

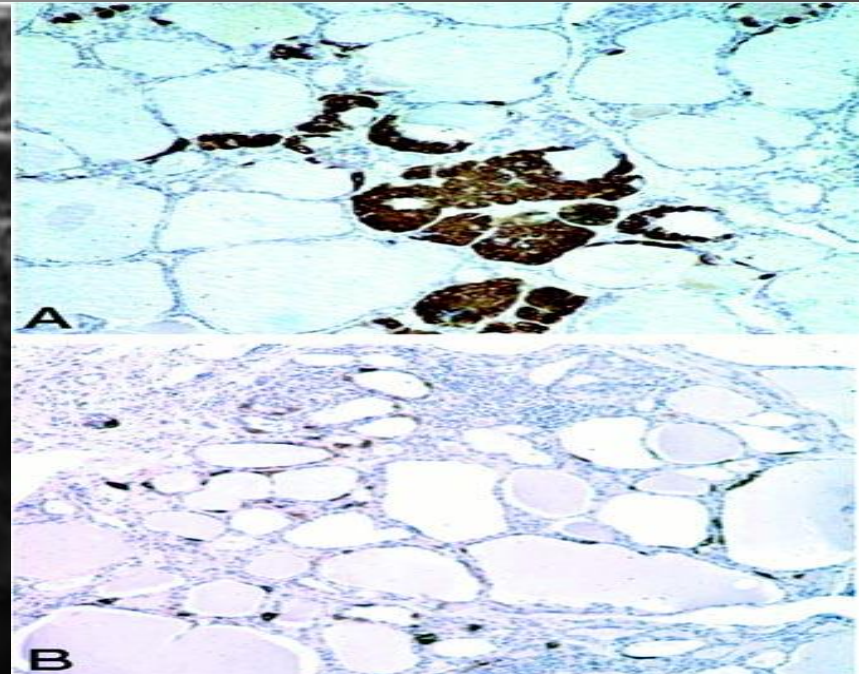
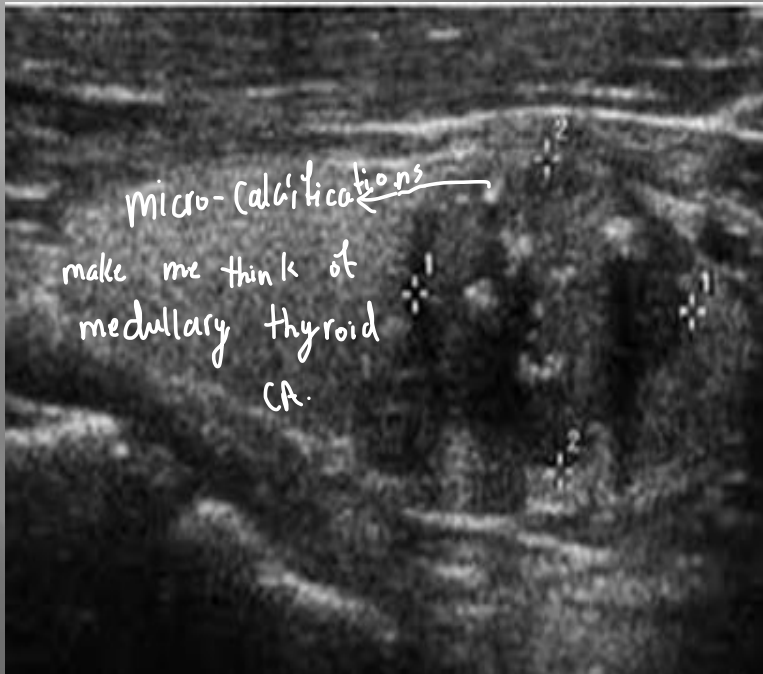
### 3. Medullary Thyroid Cancer

- ▣ Makes up about 5 % to 10% of all thyroid cancers
- ▣ More likely to run in families and associated with other endocrine disorders MEN
- ▣ Develops from the C Cells or parafollicular cells that produce calcitonin
- ▣ An elevated calcitonin level can indicate cancer



