
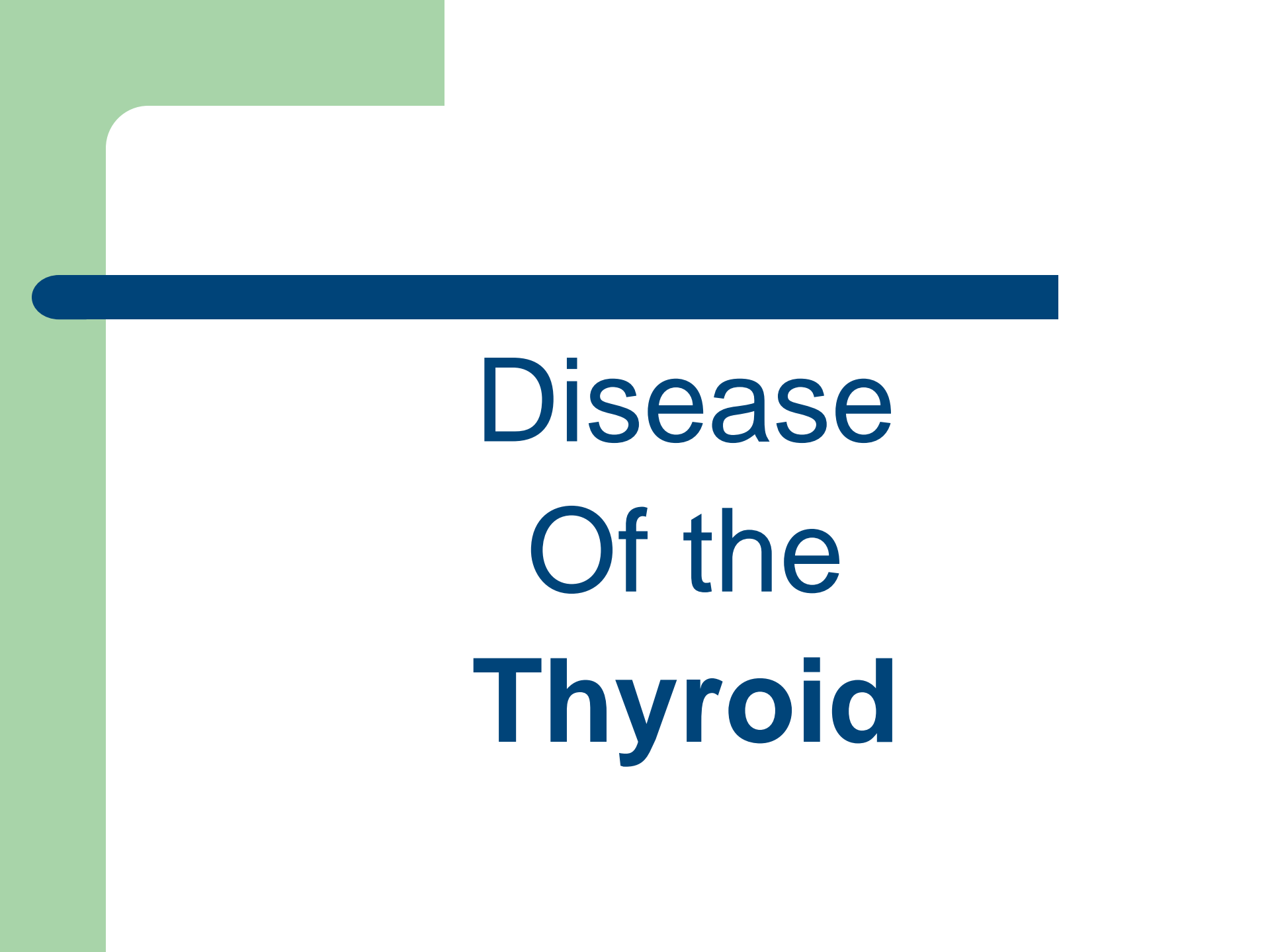


John Sutton, DO, FACOI, FACE, CCD

Carson  Tahoe  
Endocrinology  
Carson City, NV  
KCOM Class of 1989

**No Disclosures**





# Disease Of the **Thyroid**

# Iodide Metabolism/Synthesis of Thyroid Hormone

- ↳ Trap
- ↳ Oxidation
- ↳ Organification(catalyzed by TPO)
- ↳ Coupling
- ↳ Proteolysis
- ↳ Secretion
- ↳ Diodination/recycling

# Thyroid Antibodies

- ⌘ TPO antibodies are antibodies to thyroid peroxidase/AKA antimicrosomal Antibodies
- ⌘ Tg antibodies are antibodies to Thyroglobulin

# Production of Thyroid Hormone

& T4---thyroid

& T3---20 % thyroid

80% tissue

Conversion

& Reverse T3

---97% tissue T4

Conversion

**\*\* Sick Euthyroid**

# Protein Binding

- ↳ T4 0.025 % free
- ↳ T3 0.2 % free
- ↳ Free hormone is active metabolically & Unbound. T3 is metabolically active  
T4 converted to T3 in the tissues

# Thyroid Function Testing

- ⌘ T4 is TT4 (total T4)=TBG
- ⌘ T3 is TT3 (total T3)=TBG
- ⌘ T3RU is T3 resin uptake= $1/\text{TBG}$
- ⌘ TBG is thyroid binding globulin
- ⌘ TSH is thyroid stimulating hormone
- ⌘ TRH is thyroid releasing hormone



**FINAL RESULT**

**Carson Medical Group**  
1200 Mountain Street STE 230  
Carson City, NV 897033821

**PHYSICIAN INFORMATION**

Requesting:  
Ordering:

**PATIENT INFORMATION**

Name:  
DOB:  
Sex:  
Tel:

**REPORT DETAILS**

Name: **Thyroid Panel With TSH**  
Accession ID:  
Lab Ref Id:

**REPORT DATES**

Order: 07/29/2013  
Collection: 07/30/2013 16:16:00  
Report: 07/31/2013 11:06:03

NAME	VALUE	REF RANGE
F TSH	3.860	0.450-4.500 uIU/mL
F Thyroxine (T4)	17.3	H 4.5-12.0 ug/dL
- **Verified by: repeat analysis**		
F T3 Uptake	19	L 24-39 %
- **Verified by: repeat analysis**		
F Free Thyroxine Index	3.3	1.2-4.9

**ADDITIONAL NOTES**

LabCorp Phoenix, 3930 E Watkins Suite 300, Phoenix, AZ

# 50 Year Old Male

- ⌘ Fatigue, weakness, Depression
- ⌘ Constipation, weight gain
- ⌘ Slow reflex relaxation(pseudomyotonia), peri-orbital edema, cool skin, hypertension
- ⌘ Coarse skin and hair





# Diagnosis

## Primary Hypothyroidism





# Laboratory

- ⌘ Low free T4
- ⌘ High TSH
- ⌘ High cholesterol
- ⌘ High CPK
- ⌘ Positive anti-TPO
- ⌘ Positive Tgab

## 38 Year Old Female

- ⌘ History of head trauma with hypotension
- ⌘ Loss of consciousness in MVA
- ⌘ Fatigue, weakness
- ⌘ Pseudomyotonia on physical examination

# Laboratory

- ✎ Low T3
- ✎ Low Free T4
- ✎ Low TSH
- ✎ TSH alone will not be enough
- ✎ TSH may be inappropriately normal in relationship to the T3 or T4 value



# Diagnosis

Secondary  
Hypothyroidism



# Hypothyroidism Treatment

- ⌘ Levothyroxine (Synthroid, Tirosint, Levoxyl—  
Brand name ONLY)---may have to fight for it,  
but inexpensive
- ⌘ Oral absorption 80 %
- ⌘ Primary and secondary treated with same  
meds, but cannot use TSH alone as a follow-  
up tool in patients with secondary  
hypothyroidism

