Radiology of Endocrine Diseases (Interactive lecture)

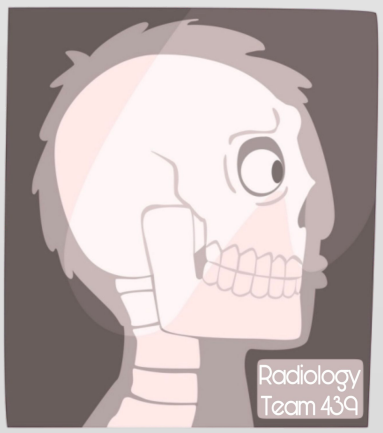
Lecture 21

Objectives

- none :)

Color index:

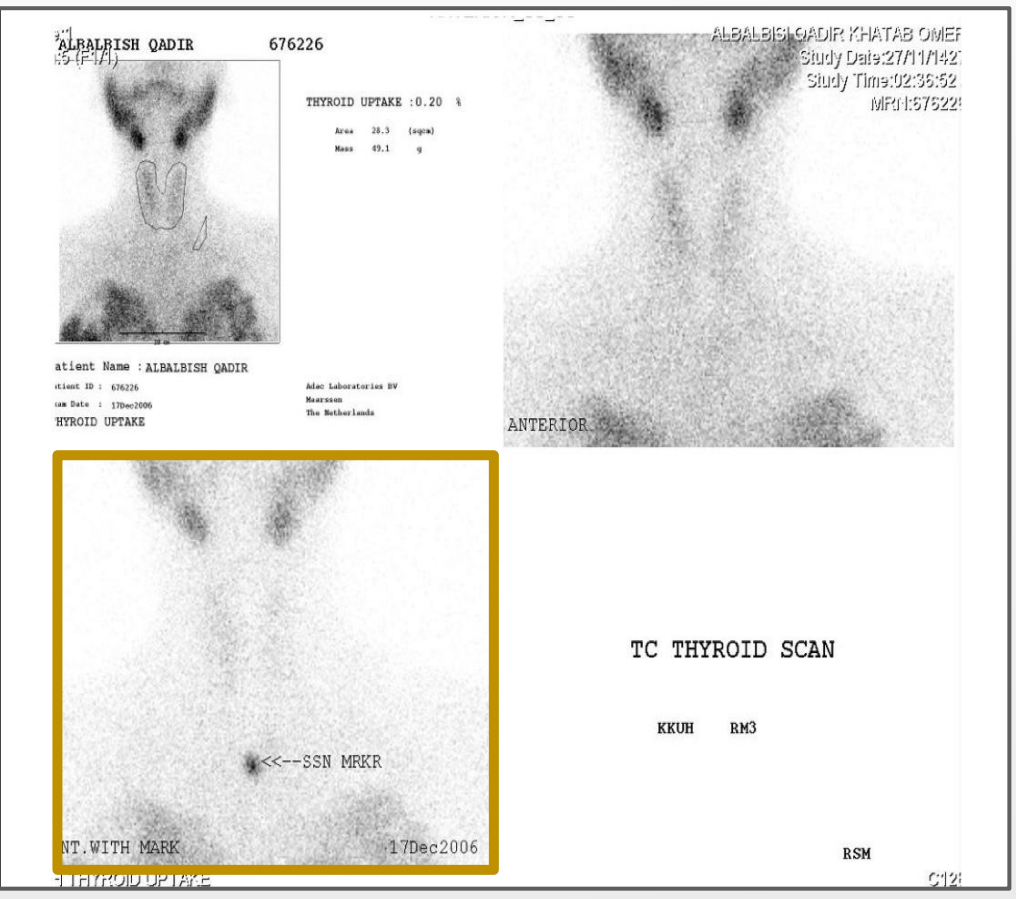
Black: Main text
Red: Important
Yellow: Golden notes
Green : Drs notes 439
Blue : Drs notes 438
Gray: Extra



Cases

Case 1

Elevated T4 and suppressed TSH. (Thyrotoxicosis with reduced uptake)



The gland is away from the marker

- **What is the study?**
Nuclear scan of the thyroid.

- **What is the agent used?**
Tc-99m Pertechnetate or Iodine 123

- **What are the imaging findings?**
Decreased uptake (underactive) in both lobes 0.20% (thyroiditis).
(Normal 0.5%-4%).

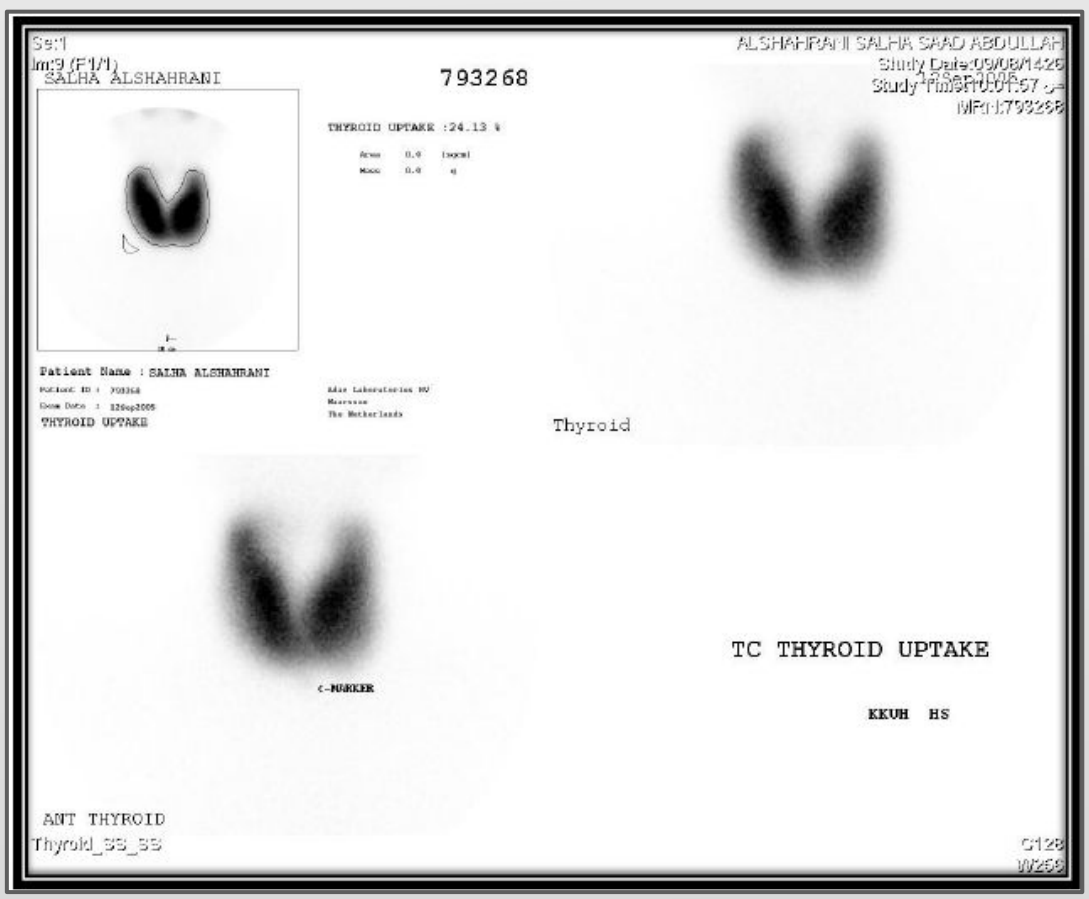
- **DDx of Thyrotoxicosis with reduced uptake:**
factitious thyrotoxicosis Iodine induced,
Or exogenous thyroxine

- **What is the most likely diagnosis?**
Subacute Thyroiditis (postpartum thyroiditis).
All the thyroid hormones went to the blood

- **What is the treatment?**
Symptomatic treatment give beta blockers.

Case 2

Female with **Elevated T4 and suppressed TSH.** (Thyrotoxicosis)



The gland is close to the marker (enlarged)

- **What is the study?**
Nuclear scan of the thyroid.

- **What is the agent used?**
Tc-99m Pertechnetate.