- Often diagnosed between the ages of **40 and 50**
- **Females and males are equally affected**
- Forms of medullary thyroid cancer include sporadic (not inherited), **MEN 2A** and **MEN 2B**, and **familial** (genetic, but not linked to other MEN-related endocrine tumors)

Remember:  
**MEN-1** → Pituitary, Parathyroid, Pancreas.  
**MEN-2** → Thyroid, Parathyroid, Adrenal



## 4. Anaplastic Thyroid Cancer

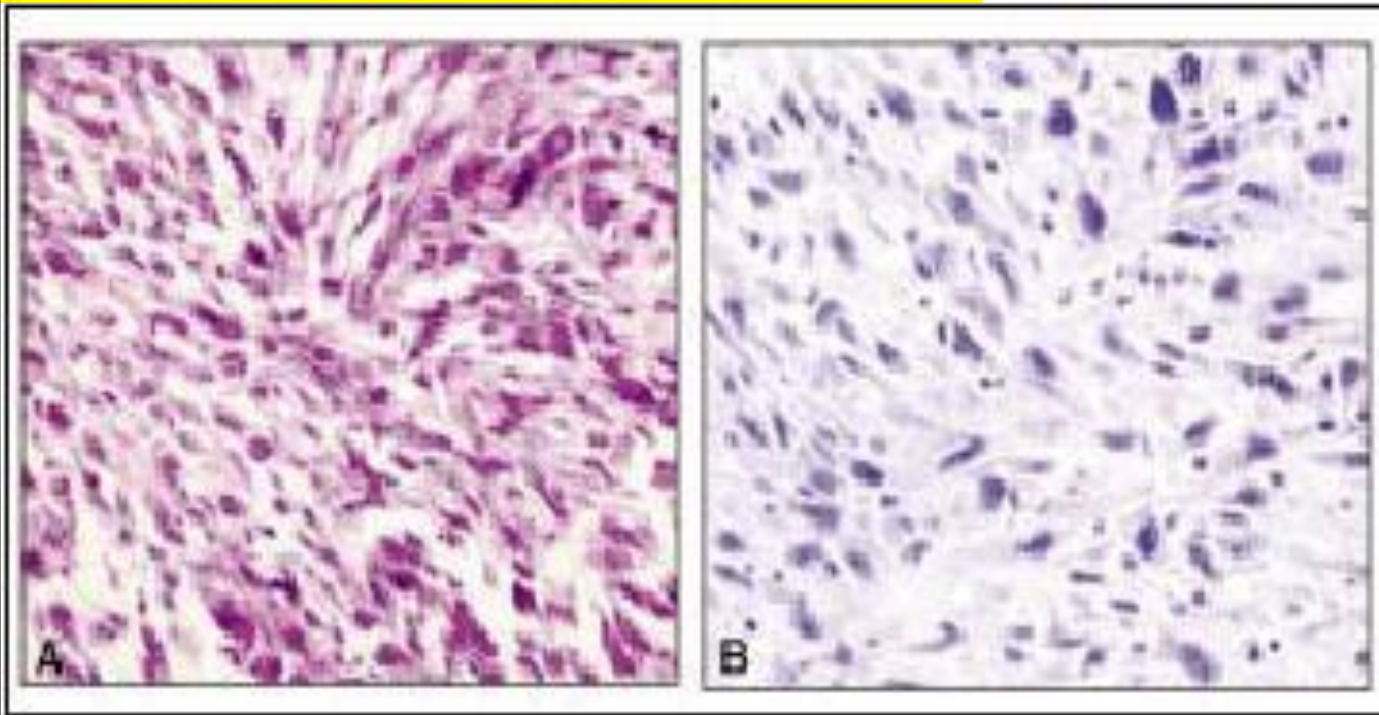
- ▣ **Very rare** — affects **fewer than 5%** of thyroid cancer patients
- ▣ Usually occurs in patients **older than 65 years**
- ▣ **Females are affected more often than males**

Poor prognosis



- ▣ **Anaplastic** means the cells **lose normal structure and organization** → **Aggressive** and **invasive**
- ▣ **Least responsive to treatment**