# Treatment Titration

- ⌘ 6 week pituitary recovery, sometimes longer
- ⌘ Rapid titration for very low thyroid function or pregnancy
- ⌘ Avoid rapid titration with CAD, elderly, children
- ⌘ No thyroxine the day of Lab TFTs

# Myxedema Coma

- ↳ Hypothermia
- ↳ Hypoventilation
- ↳ Hyponatremia
- ↳ Hypotension
- ↳ Seizures
- ↳ Hypoglycemia
- ↳ Consider associated adrenal insufficiency
- ↳ This is extreme hypothyroidism---Rec: Label extreme values as myxedema to reveal the gravity of the case at a later date

# Treatment

- ⌘ Evaluate lab for adrenal insufficiency
- ⌘ IV Thyroxine .3-.4 mg then .1 mg daily
- ⌘ Fluids
- ⌘ IV Hydrocortisone 50 to 100 mg q6-8 hrs
- ⌘ Respiratory support with intubation as necessary
- ⌘ Caution in critically ill aging patients or patients with major cardiac issues—rapid full replacement in a CAD pt might precipitate a cardiac crisis even at the correct dose

# Primary Hypothyroidism Etiology

- ↳ Hashimoto Thyroiditis
- ↳ Thyroidectomy
- ↳ I-131/external rads
- ↳ Congenital
- ↳ Iodide use
- ↳ Wolff Chaikoff
- ↳ Iodide deficiency
- ↳ uncommon in US
- ↳ Treatment with Lithium, Amiodarone
- ↳ Treatment with Methimazole or PTU---PTU is now out of the standard, only to be used in 1st Trimester Pregnancy
- ↳ Infiltrative, injury

## Secondary Hypothyroidism Etiology

- ↳ Hypothalamic=radiation, trauma, infiltrative, neoplastic
- ↳ Pituitary=necrosis/infarction, neoplastic lesion or cyst, aneurysm, infiltrative, trauma, hemochromatosis, autoimmune
- ↳ Resistance to thyroid hormone generalized

# Primary vs Secondary Hypothyroidism

- ⌘ What is the end organ hormone? FT4 and T3
- ⌘ What responds from the pituitary? TSH
- ⌘ Is the response appropriate?
- ⌘ Example: Low FT4, normal TSH is an inappropriate pituitary response—problem potentially in the pituitary
- ⌘ Example: Low FT4, High TSH is the appropriate response---problem is in the thyroid



## 33 Year Old Male

- ⌘ Nervous, insomnia, diaphoresis, palpitations, weight loss, tremor, loose + frequent stool, heat intolerance, emotional
- ⌘ Tachycardia, thyroid bruit, goiter, warm damp skin, vitiligo, proptosis





# Diagnosis

**Hyperthyroidism**



















# Laboratory

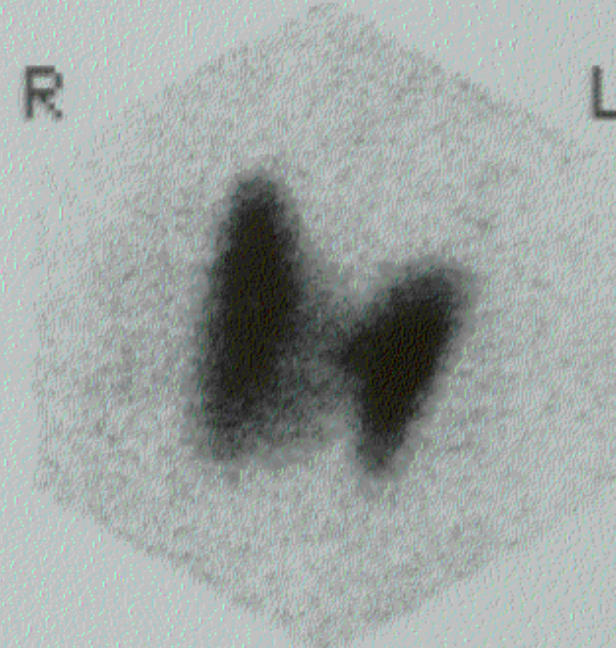
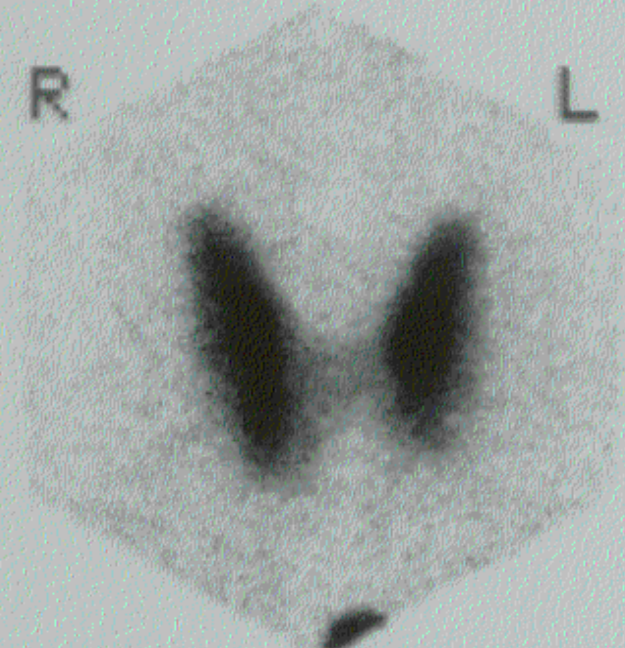
- ⌘ High free T4
- ⌘ Low or absent TSH
- ⌘ High T3
- ⌘ High FTI
- ⌘ High Thyroglobulin
- ⌘ High antibodies:  
TSI, TPO, TG

# Thyroid Imaging

- ⌘ Thyroid uptake and scan with  $^{123}\text{I}$ -Iodine
- ⌘ Uptake with low dose  $^{131}\text{I}$ -Iodine with uptake probe + Scan/image with technetium
- ⌘ Diffuse uptake of tracer on image in more significantly hyperthyroid patients



M  
Z 1.0  
100K  
2K  
86S



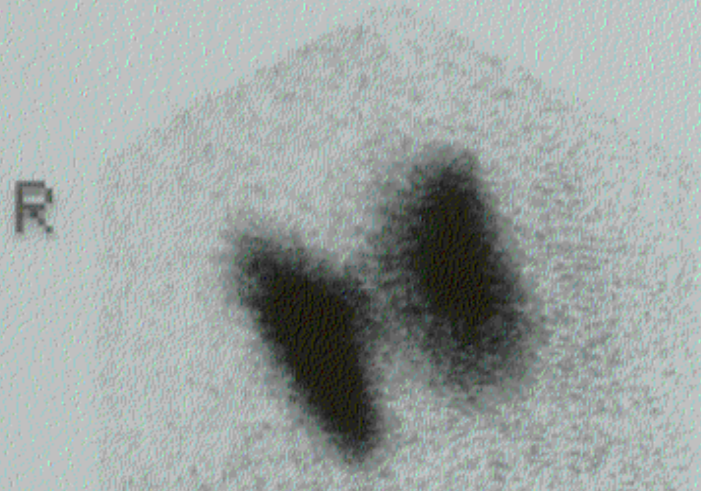
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100K  
1K  
82S

ANT D=1"