- **What are the imaging findings?**
Enlarged gland with Bilateral diffuse uptake 24.13%
(Normal 0.5%-4%)

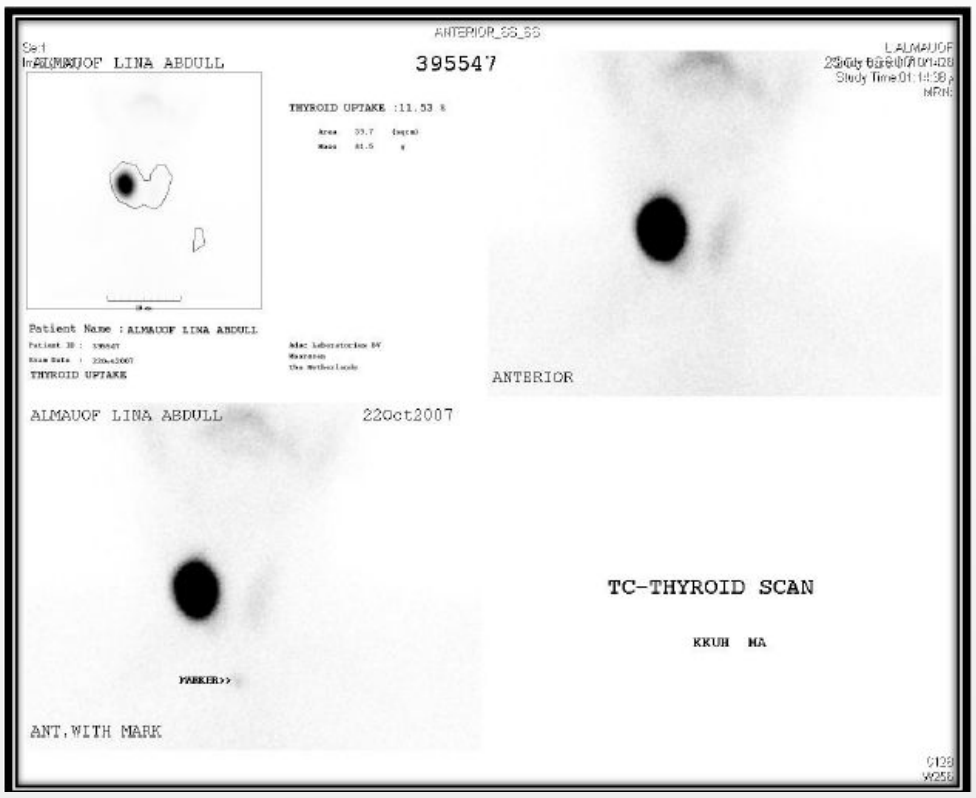
- **What is the most likely diagnosis?**
Grave's disease (because it is diffused) (hyperthyroidism).

- **What is the treatment?**
Need definitive treatment (3 modalities) :
1)Medical (Antithyroid).
2) Surgical .
3)Radioactive **iodine 131 (RAI).**

- **Give 4 causes of increased thyroid uptake?**
1) Autonomous toxic nodule.
2) Multinodular toxic goiter (Plummer's Disease).
3) Enzyme defects (Dyshormonogenesis).
4) Iodine starvation > Iodine deficiency.

Case 3

Elevated T4 and suppressed TSH.



- **What is the study?**
Nuclear scan of the thyroid.

- **What is the agent used?**
Tc-99m Pertechnetate.

- **What are the imaging findings?**
Hot nodule on the right lobe suppressing the left, elevated uptake 11.53% (Normal 0.5%-4%)

- **What is the most likely diagnosis?**
Autonomous/ Single toxic nodule.

- **What is the treatment?**
1st option: RAI (Iodine 131) 1st line therapy.
2nd option: surgery.

- **What is the chances of this nodule of being malignant?**
low chance of being malignant < 5%.

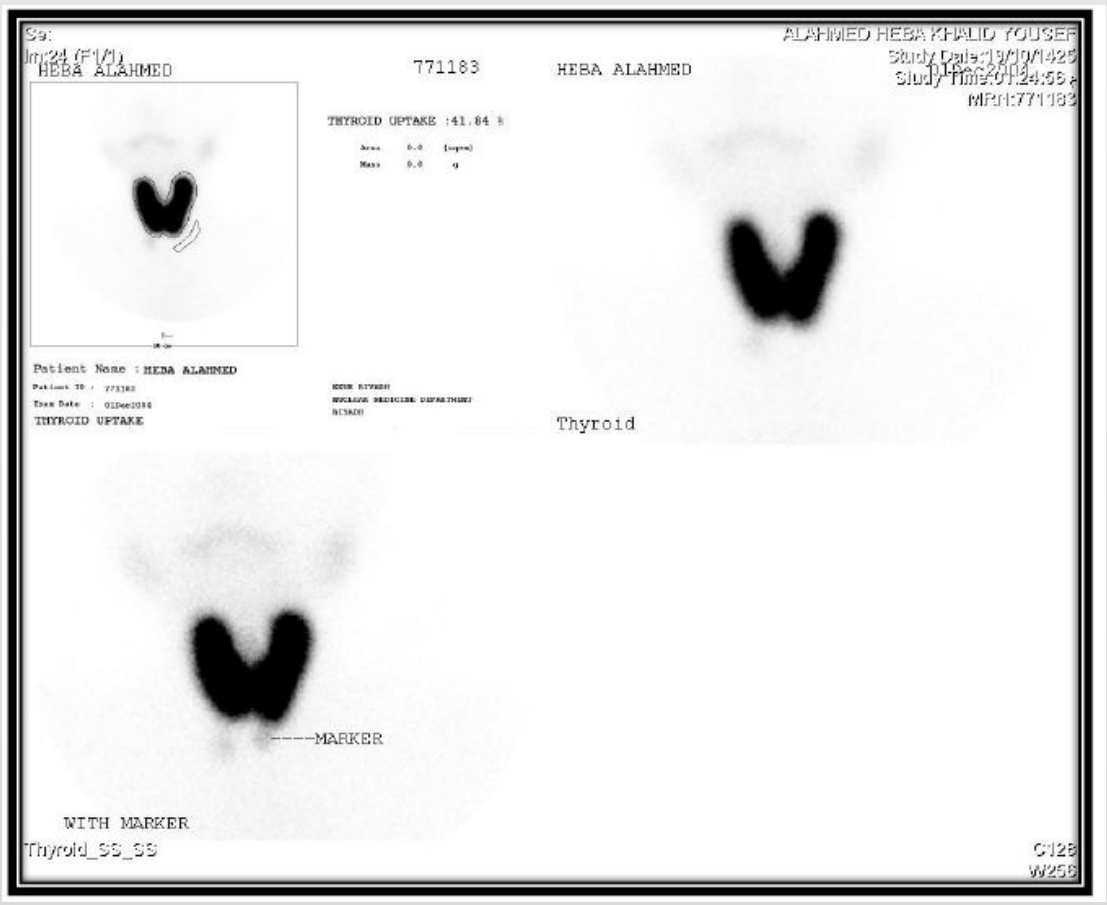
teaching point

In patients with thyrotoxicosis , thyroid scan is used to differentiate thyrotoxicosis with hyperthyroidism which needs definitive treatment from thyrotoxicosis without hyperthyroidism needs symptomatic treatment

Case 4

(Thyrotoxicosis = Elevated T4, if it was from the thyroid it is hyperthyroidism)

Elevated TSH and low T4 (2 YEARS OLD) (Hypothyroidism)



- **What is the study?**
Nuclear scan of the thyroid (for a child).

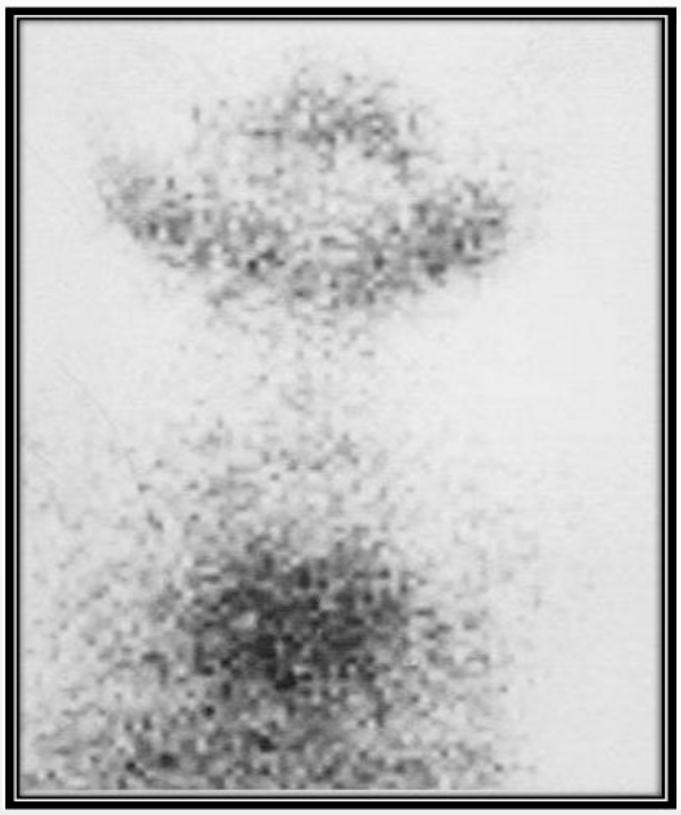
- **What is the agent used?**
Tc-99m Pertechnetate.

- **What are the imaging findings?**
Enlarge gland with diffuse elevated uptake (41.84).