Very poorly differentiated



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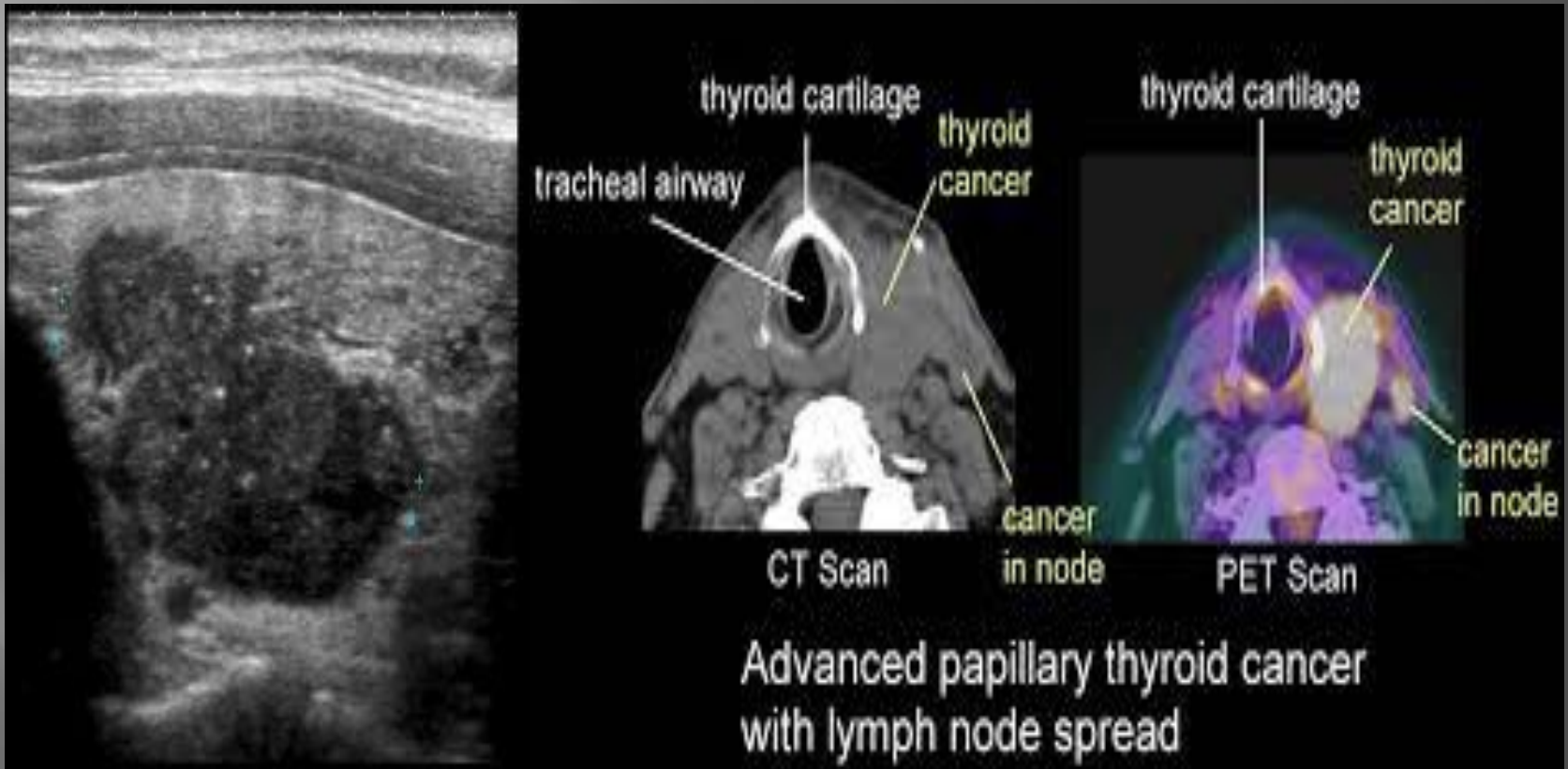
<http://www.medscape.com>

**Undifferentiated** (anaplastic) **carcinoma**. (A) Spindle cells in storiform growth pattern. (B) Prominent hyperchromatism and atypia of tumor cells