SSN

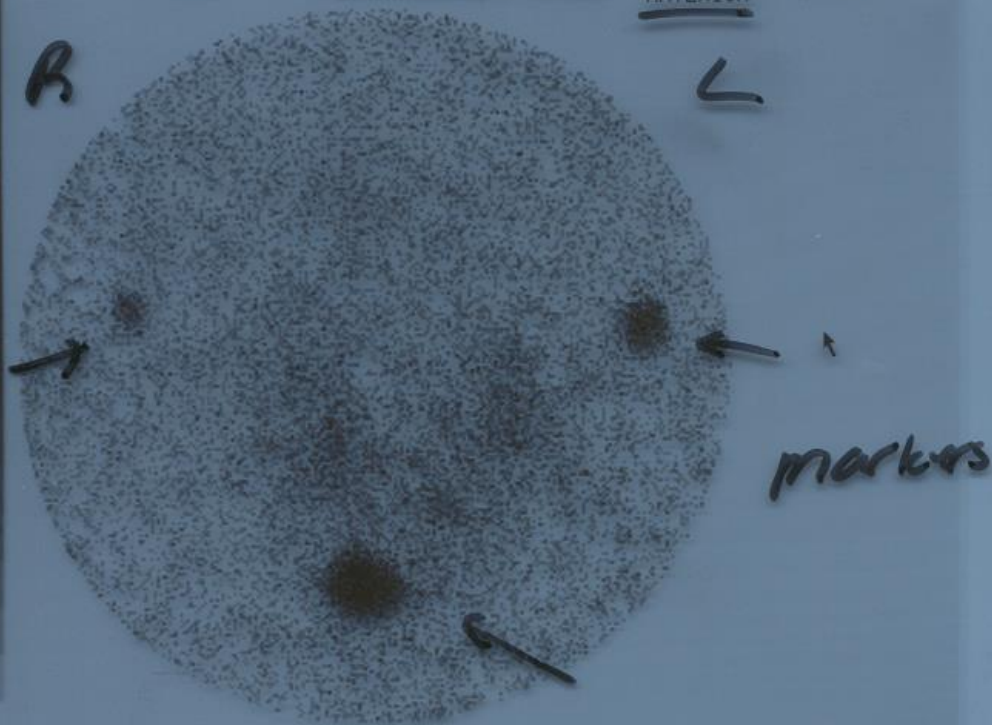
RAO

M  
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1K  
80S



L





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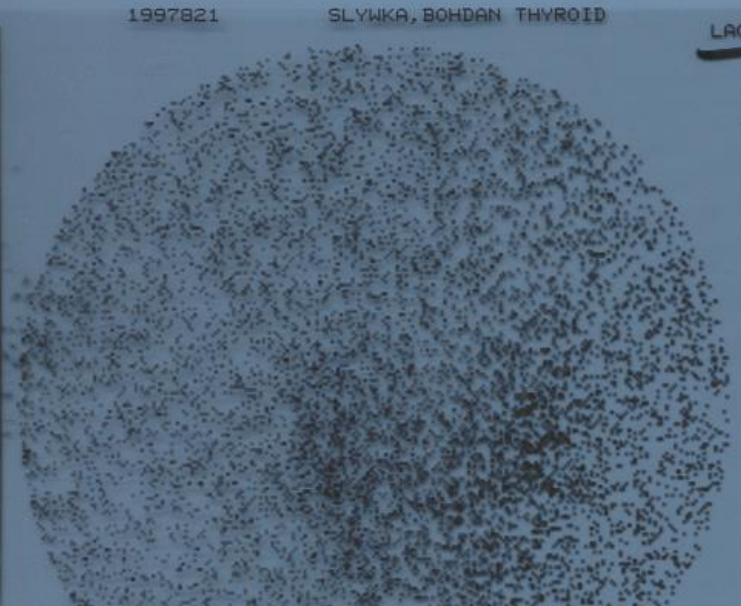