- **What is the most likely diagnosis?**
Dyshormonogenesis (enzyme deficits)
Iodine deficiency will have the same scenario except it's unlikely to appear in a 2 y.o. Usually in the adult
Hypothyroidism ---> Hashimoto
Congenital hypothyroidism
Considering the patient's age --> enzyme defect, so low T4

Case 5

A newborn with **Elevated TSH and low T4** (clinical hypothyroidism)



- **What is the study?**
Nuclear scan of the thyroid (for a child).

- **What is the agent used?**
Tc-99m Pertechnetate.

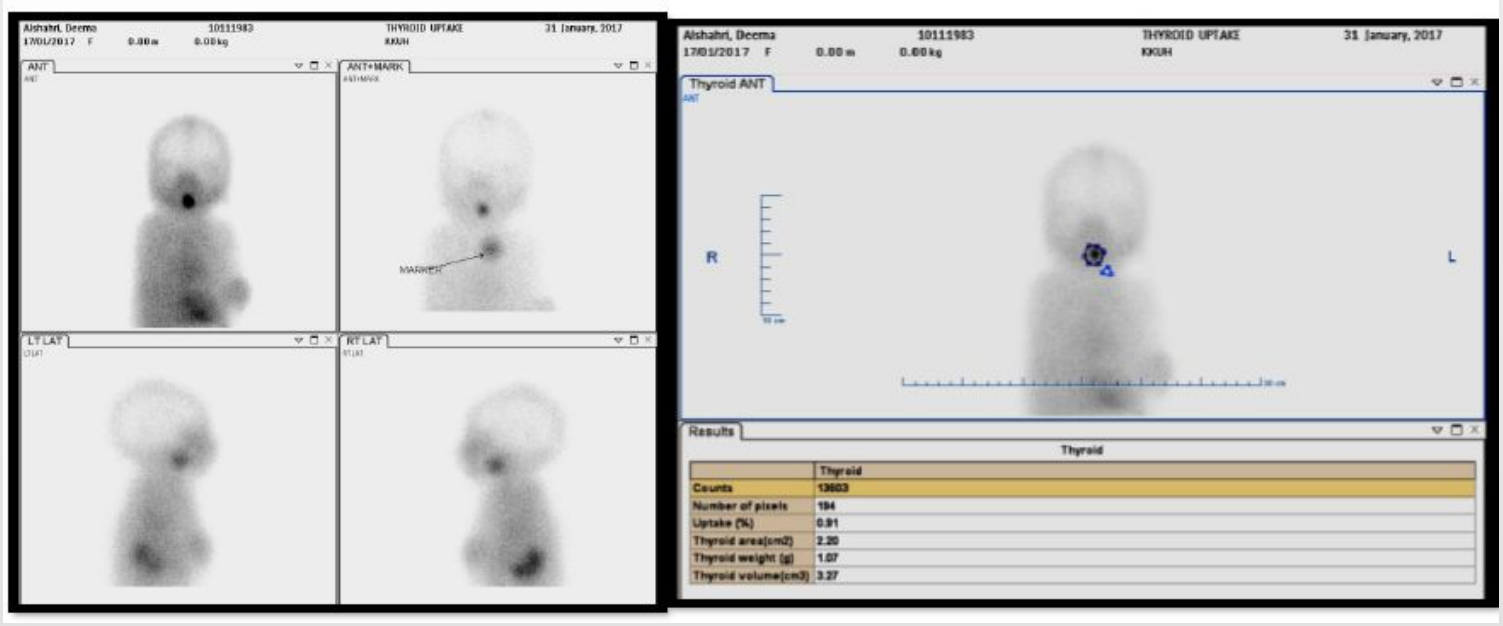
- **What are the imaging findings?**
Absence of thyroid gland.

- **What is the most likely diagnosis?**
Agenesis. (Congenitally absent gland)

- **What is the treatment?**
Thyroxin.

Case 6

Baby present with hypothyroidism



- **What is the study?**
Nuclear scan of the thyroid
- **What are the imaging findings? Sublingual thyroid (ectopic thyroid)**
abnormal location .
- **What is the most likely diagnosis?** Sublingual thyroid (ectopic thyroid).
- **What is the treatment?**
- The uptake here = 0.91% (normal).
- Normal range 0.5-4%.

teaching point

In patients with neonatal hypothyroidism, thyroid scan is used to differentiate dyshormonogenesis from ectopic thyroid and thyroid aplasia.

Case 7

A young female patient presented with a **palpable Neck Mass**

- **What is the study?**
Nuclear scan of the thyroid.

- **What is the agent used?**
Tc-99m Pertechnetate.

- **What are the imaging findings?**
Enlarged cold nodule on the left with decreased uptake.

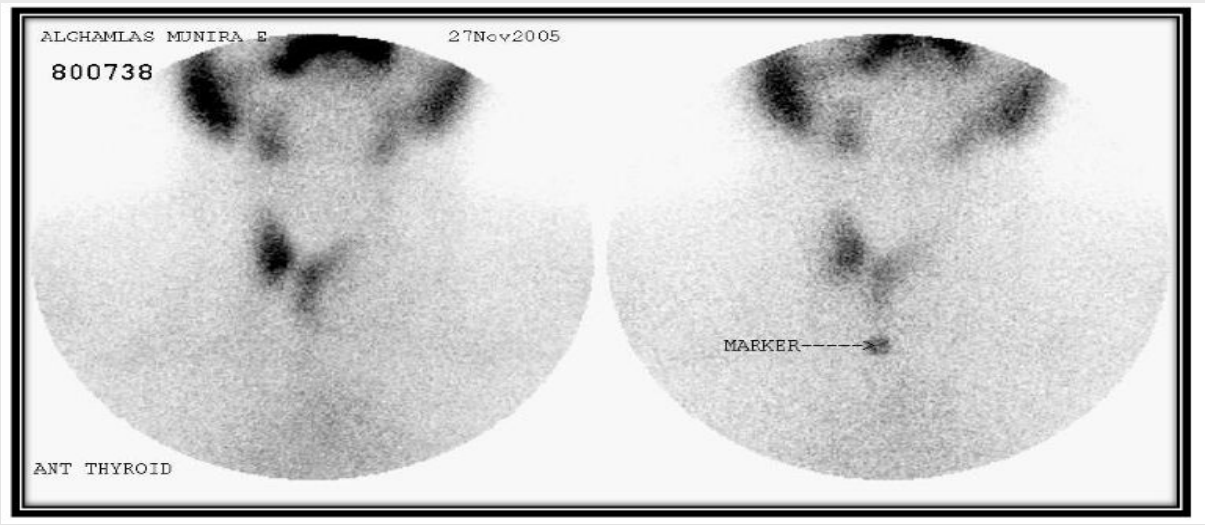
- **What is the most likely diagnosis?**
Mass on the left side with 15% chance to be malignant in females and 20% in males.

- **What is the treatment?**
FNA to confirm.
If it turns malignant next step is surgery to remove it.

- Suprasternal notch should be under the isthmus.

Case 8

A patient presented with a **palpable neck mass,** In addition to SOB and dysphasia



- **What is the study?**
Nuclear scan of the thyroid.

- **What is the agent used?**
Tc-99m Pertechnetate.

- **What are the imaging findings?**
Decrease uptake in left thyroid lobe (Cold nodule). A mass in the left lobe pushing the thyroid to right. (marker is useful here to tell if there is tracheal shift because it is always below the isthmus. here it is under the nodule so it is pushed). To confirm the tracheal deviation do X-Ray.

- **What is the most likely diagnosis?**
Mass on the left side.

