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/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 exteme 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 Methim-azole 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

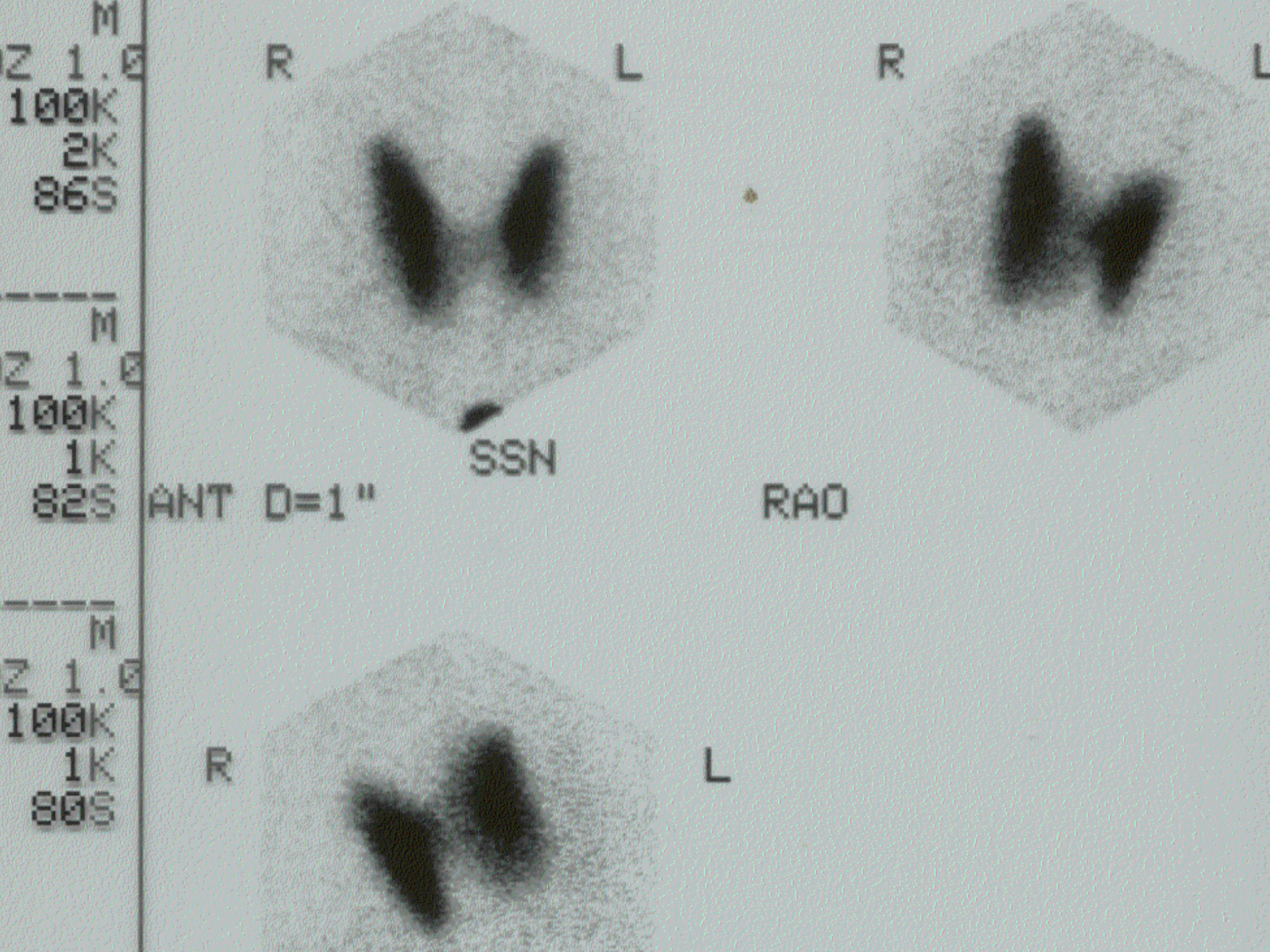
Hyperthyroidism

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-Iodine
- Uptake with low dose 131-Iodine with uptake probe + Scan/image with technetium
- Diffuse uptake of tracer on image in more significantly hyperthyroid patients