THYROID SCAN 11 May 2000 at 11:55

1997821

SLYWKA, BOHDAN THYROID

ST. JOSEPH  
LAO

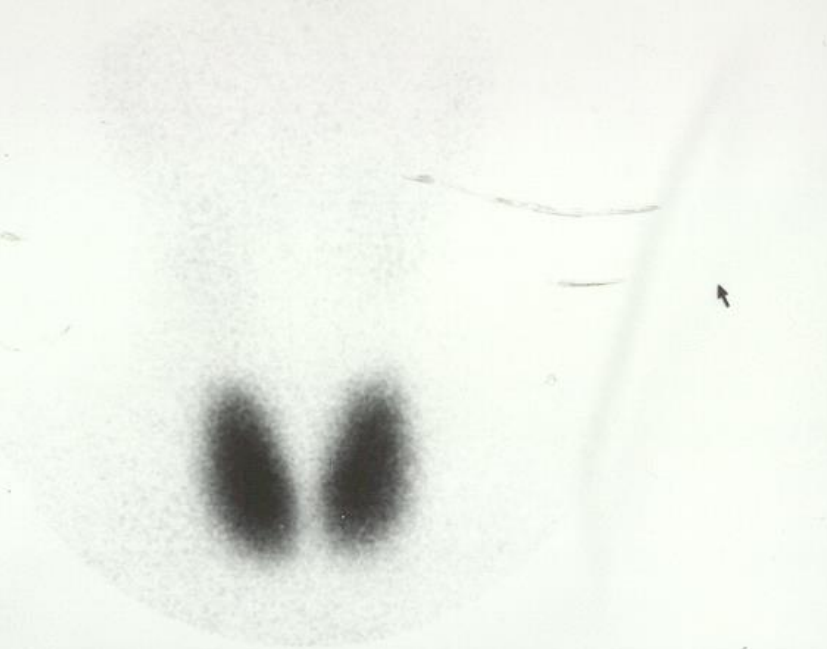


2hr. uptake = 2.0  
24hr uptake = 3.0

123

BEAUMONT TROY

RT ANTERIOR 5 - 6 MIN LT



Scr 1

TECH THYROID 22 Nov 2000 at 16:11

25

BEAUMONT TROY

RT ANT PINHOLE LT

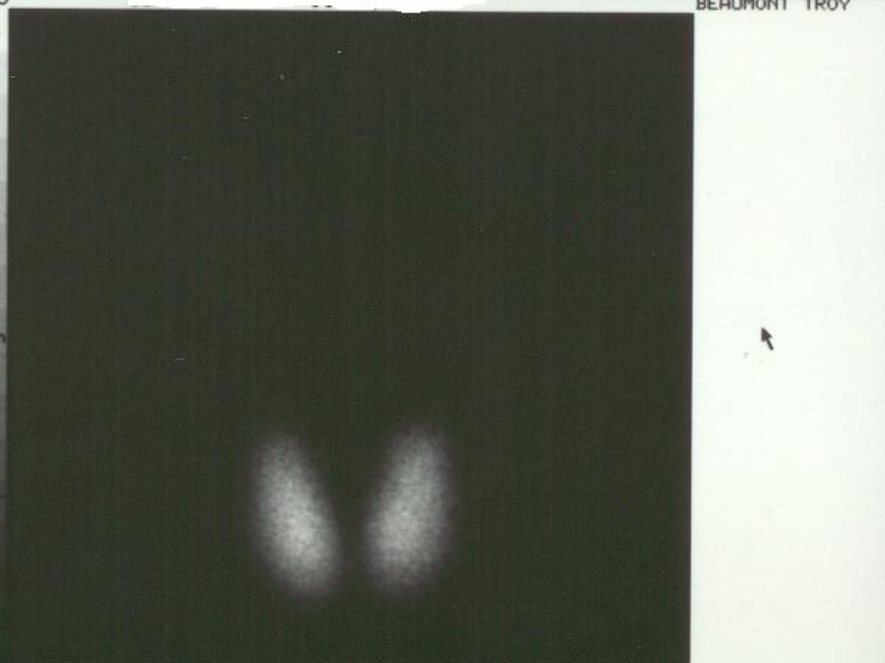


Scr 1

TECH THYROID 22 Nov 2000 at 16:11

125

BEAUMONT TROY

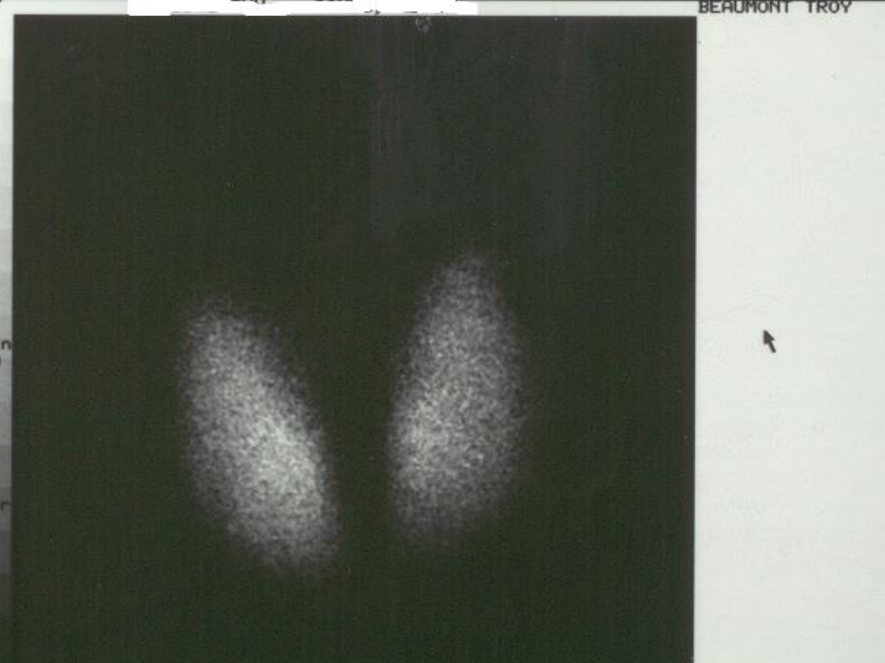


Win A

Scr 1

27

BEAUMONT TROY



Win A

Scr 1

Scanning



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L A 0 45 150.00 K COUNT 39.942 SEC.

Scr  
1



THYROID 29 Nov 1999 at 9:25  
39409786 SAWICKE KIMBERLY 6TCTHY HENRY  
R A 0 45 150.00 K COUNT 35.032 SEC.



Scr  
1



# Treatment

↳ Antithyroid meds---  
Methimazole & PTU

↳ Beta Blockers

↳ 131-Iodine

↳ Surgery

↳ Propylthiouracil (PTU)  
has now been  
considered as a safety  
risk to the liver; should  
only be used in  
pregnancy, 1st  
trimester



# Treatment

- ↳ **Anti-thyroid meds:** CBC, LFT's, Fever/sore throat; less effective with large gland; preferred in children & pregnancy (PTU).
- ↳ **131-Iodine:** highly effective; aim is hypothyroidism. High dose with large or nodular thyroid, after proof of benign nodules
- ↳ **Surgery:** general surgery and anesthetic risk, need pre-treatment with anti-thyroids, Beta blocker treatment; May be preferred in nodular thyroid disease

# Hyperthyroid Etiology

- ↳ Graves disease
- ↳ Toxic MNG
- ↳ Toxic Nodule
- ↳ Iodine induced  
(Jod Basedow)
- ↳ HCG
- ↳ Thyroiditis
- ↳ Thyrotoxicosis Factitia
- ↳ Rare: thyroid cancer  
Struma Ovarii, HCG or  
TSH tumor

# Radioactive Iodine Uptakes

↳ High: Graves, TSH, HCG, Hashimoto

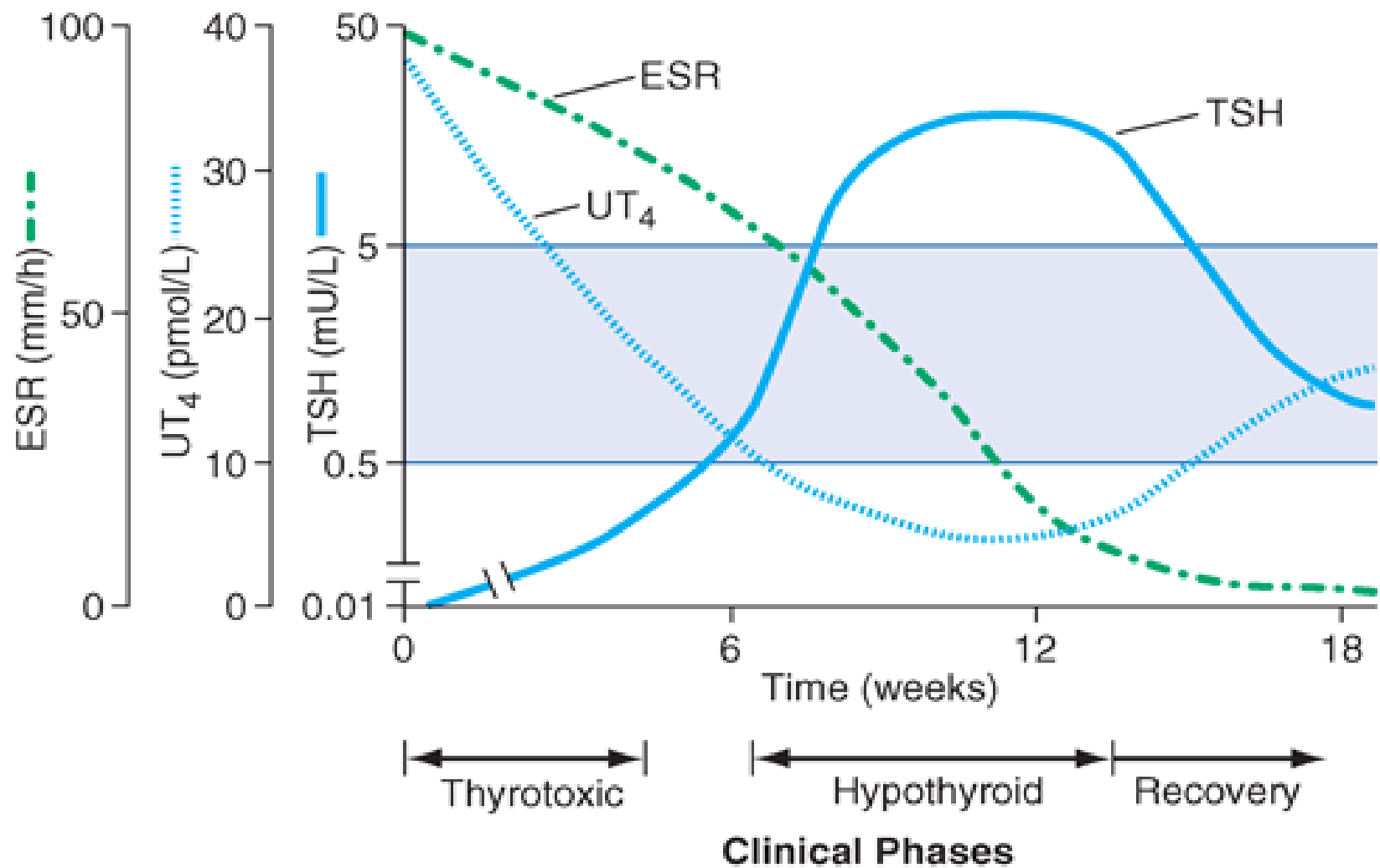
↳ High to normal: Toxic MNG, Toxic Nodule

↳ Low: Factitious, Mets, Struma Ovarii, Iodine induced, Thyroiditis (silent & subacute)

\*\*note thyroglobulin level in thyroiditis would be up, but Tg would be down in Factitious thyroid hormone administration