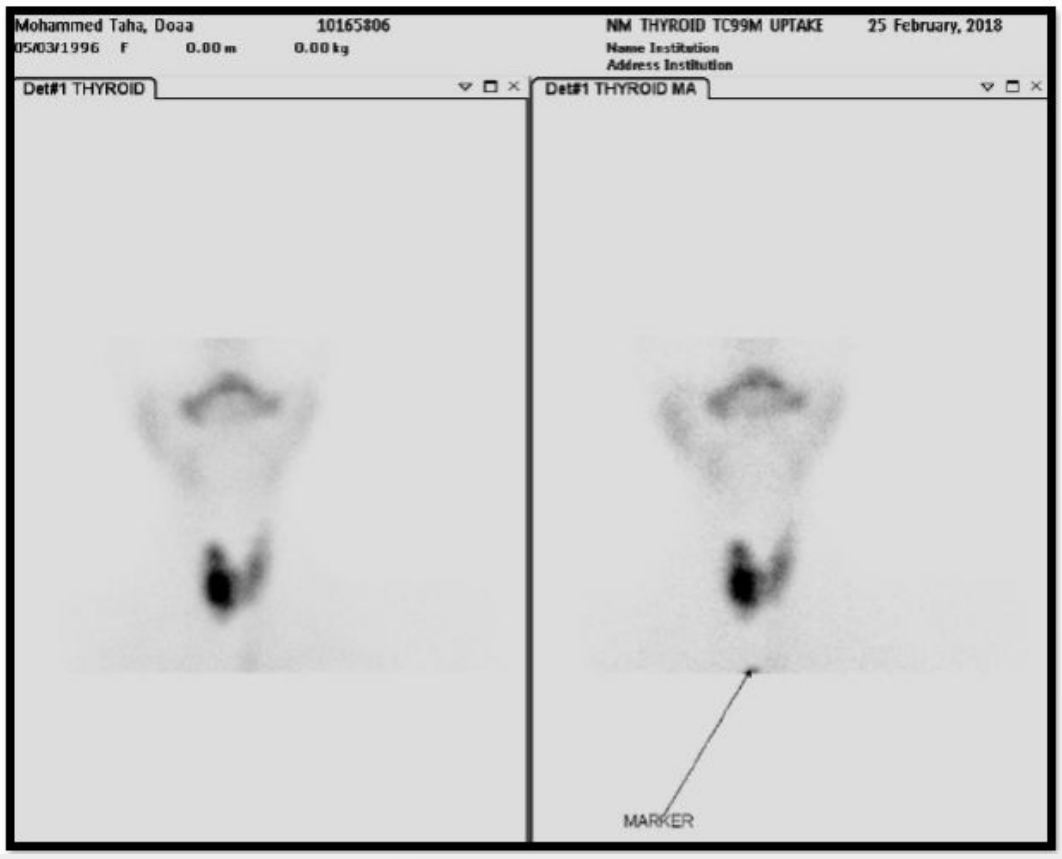
- **What are the chance of this nodule to be malignant?**
15%-20%.

- **What is the treatment?**
FNA to confirm.
If it turns malignant next step is surgery to remove it.

- Name some compression symptoms?
1-Dysphagia 2-Hoarseness of voice 3- Dyspnea.

Case 9

A patient presented with a **palpable neck mass.**



- **What is the study?**

Nuclear scan of the thyroid.

- **What are the imaging findings?**

Focal increased uptake (warm nodule) on the right lobe (because we can see normal thyroid).

- **What are the chance of this nodule to be malignant?**

Less than 5%.

patients with neck mass, thyroid scan is used to differentiate cold from hot thyroid nodules.

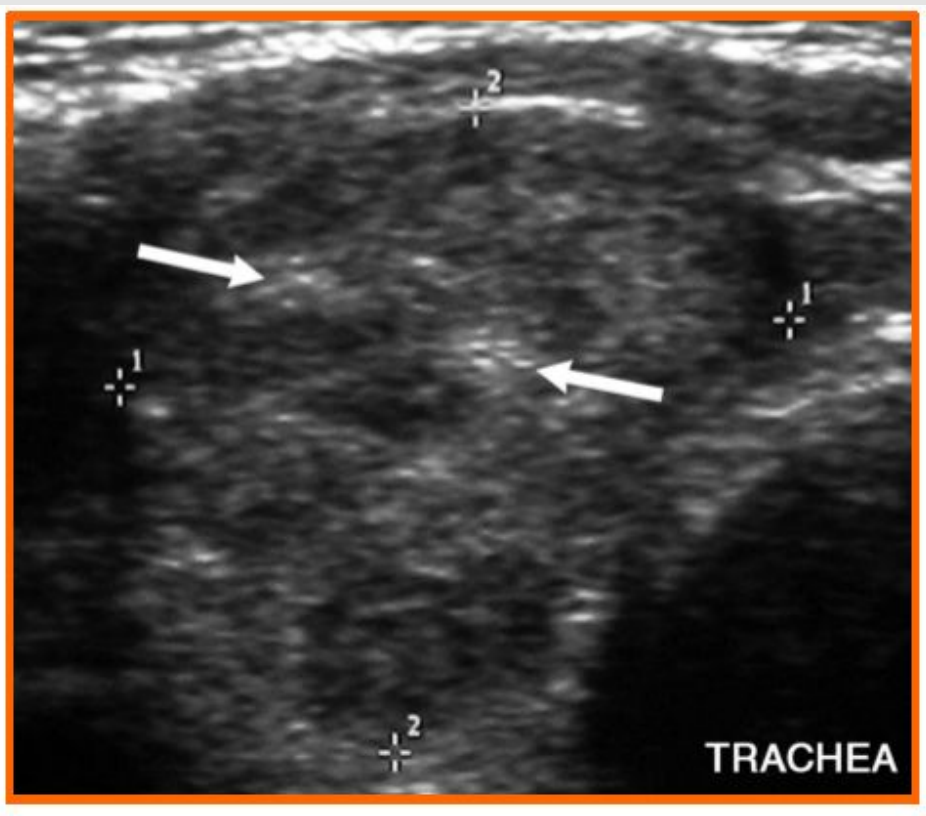
If a nodule appeared warm in tech-99m scan do an iodine 123 scan, if it appeared cold then it is a discordant nodule and the chance of malignancy is 20%

teaching point

In patients with neck mass, thyroid scan is used to differentiate cold from hot thyroid nodules.

Case 10

Right Thyroid lobe : Papillary thyroid carcinoma in a 42-year-old man.



- **What is the study?**

Sonogram (Ultrasound).

- **What are the imaging findings?**

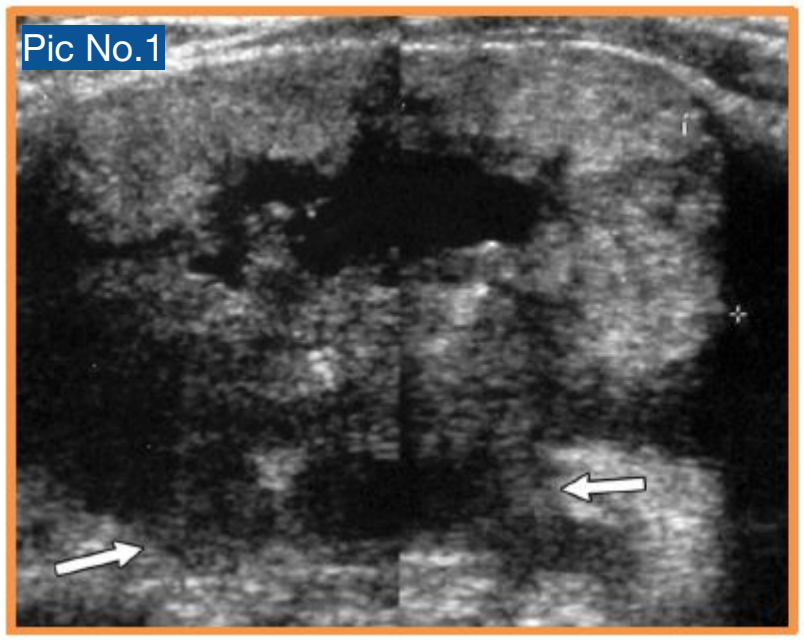
Transverse sonogram of the right lobe of the thyroid demonstrates:
Punctate echogenic foci without posterior acoustic shadowing, findings indicative of **microcalcifications (arrows).**

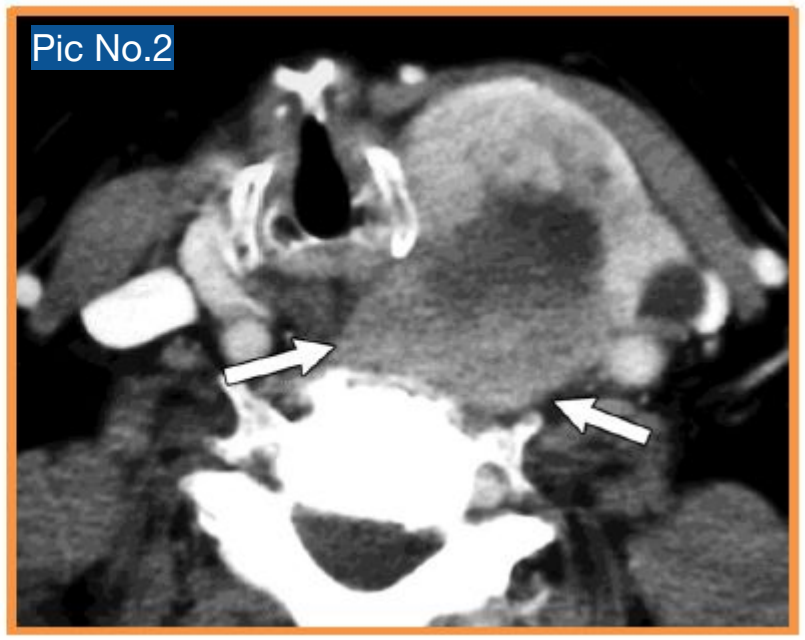
- **What is the most likely diagnosis?**

Thyroid carcinoma (until proven otherwise), do FNA to confirm.