M
Z 1.0
100K
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86S
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R
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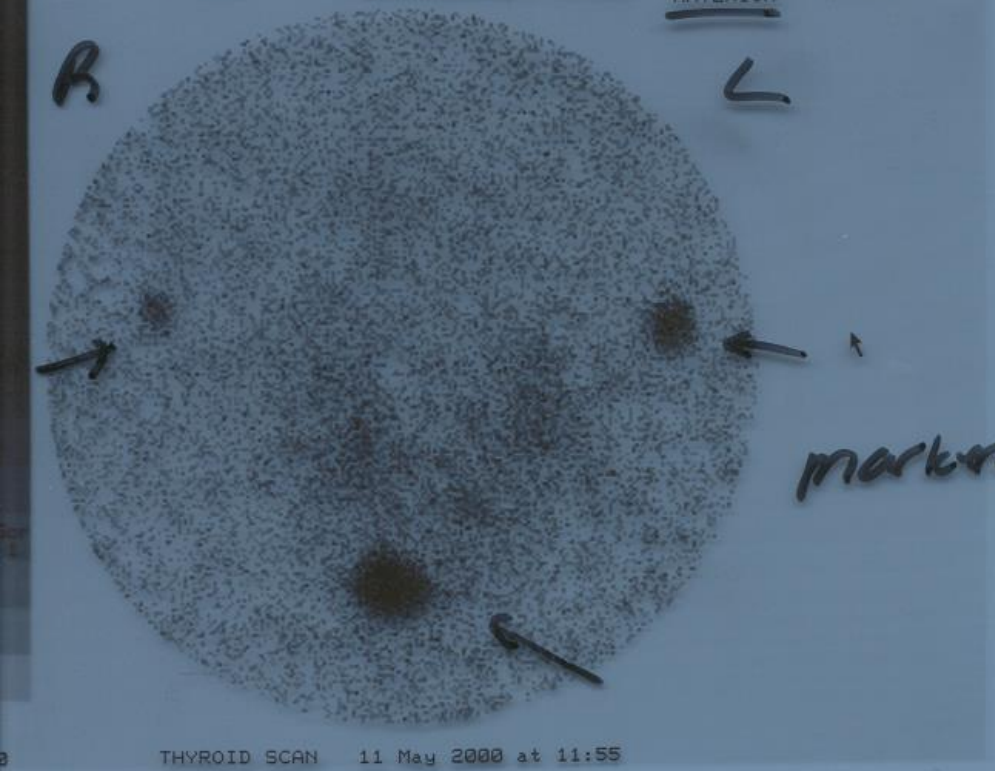