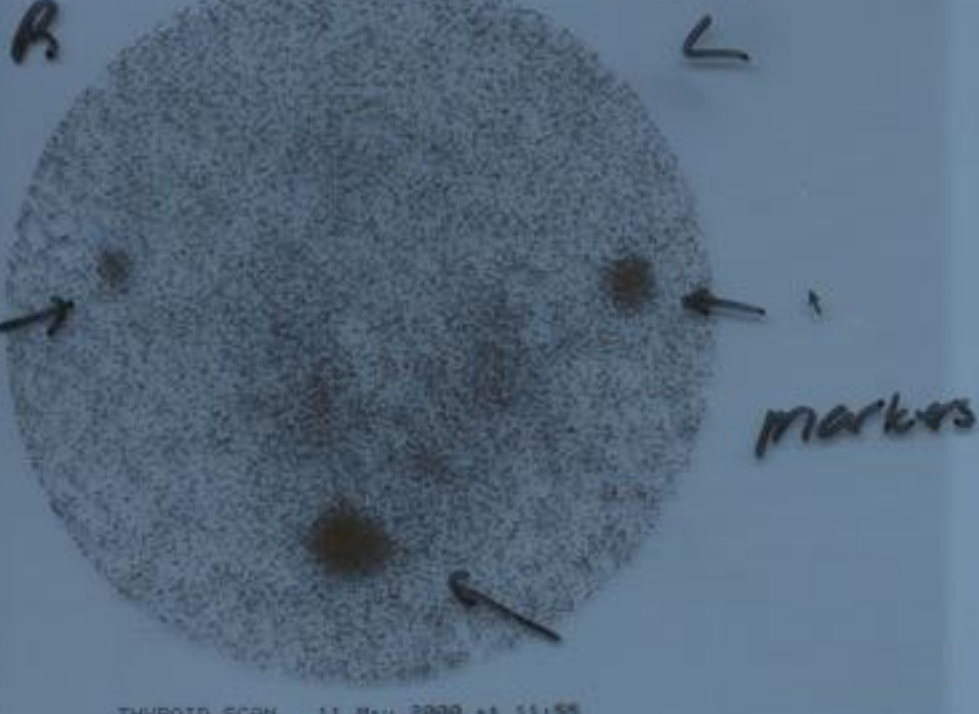
# Terminology Thyroiditis

- ⌘ This terminology is referring to “silent” thyroiditis & “subacute (DeQuervain)” thyroiditis
- ⌘ Hashimoto Thyroiditis is referred to as “Hashimoto” without the designation of the term thyroiditis



Source: Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine, 18th Edition*: [www.accessmedicine.com](http://www.accessmedicine.com)

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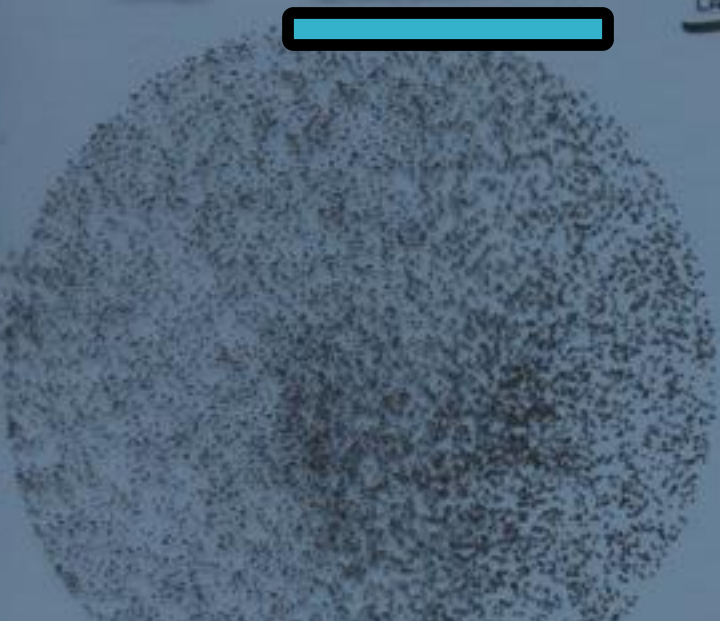
THYROID SCAN 11 May 2000 at 11:55



0 THYROID SCAN 11 May 2000 at 11:55

1997821 SLYNKA, BONDRAN THYROID ST. JOSEPH

LAO



2hr. uptake = 2.65  
24hr uptake = 3.67

Pin Hole Imaging

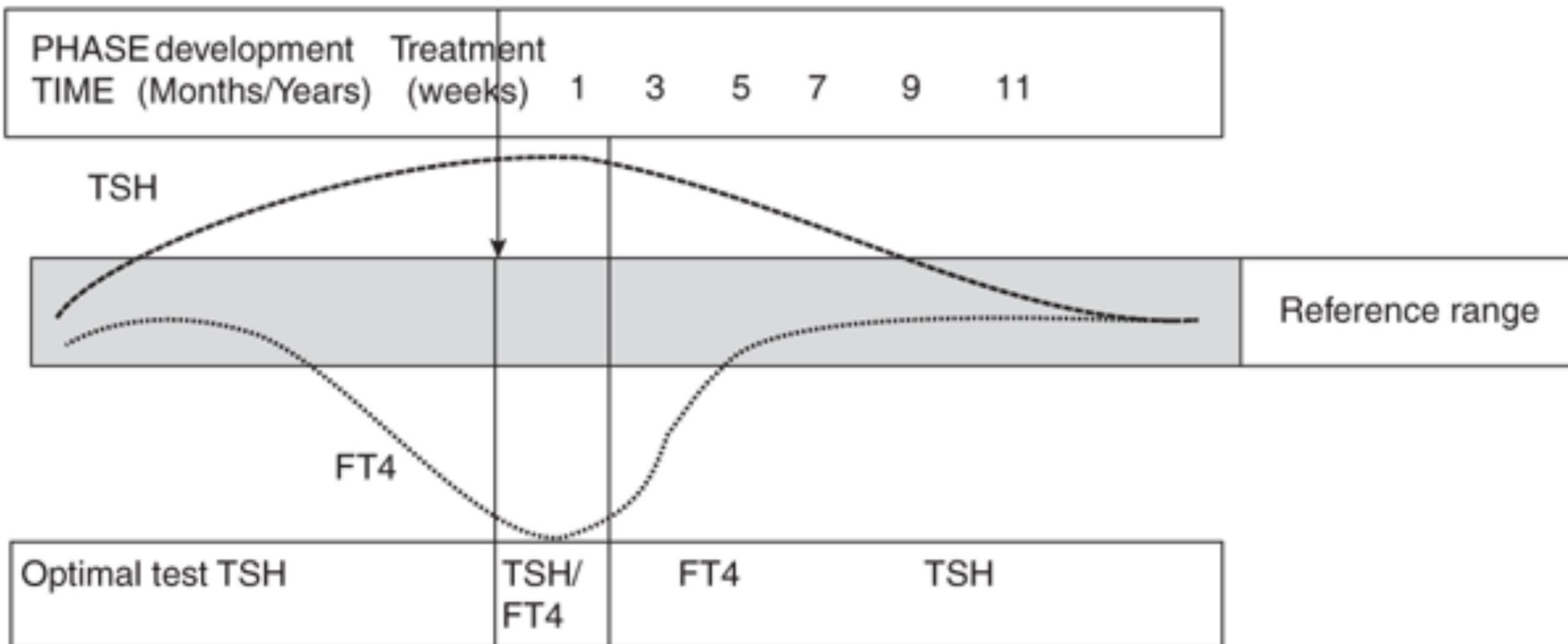


5cm SS Marker  
Rt Anterior Lt



Rt Anterior Lt

## Test changes in primary hypothyroidism during disease and treatment



Source: Howard M. Reisner: Pathology: A Modern Case Study

[www.accessmedicine.com](http://www.accessmedicine.com)

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# Thyroid Scan helps determine next step

❏ Is the thyroid overproducing?