Case 11

Anaplastic thyroid carcinoma in an 84 year old woman





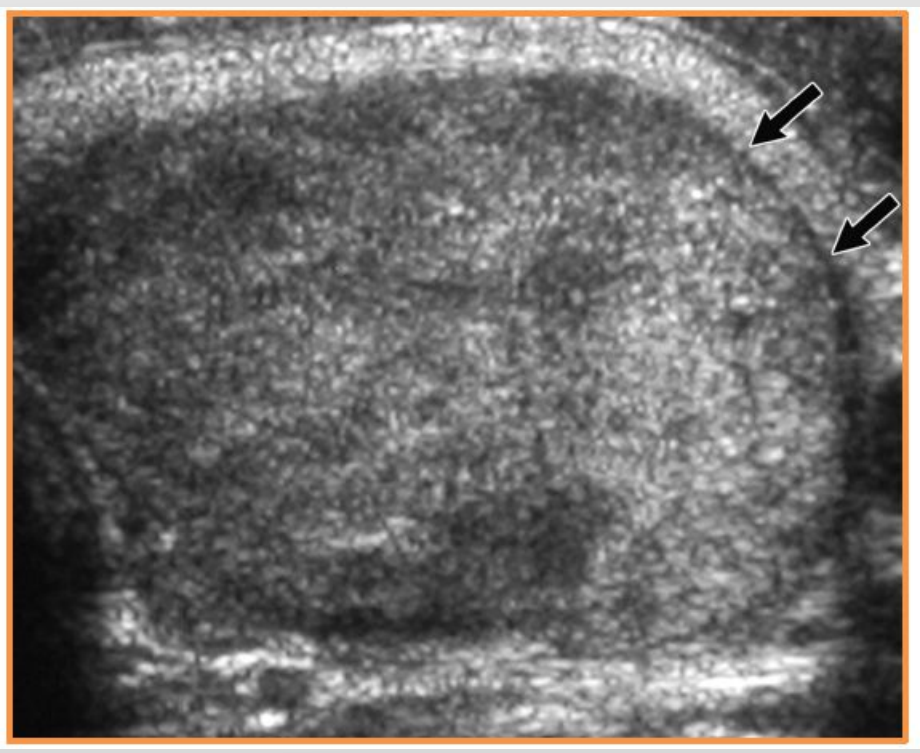
● What is the study?
Ultrasound (pic No.1) & Contrast-enhanced CT (pic No.2)

● What are the imaging findings?
1. Transverse sonogram of the left lobe of the thyroid shows an advanced tumor with infiltrative posterior margins (arrows) and invasion of prevertebral muscle.
2. Axial contrast-enhanced CT image shows a large tumor that has invaded the prevertebral muscle (arrows).

● What is the most likely diagnosis?
You need FNA to confirm but most likely it's Anaplastic thyroid carcinoma (anaplastic is very aggressive it usually invades the surrounding tissue).
● In the CT, the capsule invaded. We think it is anaplastic carcinoma which has bad prognosis. Invasion indicates malignancy. In the US, the mass has irregular margins.

Case 12

A 30 year old woman presented with a neck mass.



● What is the study?
Sonogram (Ultrasound).

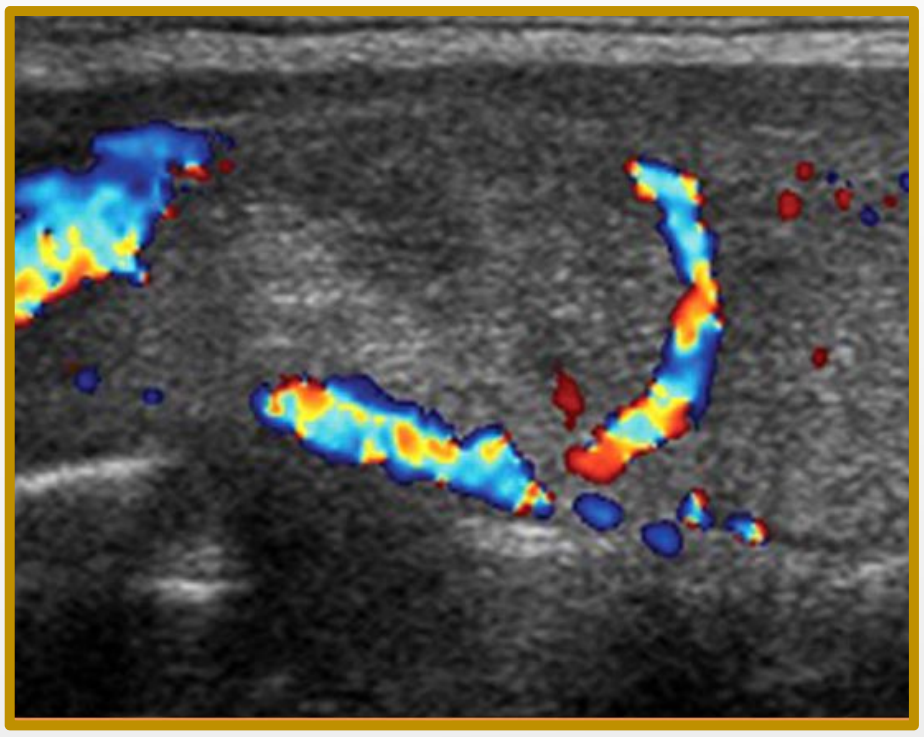
● What are the imaging findings?
Transverse sonogram of the left lobe of the thyroid shows a **follicular adenoma** with a hypoechoic halo (arrows).

● What is the most likely diagnosis?
Follicular adenoma, FNA to confirm.

● Halo shows smooth regular margins, indicating a benign condition.

Case 13

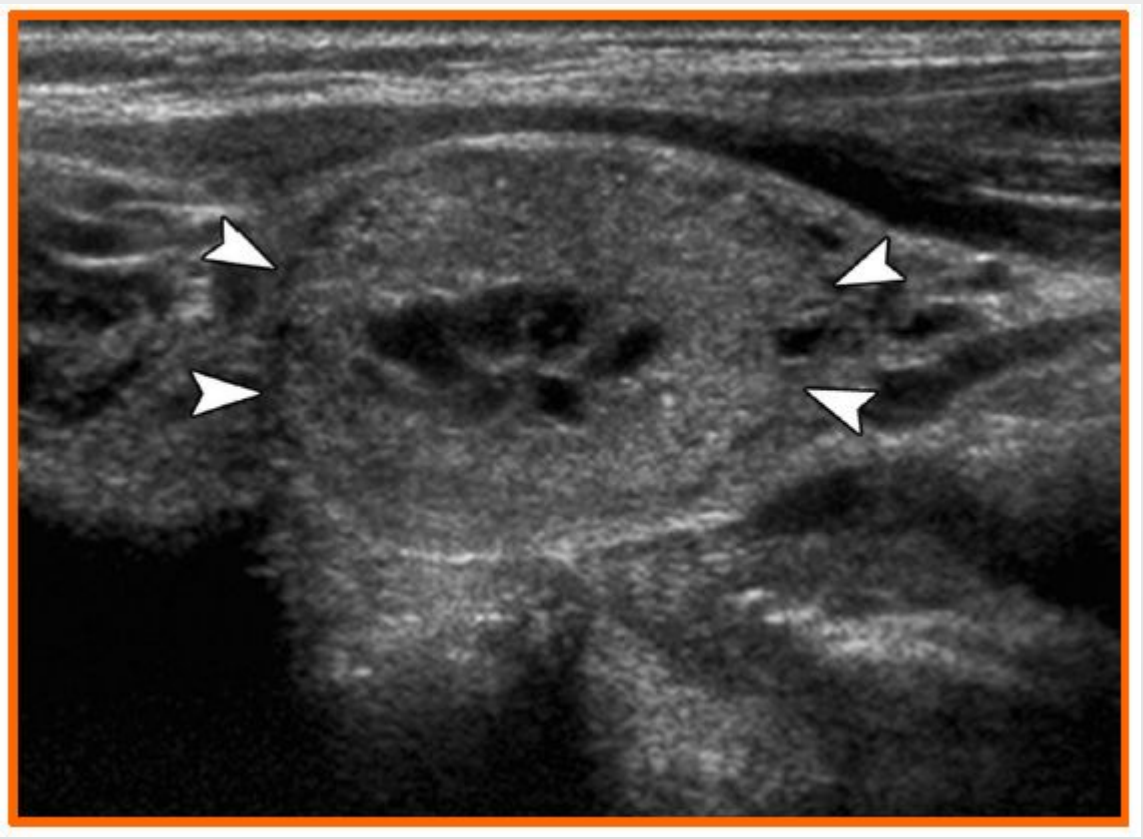
36 year old woman presented with a neck mass.