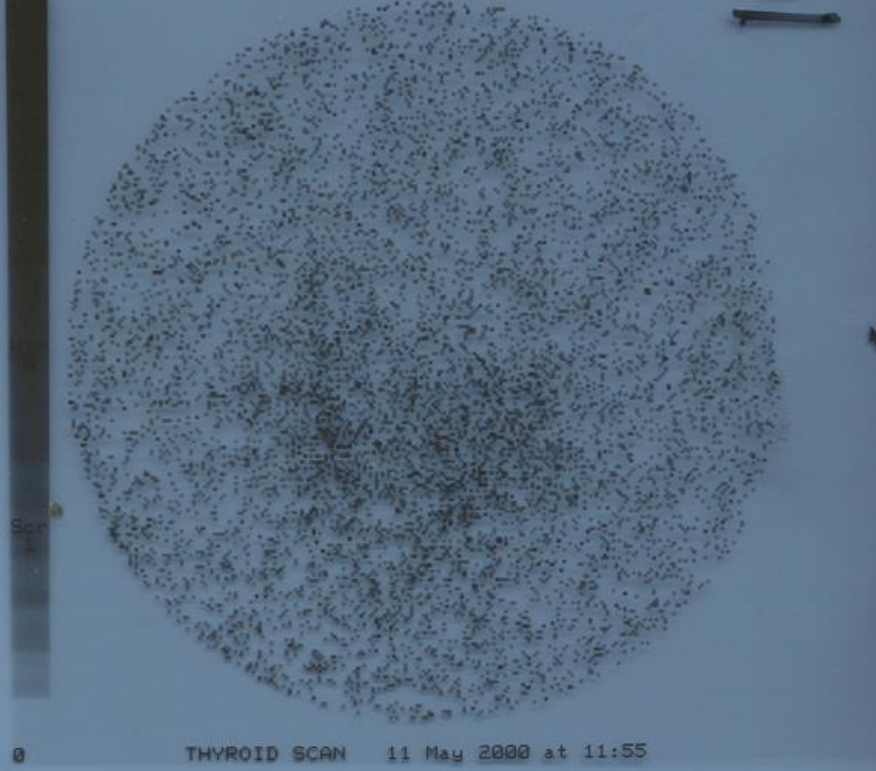

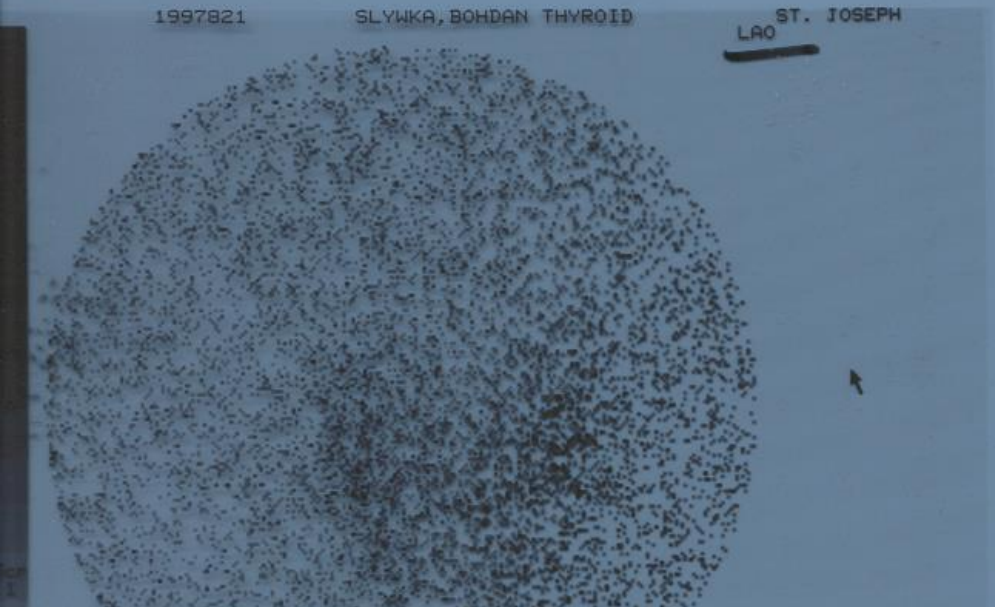

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