This pt is consistently adding fuel to the fire

Nuclear uptake will remain high as in Graves

❏ Is the thyroid inflamed (Thyroiditis) and spilling out all of its thyroid hormone?

This patient's thyroid will over time deplete itself of thyroid hormone: 1st high, then normal, low

# Goiter Non-toxic

- ⌘ Nuclear Imaging: Not necessary
- ⌘ If Nodule or nodules, may want thyroid scan to determine area of decreased uptake
- ⌘ Prefer to image with 123-Iodine
- ⌘ Nuclear scan may identify non-palpable abnormal areas of high or low uptake
- ⌘ Consider ultrasound to check for nodules

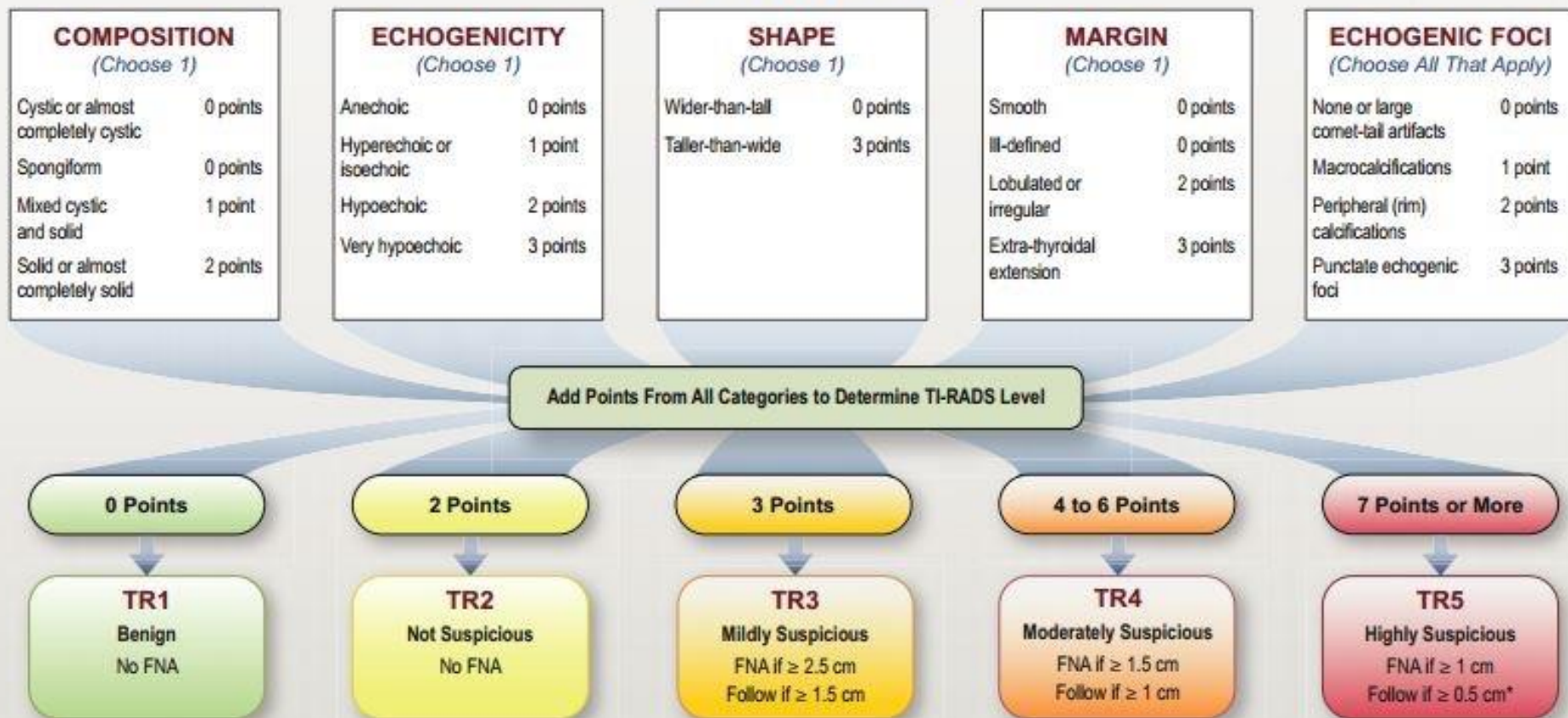
# Hypothyroidism

- ⌘ Imaging not necessary if no abnormality on physical examination
- ⌘ Imaging may be necessary if there is a family history of certain aggressive thyroid cancer or a personal history of radiation treatment or exposure other than x-rays

# Biopsy-Which Nodule?

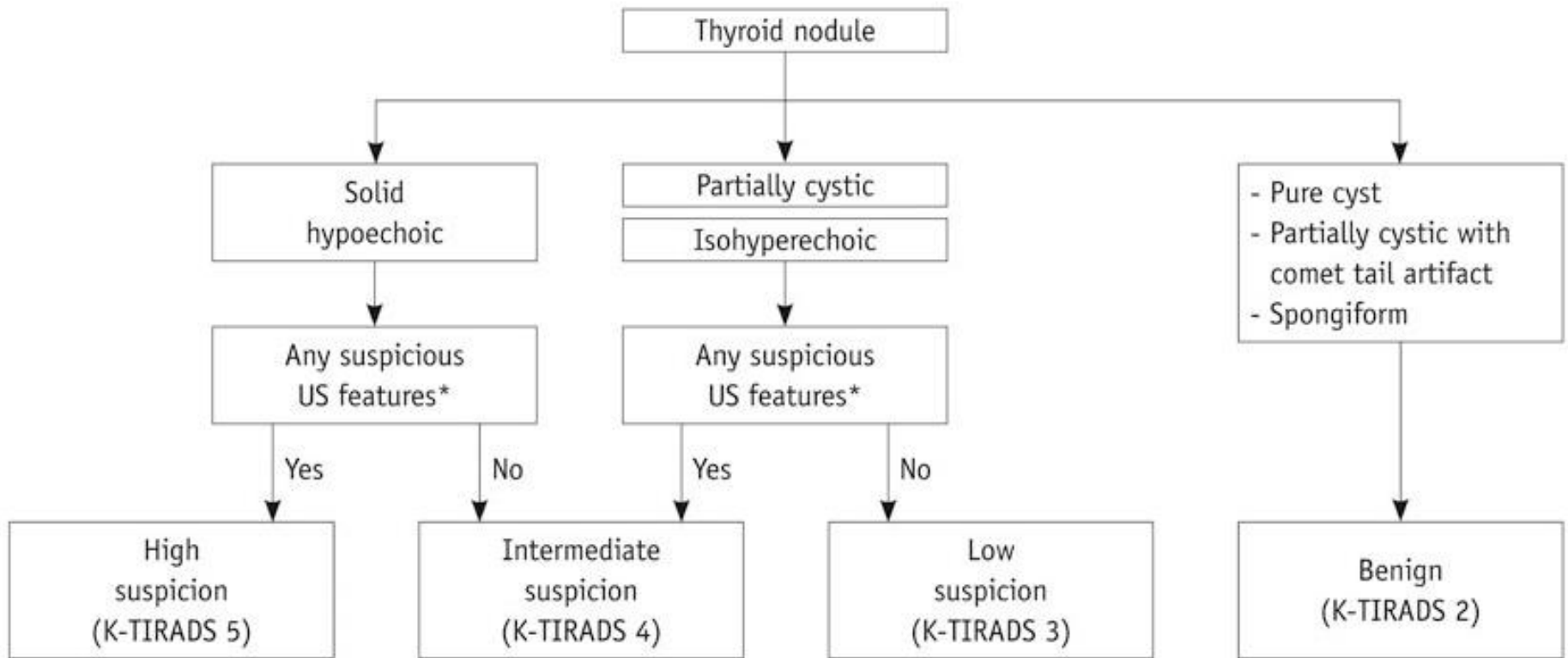
- ⌘ Physical examination
- ⌘ Ultrasound characteristics
- ⌘ Personal history of radiation or family history  
Thyroid Cancer
- ⌘ Size: Nodules < than 1.0 cm less significant,  
>1.5 cm more significant
- ⌘ Quantity: Risk is not lower with multiple vs  
single nodule
- ⌘ Do not need to biopsy hyperfunctioning  
nodule in nuclear imaging