•What is the study?
Doppler ultrasound.

• What are the imaging findings?
Longitudinal color Doppler sonogram of the right lobe of the thyroid shows perinodular blood flow around a follicular adenoma (benign nodules are less vascular than malignant nodules).
why benign? no calcifications, low vascularity, Regular borders.

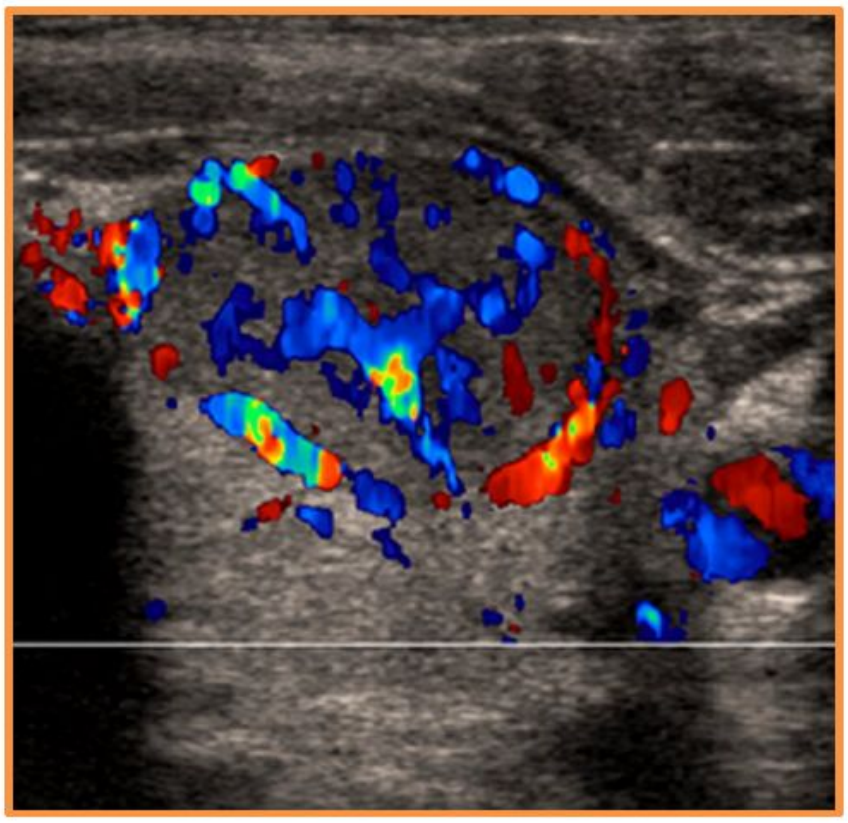
• What is the most likely diagnosis?
Follicular adenoma, do FNA to confirm.



US images of thyroid nodules of varying parenchymal composition (Solid to cystic = Mixed). Halo indicates no invasion. no microcalcifications. Proved to be benign by cytologic exam “No psammoma bodies”. benign cystic degeneration.

Case 14

36 year old woman presented with a neck mass.



- **What is the study?**
Doppler ultrasound.

- **What are the imaging findings?**
Colour Doppler mode shows marked internal vascularity (highly vascular), indicating increased likelihood that the nodule is malignant.

- **What is the most likely diagnosis?**
papillary carcinoma (predominantly solid thyroid nodule)

teaching point

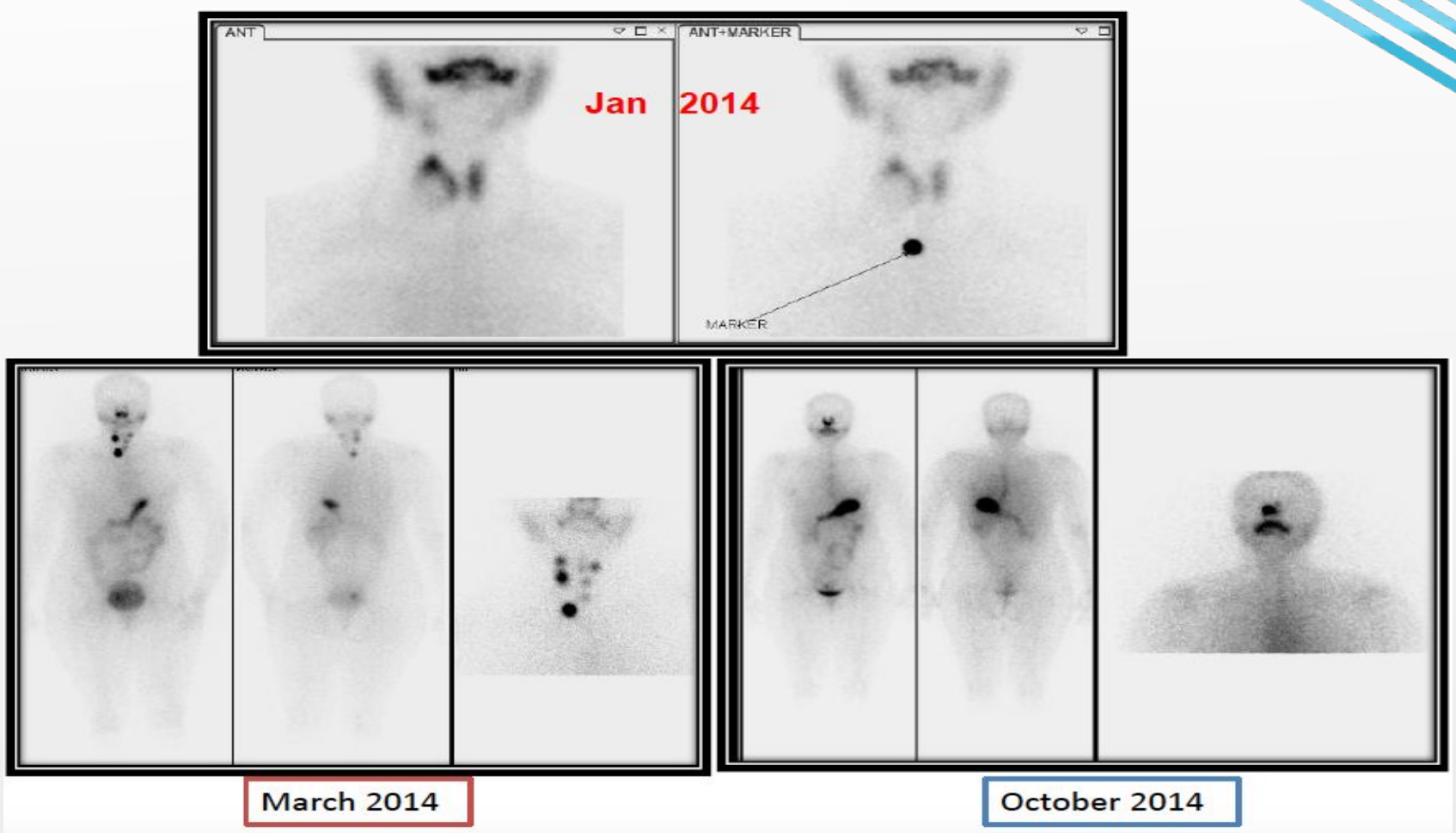
In patients with thyroid nodules ultrasound and color doppler is used to:
1. Determine number of nodules.
2. Differentiate solid from cystic nodules.
3. Characterize thyroid nodule : Benign versus malignant.
4. Assess for regional associate lymph node involvement.

How to differentiate between benign and malignant nodules ?

		benign	malignant
1	calcifications	✗	✓
2	halo shows Regular margins	✓	✗
3	vascularity	↓	↑

Case 15

32 years old female patient presented with neck swelling.



● **What is the study?**
Nuclear thyroid scan.

● **What is the most likely diagnosis?**
Papillary carcinoma
It can be follicular or anaplastic as well.

● **What is the agent used?**
Technetium

● **What are the imaging findings?**
In jan 2014 we have cold nodule with low uptake in the right lower lobe of thyroid (Next step? **FNA**)
We did thyroidectomy. we didn't operate on lymph node. On March 2014 We see multiple hot nodules that spread locally in the neck to lymph nodes we suspect this patient to have papillary carcinoma (Due to mode of transmission) we give her radiation therapy with iodine-131 100 mg.
Oct 2014 for 3 months we do scan to exclude any remnant. The patient responds to treatment.

● **Prognosis?**
It is good because papillary has only lymph node metastasis, so usually it spreads locally.
(Follicular has hematogenous metastasis -bad prognosis-)

● **What is the marker for well-differentiated thyroid tumors?**
Thyroglobulin.

● **What is the marker for Medullary carcinoma?**
Calcitonin.