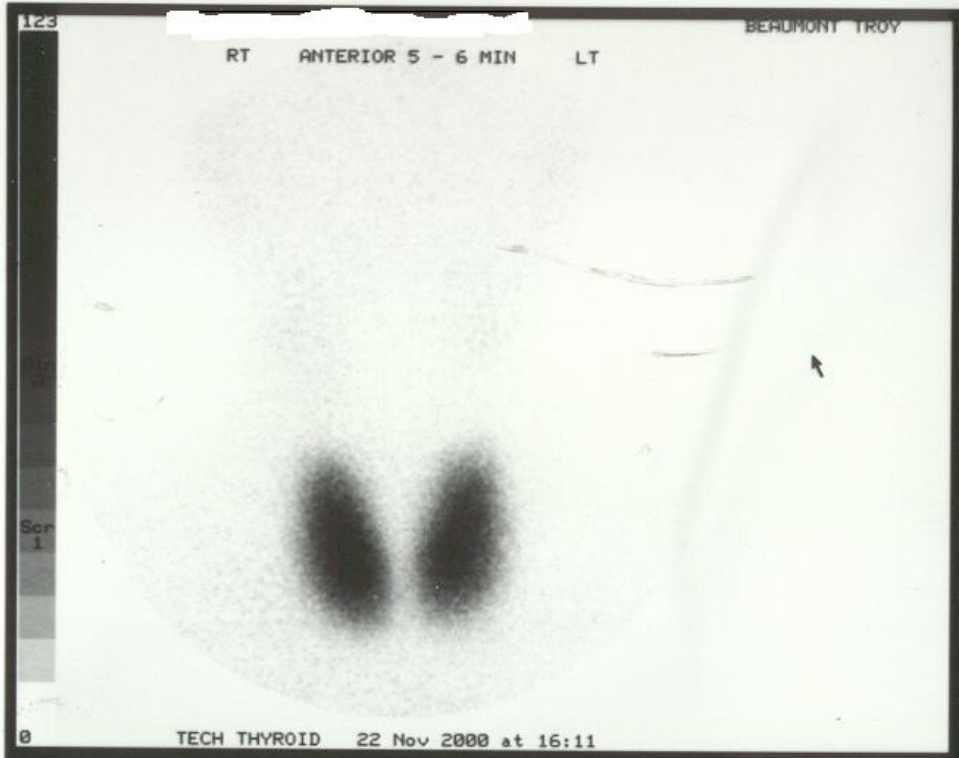
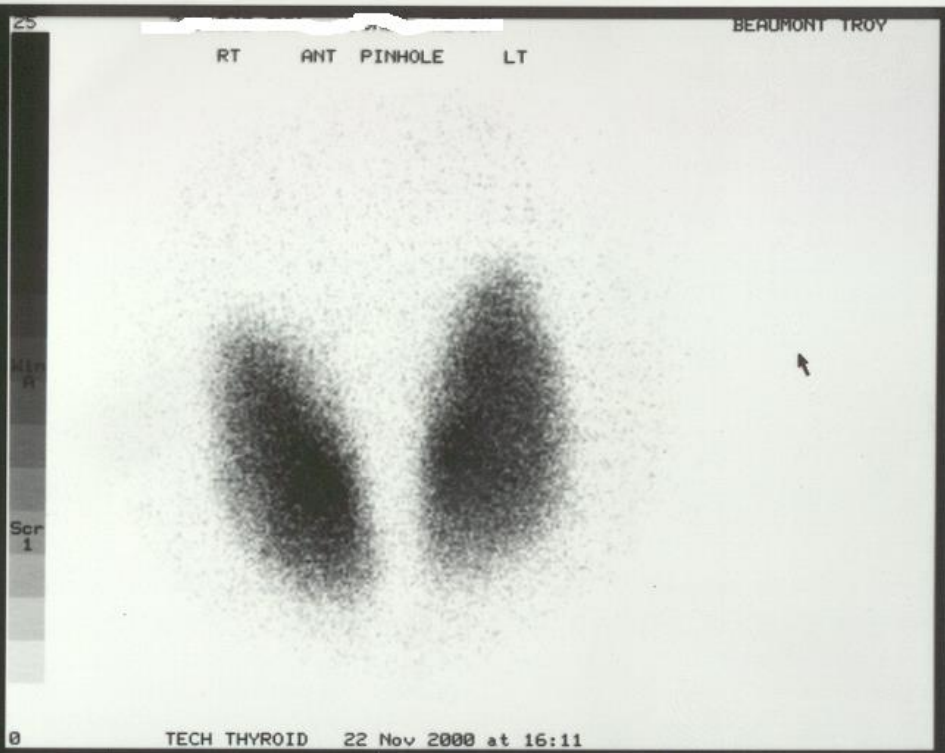
24hr uptake = 3.0