# ACR TI-RADS



COMPOSITION	ECHOGENICITY	SHAPE	MARGIN	ECHOGENIC FOCI
<p><i>Spongiform</i>: Composed predominantly (&gt;50%) of small cystic spaces. Do not add further points for other categories.</p> <p><i>Mixed cystic and solid</i>: Assign points for predominant solid component.</p> <p>Assign 2 points if composition cannot be determined because of calcification.</p>	<p><i>Anechoic</i>: Applies to cystic or almost completely cystic nodules.</p> <p><i>Hyperechoic/isoechoic/hypoechoic</i>: Compared to adjacent parenchyma.</p> <p><i>Very hypoechoic</i>: More hypoechoic than strap muscles.</p> <p>Assign 1 point if echogenicity cannot be determined.</p>	<p><i>Taller-than-wide</i>: Should be assessed on a transverse image with measurements parallel to sound beam for height and perpendicular to sound beam for width.</p> <p>This can usually be assessed by visual inspection.</p>	<p><i>Lobulated</i>: Protrusions into adjacent tissue.</p> <p><i>Irregular</i>: Jagged, spiculated, or sharp angles.</p> <p><i>Extrathyroidal extension</i>: Obvious invasion = malignancy.</p> <p>Assign 0 points if margin cannot be determined.</p>	<p><i>Large comet-tail artifacts</i>: V-shaped, &gt;1 mm, in cystic components.</p> <p><i>Macrocalcifications</i>: Cause acoustic shadowing.</p> <p><i>Peripheral</i>: Complete or incomplete along margin.</p> <p><i>Punctate echogenic foci</i>: May have small comet-tail artifacts.</p>

\*Refer to discussion of papillary microcarcinomas for 5-9 mm TR5 nodules.



Scanning



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39409786 SAWICKE KIMBERLY 6TCTHY  
L A 0 45 150.00 K COUNT 39.942 SEC.

Scr  
1



THYROID 29 Nov 1999 at 9:25  
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R A 0 45 150.00 K COUNT 35.032 SEC.



Scr  
1











# Thyroid Nodules

- ⌘ FNA dominant palpable or solitary lesions, But 1st verify thyroid function & ultrasound for other nodules
- ⌘ Do not assume every palpable abnormality is a nodule
- ⌘ 90-95 % benign, risk of cancer > in men
- ⌘ Common in Hashimoto
- ⌘ Scan not necessary if normal thyroid function or low thyroid function

# Adverse Physical Findings by U/S

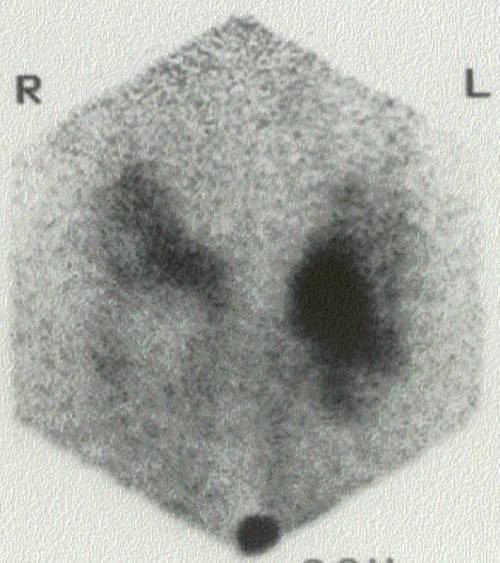
- ⌘ Microcalcifications {dense calcification with shadowing is less suspicious}
- ⌘ Increased central flow by doppler
- ⌘ Hypoechoic----most nodules are, but hyperechoic nodules less suspicious
- ⌘ Absent thin halo/sonolucent rim
- ⌘ Irregular Border

# Pathology Classification (Bethesda)

- ↳ Insufficient
- ↳ Benign
- ↳ Atypia of undetermined significance
- ↳ Follicular neoplasm or suspicious for follicular neoplasm
- ↳ Suspicious for malignancy
- ↳ Malignant



-----  
FR 1 M  
ROT 270Z 1.0  
TCNT= 100K  
RATE= 1K  
T/FR= 89S



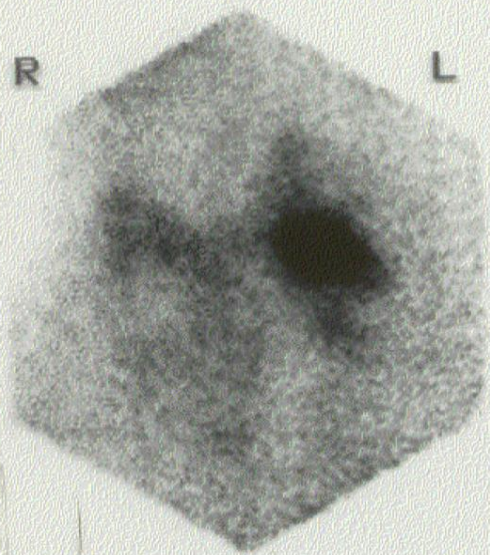
SSN

ANT D=1"



RAO D=1"

-----  
FR 3 M  
ROT 270Z 1.0  
TCNT= 100K  
RATE= 1K  
T/FR= 94S



ANT D=1"



# Treatment

- ⌘ Surgery for suspicious lesions by FNA
- ⌘ Follicular lesions: cannot always determine if cancer is present/cytologic characteristics
- ⌘ Consider Molecular testing to guide need for surgery
- ⌘ Benign lesions observe
- ⌘ For benign lesions, suppression with thyroid hormone is Not in the standard of care







# Thyroid Cancer

- ⌘ Papillary (Well differentiated)
- ⌘ Follicular/Hurthle Cell  
(Well differentiated)
- ⌘ Medullary
- ⌘ Lymphoma
- ⌘ Poorly differentiated/Anaplastic

# Prognosis

- ⌘ Papillary most common and best prognosis
- ⌘ Anaplastic is least common and worst prognosis

# Treatment

- ⌘ Total thyroidectomy for well differentiated carcinoma followed by 131-Iodine remnant ablation, depending on prognosis/risk
- ⌘ Pre-op node evaluation---morphology/architecture, which might change the extent of surgery
- ⌘ Serial whole body scans with 131-Iodine while hypothyroid or using recombinant TSH on low iodine diet
- ⌘ Suppression of TSH with Brand named T4
- ⌘ Periodic ultrasound imaging to identify early recurrence or mets---Biopsy suspicious nodes cytology with Tg washout