- Treatment?

iodine 131

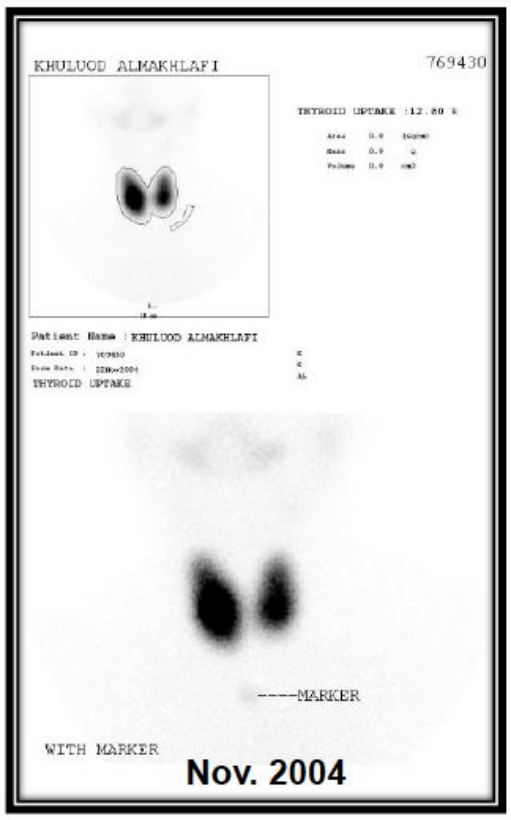
Types of thyroid malignancies :
well differentiated

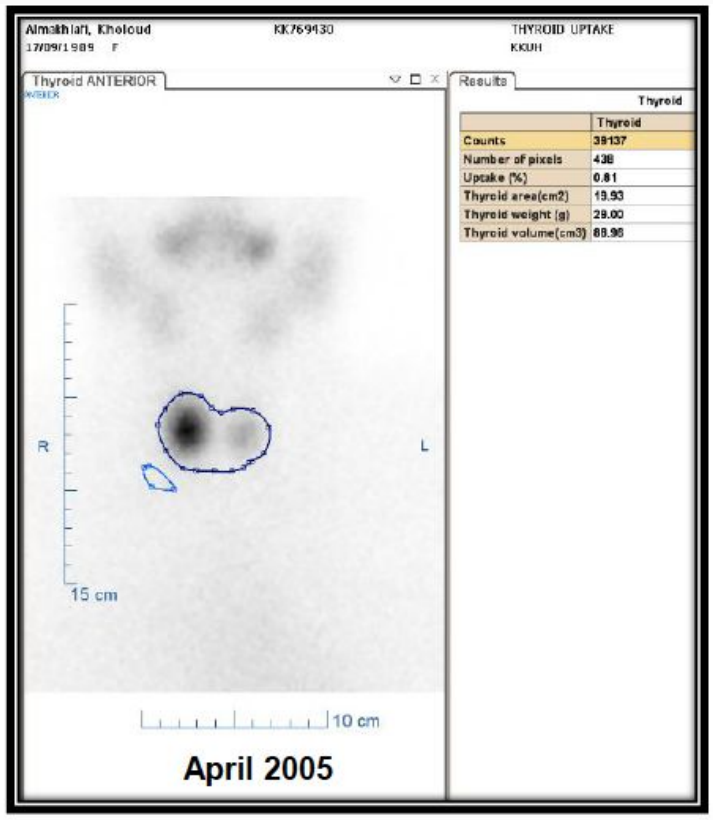
- Follicular cells derived
1. Follicular carcinoma
2. Papillary carcinoma (has the best prognosis)
3. Hurtle cell carcinoma
- Parafollicular cells derived
1. medullary carcinoma

undifferentiated
Anaplastic carcinoma

Case 16

26 years old female patient presented with thyrotoxicosis symptoms.





- **What is the study?**
  Nuclear scan of the thyroid.

- **What is the agent used?**
  Tc-99m Pertechnetate.

- **What are the imaging findings?**
  Diffuse enlargement with Increased uptake 12.6%. In (November 2004 right picture) patient received treatment and had a good response. In (April 2005 left picture) another image taken found to have a decrease in uptake with 0.81%.

- **What is the most likely diagnosis?**
  Graves (November). treated with iodine-131, 5-15 mg.

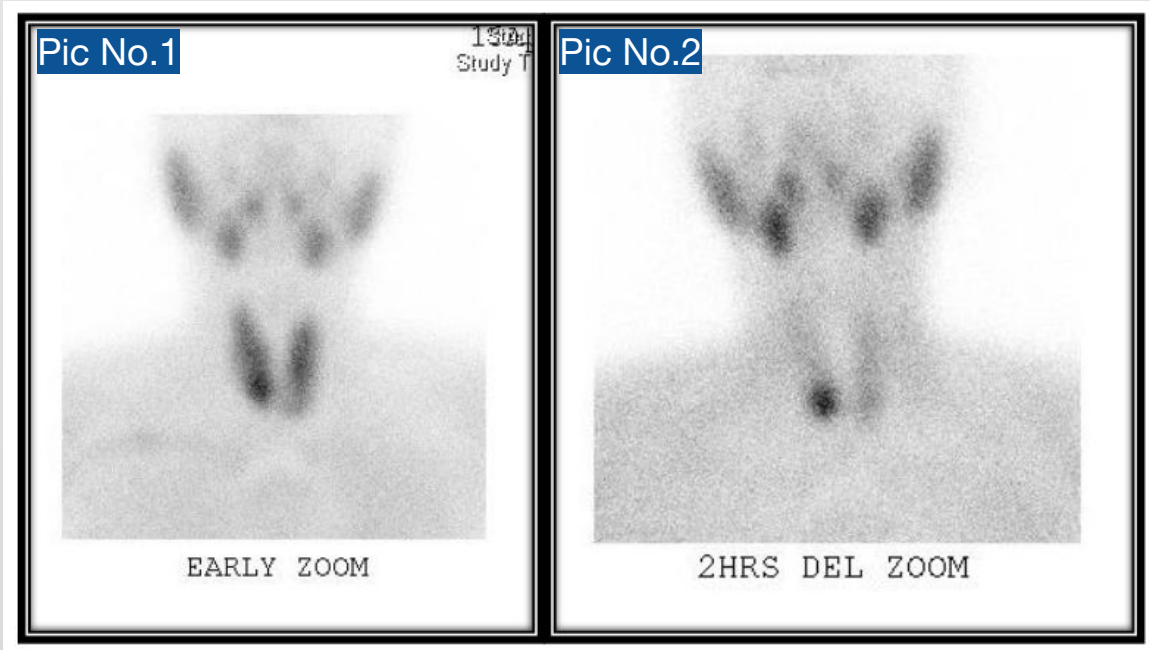
- **what is the main side effect of iodine 131?**
  Hypothyroidism (April).

teaching point

Iodine 131 is used to treat thyroid disorders including thyroid cancer and hyperthyroidism

Case 17

A patient with High PTH and High Ca. (hyperparathyroidism)



Early uptake of thyroid and right lower parathyroid (pic No.1) in the delayed phase washout of the thyroid with retained activity of the right lower parathyroid (pic No.2)

- **What is the study?**
  Parathyroid scan.

- **What is the agent used?**
  Tc-99m Sestamibi (Dual Phase).

- **What are the imaging findings?**
  Right lower parathyroid nodule.

- **What is the most likely diagnosis?**
  Right lower parathyroid adenoma.

- The diagnosis of hyperparathyroidism is biochemical (high PTH) then you do parathyroid scan to localize the source

Case 18

A patient with High PTH and High Ca.

- **What is the study?**
Parathyroid scan. ask for MRI if you can not tell.

- **What is the agent used?**
Tc-99m Sestamibi (Dual Phase), which usually concentrates in cells with mitochondria.

- **What are the imaging findings?**
False negative because it is from the clear cells which has no mitochondria.

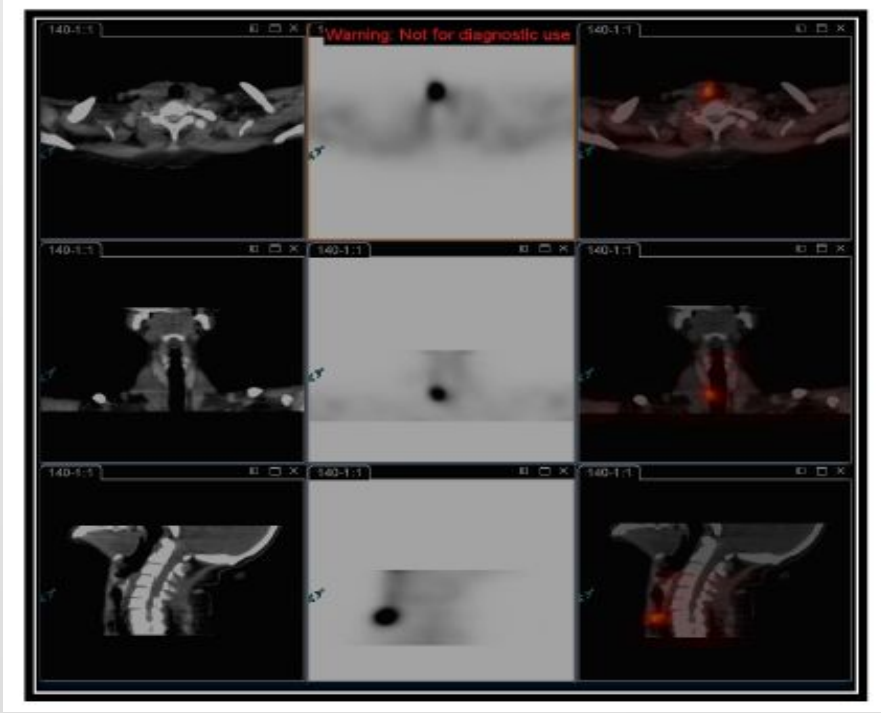
- **What is the most likely diagnosis?**
Parathyroid adenoma.