123
BEAUMONT TROY
RT ANTERIOR 5 - 6 MIN LT
Win A
Scr 1
0
TECH THYROID 22 Nov 2000 at 16:11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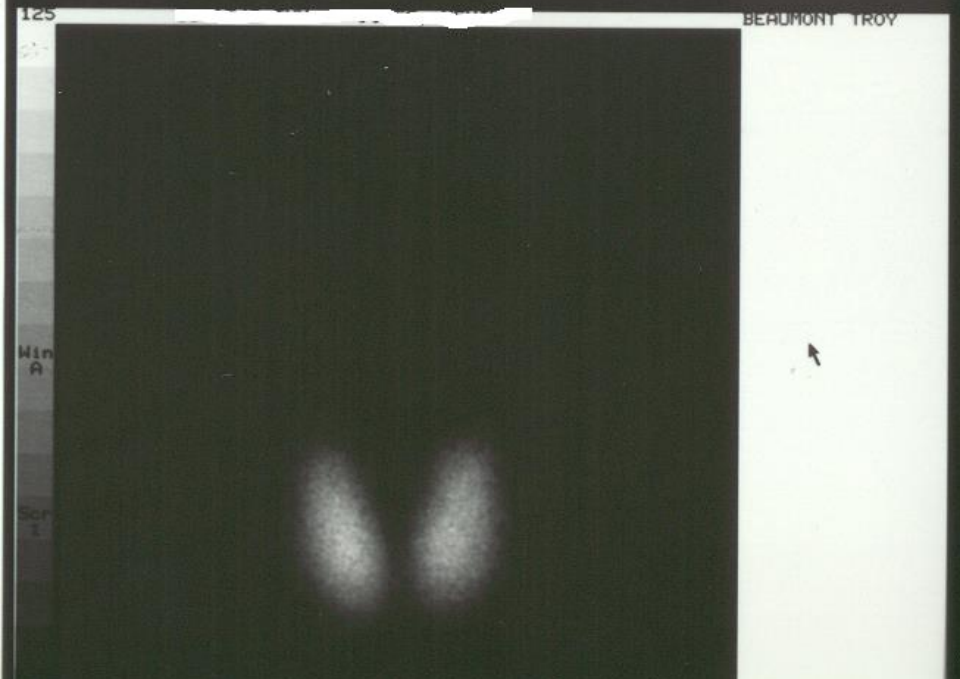
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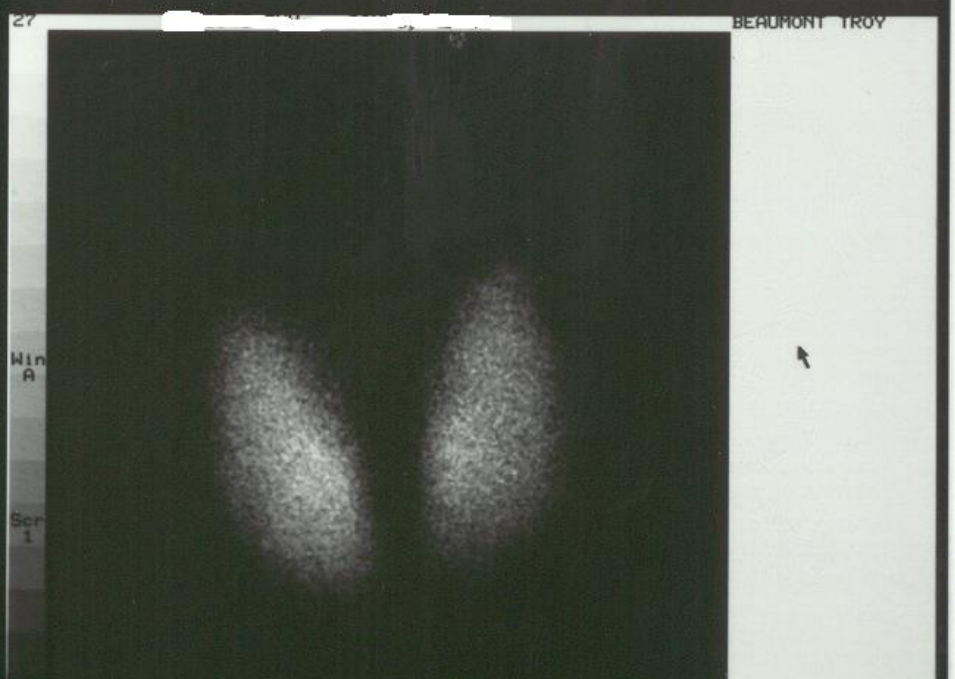
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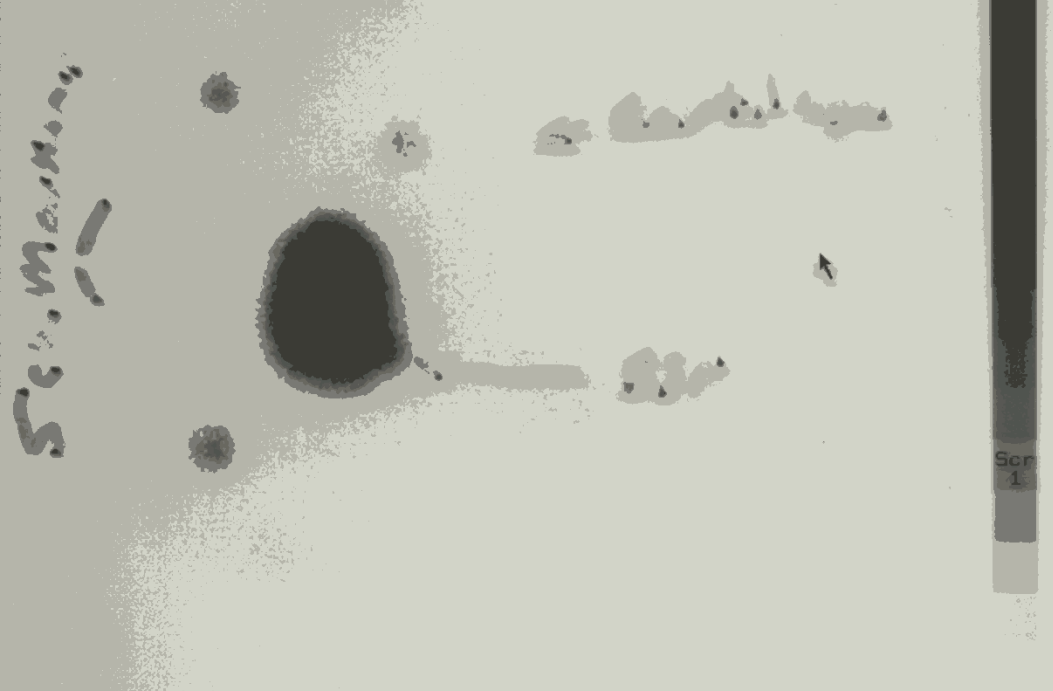
Win A
Scr 1