Ac: 643326  
Lossy 6:1  
I-131 TOTAL BODY  
Series 1

R Anterior L

Anterior

L Posterior R

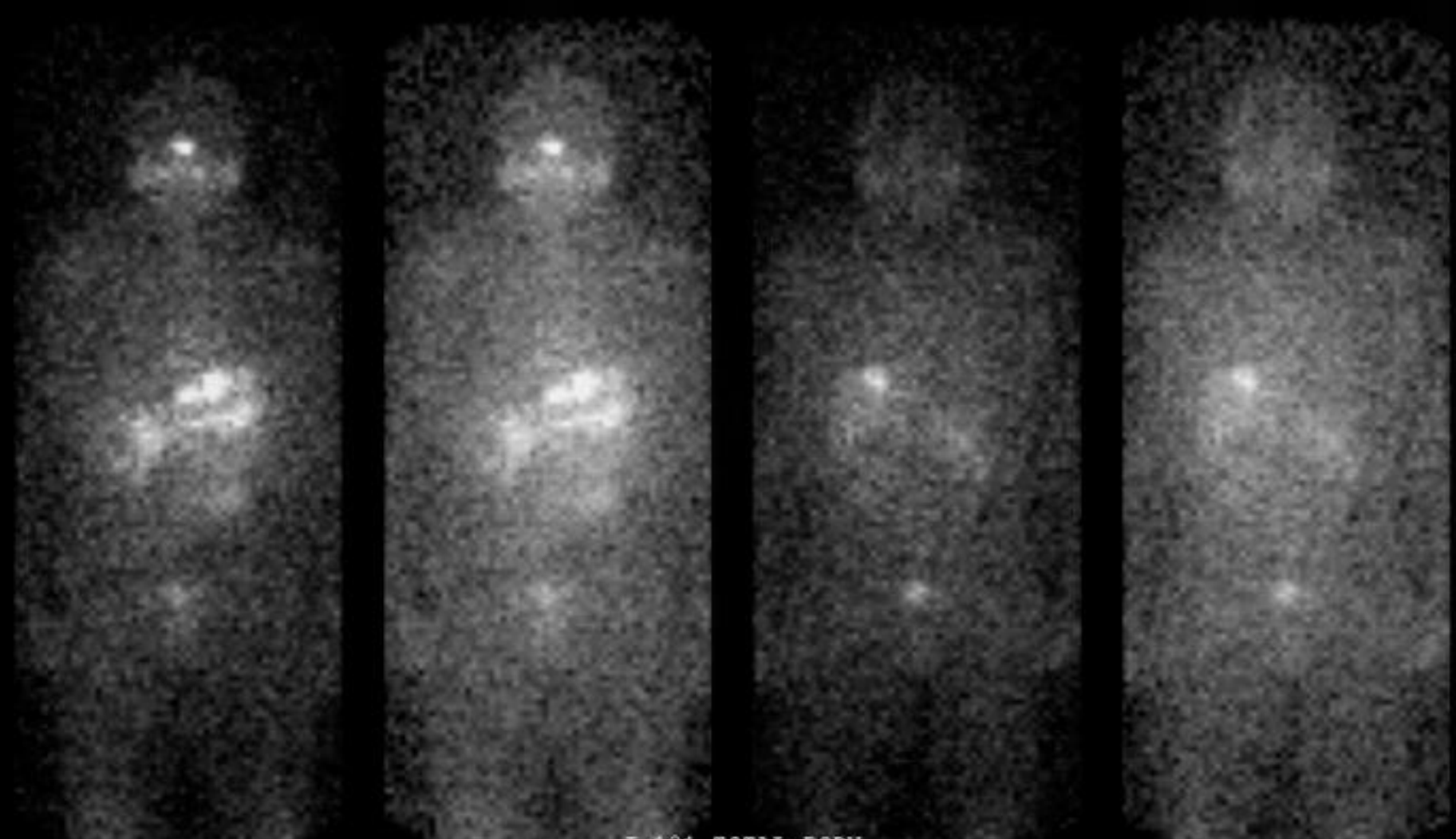
Posterior

I-131 Total Body Scan  
48 Hour Delay  
3.18 mCi I-131



Ac: 1567455

Series 1



I-131 TOTAL BODY  
 48HR DELAY  
 I-131: 3.24mCi

R Anterior L

Anterior

L Posterior R

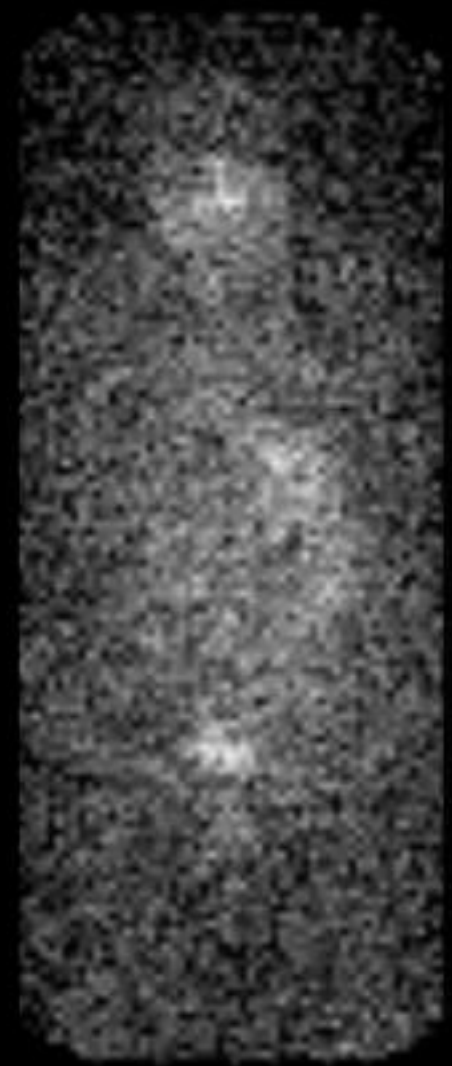
Posterior

Series 1

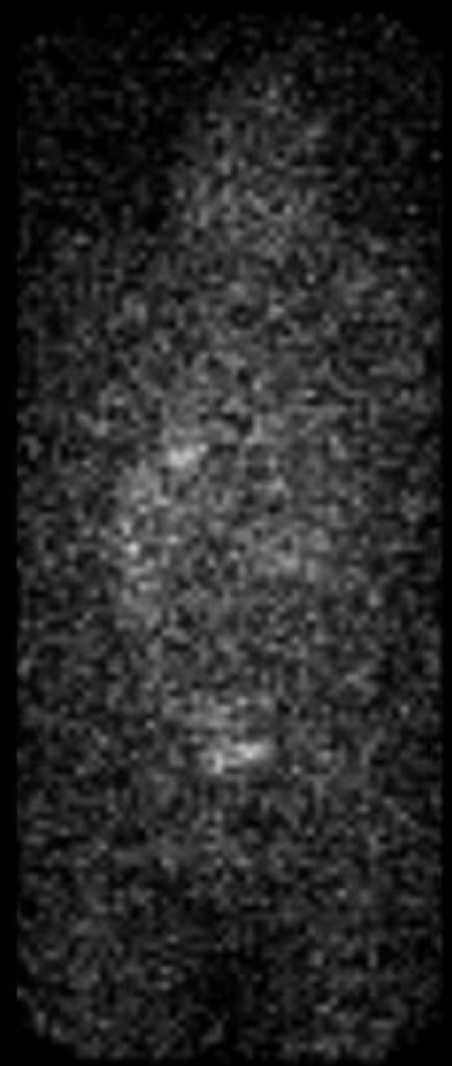




R Anterior L



Anterior



L Posterior R



Posterior

# Treatment

- ⌘ Medullary Carcinoma: aggressive surgical resection and node dissection Radioactive iodine unhelpful; evaluate patient for familial disease/genetic testing; Commonly sporadic
- ⌘ Anaplastic: rapid progression; consider external radiation or chemotherapy

# Multiple Endocrine Neoplasia 1

- ⌘ Parathyroid neoplasm:
  - Hyperparathyroidism (80 %)
- ⌘ Pancreatic neoplasm
- ⌘ Pituitary neoplasm
- ⌘ Others: uncommon neoplasms

# Multiple Endocrine Neoplasia 2

↳ **Signal tumor: Medullary Thyroid Carcinoma (MTC)**

↳ **MEN 2a: MTC, Hyperparathyroidism, pheochromocytoma**

↳ **MEN 2b: MTC, pheochromocytoma, marfanoid, multiple mucosal neuromas**