- **Remember:**
Sestamibi is taken up by mitochondria in parathyroid.
Parathyroid has two types of cells: Chief cells with no mitochondria and Oxyphil cells (Rich in mitochondria)
Low mitochondria = Low uptake

- **Next step?**
18F-choline PET/CT
(If the scan is negative you do it)

Case 19

A patient with High PTH and High Ca.



- **What is the study?**
Parathyroid scan & SPECT CT.

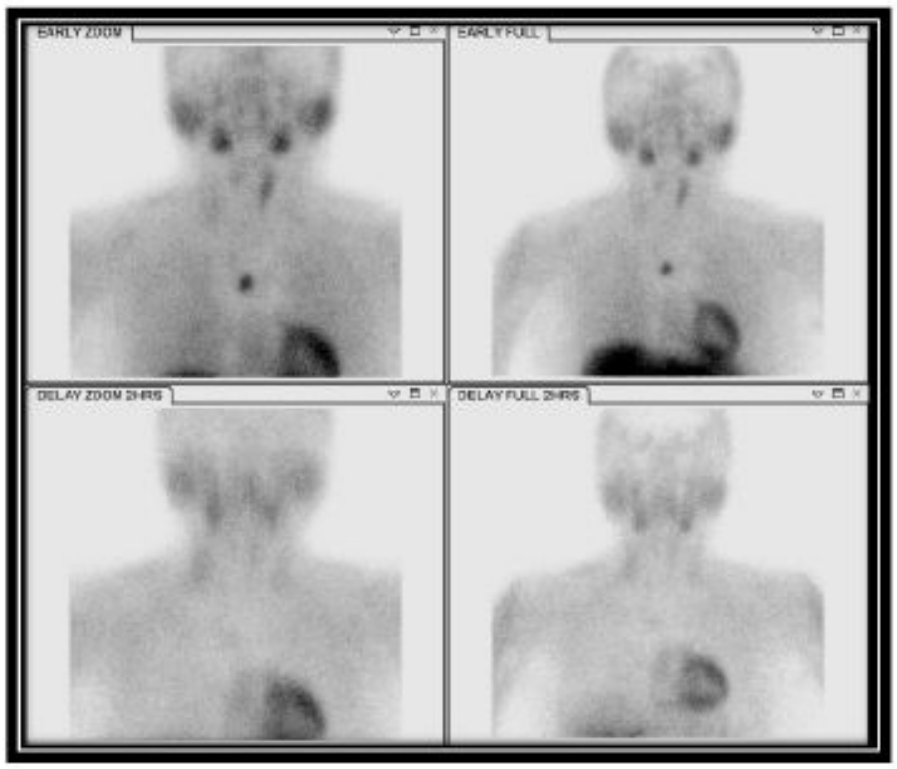
- **What is the agent used?**
Tc-99m Sestamibi (Dual Phase).

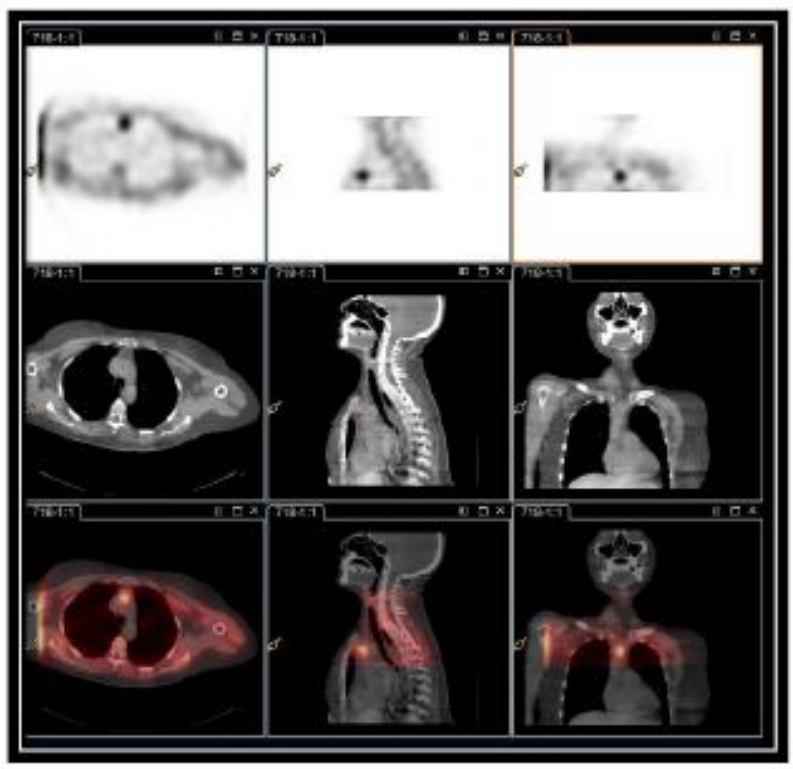
- **What are the imaging findings?**
Adenoma anterolateral to the trachea approved by SPECT CT. (Adenoma close to the the skin. Superficial on sagittal view).

- **What is the most likely diagnosis?**
Ectopic Parathyroid adenoma.
To help the surgeon we order SPECT CT to localize tumor.

Case 20

30 year old male patient with suspected hyperparathyroidism.





- **What is the study?**

Parathyroid scan and SPECT CT.

- **What is the agent used?**

Tc-99m Sestamibi (Dual Phase), (SPECT CT).

- **What are the imaging findings?**

Ectopic retrosternal nodule (PT adenoma).

- **What is the plan of treatment?**

Both Thoracic (because it's retrosternal) and endocrine surgeons need to be involved in this surgery.

teaching point

In patients with hyperparathyroidism, parathyroid scan is used to detect and localize eutopic and ectopic parathyroid adenoma.

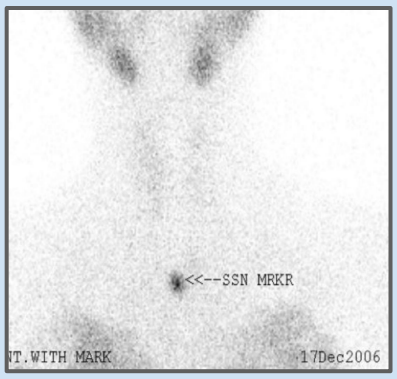
Quiz

1-what is the main side effect of iodine 131?

a. Hyperthyroidism
b. Itching skin
c. Hypothyroidism
d. Nausea and vomiting

2- Female patient with signs and symptoms of thyrotoxicosis. Thyroid scan shown below what is the diagnosis ?

a. Grave's disease
b. Thyroid factitious
c. Plummer's disease
d. Iodine deficiency



3- which one of the following is the most commonly used radiopharmaceuticals for thyroid scan:

a. Tc-99m pertechnetate
b. Iodine 131
c. Tc-99m MDP
d. Gallium 67 citrate

4- which of the following radiopharmaceuticals is the gold standard for the tumor imaging ?

a. Iodine-111 octreotide
b. Thallium chloride 201
c. Gallium 67 citrate
d. Fluorine 18 FDG

5- which of the following pharmaceuticals is used as a therapeutic agent ?

A) F-18 FDG
B) I-131
C) Ga-68
D) I-123

Answers
1)C
2)B
3)A
4)D
5)B

Team leaders

- Reem Alamri
- Alwateen Alaradi
- Bandar Alharbi

Team members

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- Farah Albakr
- Sara Alrashidi
- Nouf Albrikan
- Renad Alosaimi
- Duaa Alhumoudi
- Norah Almasaad
- Arwa Alkahtani
- Hind Almotywea
- Ibrahim Alabdulkarim
- Mohamed Albabtain
- Abdulaziz Alamri
- Abdulrahman Alswat
- Munib Alkhateb
- Mohammed Alkathiri
- Omar Alhalabi
- Homoud Algadheb
- Salem Alshihri
- Nasser Almutawa

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