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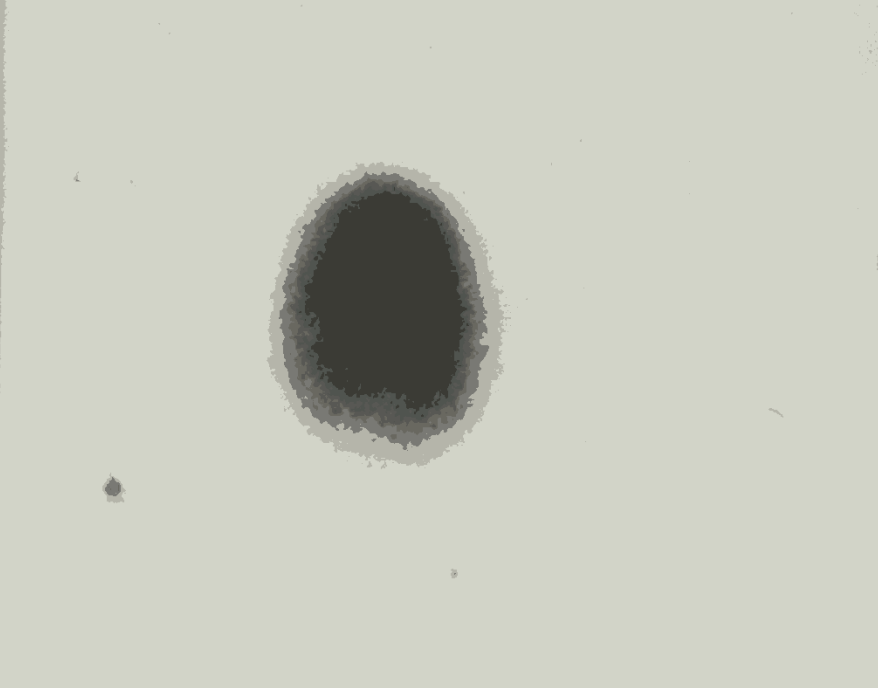

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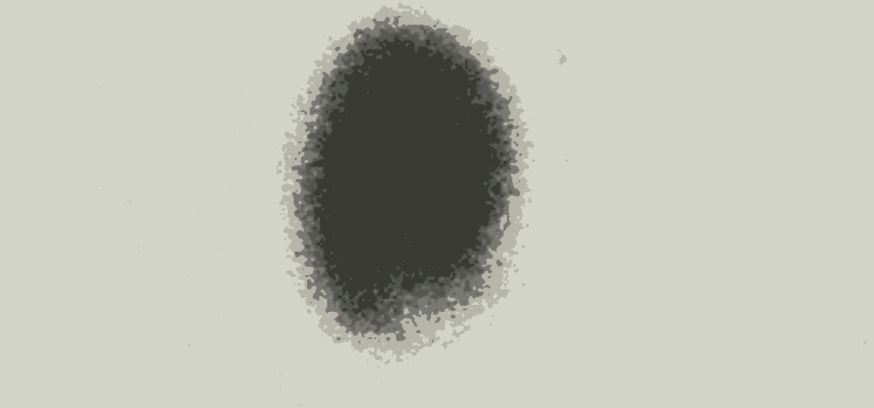