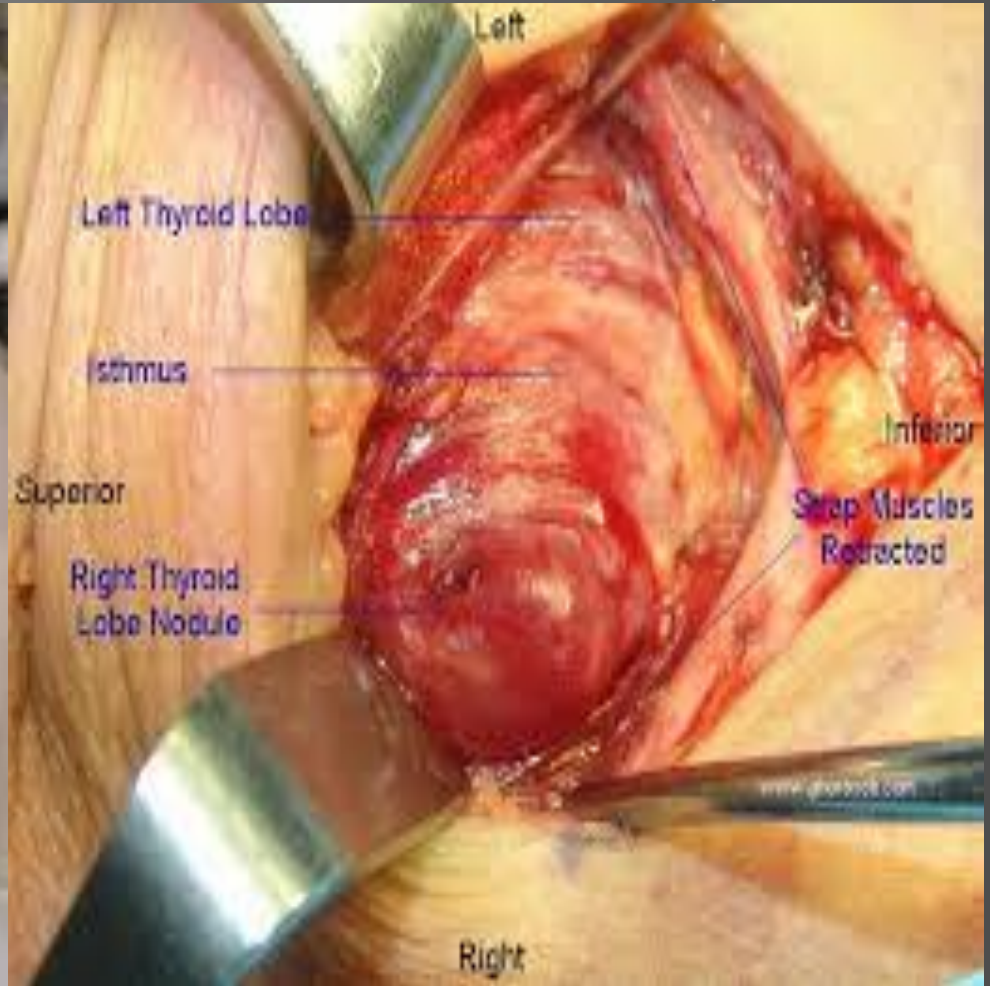
# Diagnostic tests

1. **Imaging studies** (thyroid ultrasound, CT neck, PET scan).  
Very sensitive  
Retrosternal goiter/  
mediastinal masses



2. The gold standard is thyroid FNA or surgery.

Hemithyroidectomy or  
Total thyroidectomy





# Treatment

1. **Surgery** (total, subtotal or hemi-thyroidectomy) →  
Need an experienced thyroid surgeon.



2. **I131 ablation**

From google: Image-guided ablation uses ultrasound imaging to guide a small needle into the thyroid nodule. The special needle uses heat, or thermal energy, to kill the cells in the nodule. Ablation has fewer complications and risks compared with traditional surgery.



### 3. External beam radiation

From google: uses high doses of radiation to destroy cancer cells and shrink tumors



### 4. Chemotherapy

Stage 4  
Bone or lung Mets



# Secondary thyroid tumors

1. **Thyroid lymphoma**



2. **Metastasis** (Kidney, Lung, Bone, Melanoma)



1. Williams Textbook of Endocrinology
2. Medscape.com
3. UpToDate.com