Treatment

- 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

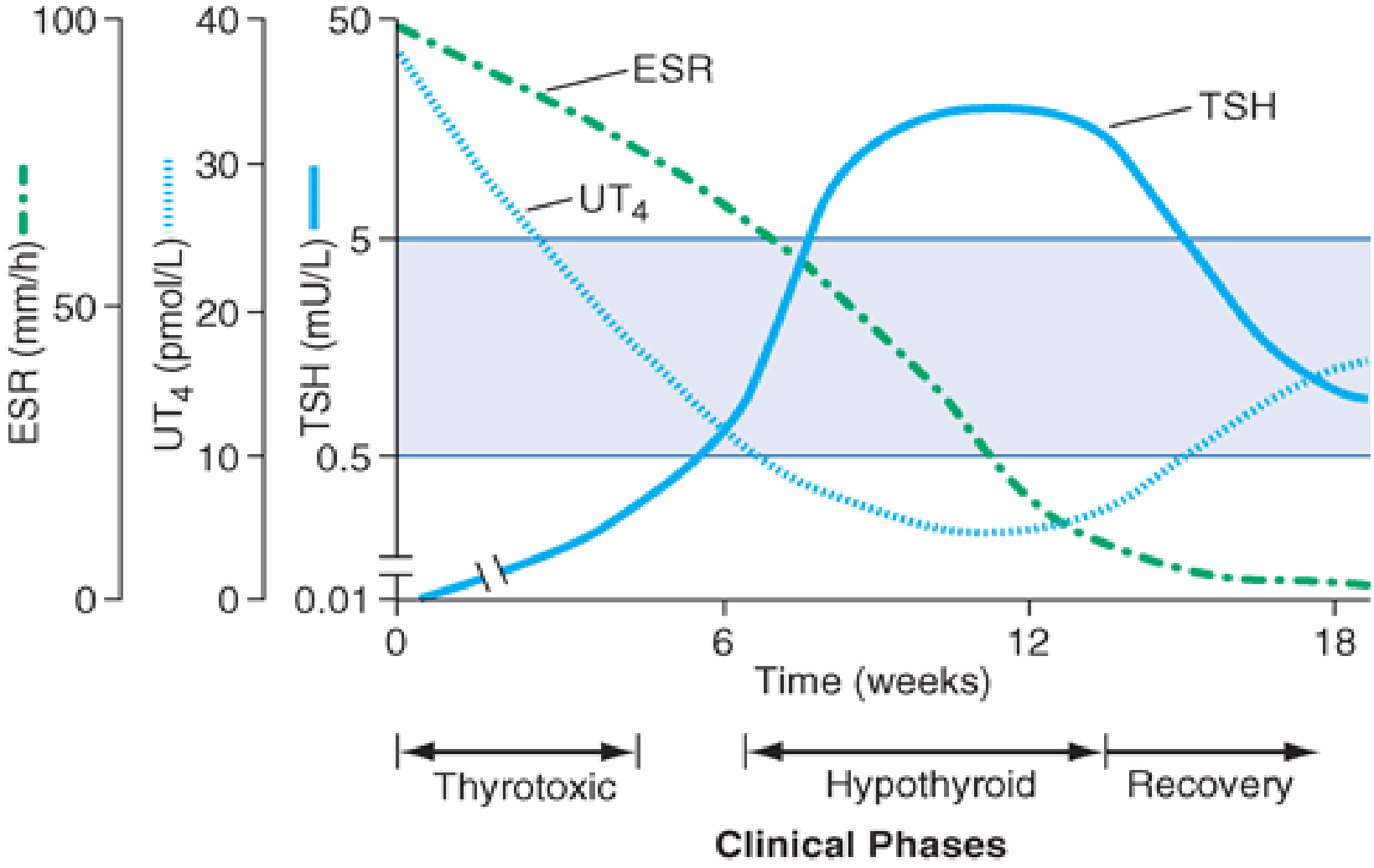
- High: Graves, TSH, HCG, Hashimoto
- High to normal: Toxic MNG, Toxic Nodule
- Low: Factitious, Mets, Struma Ovarii, Iodine induced, Thyroiditis (silent & subacute)

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

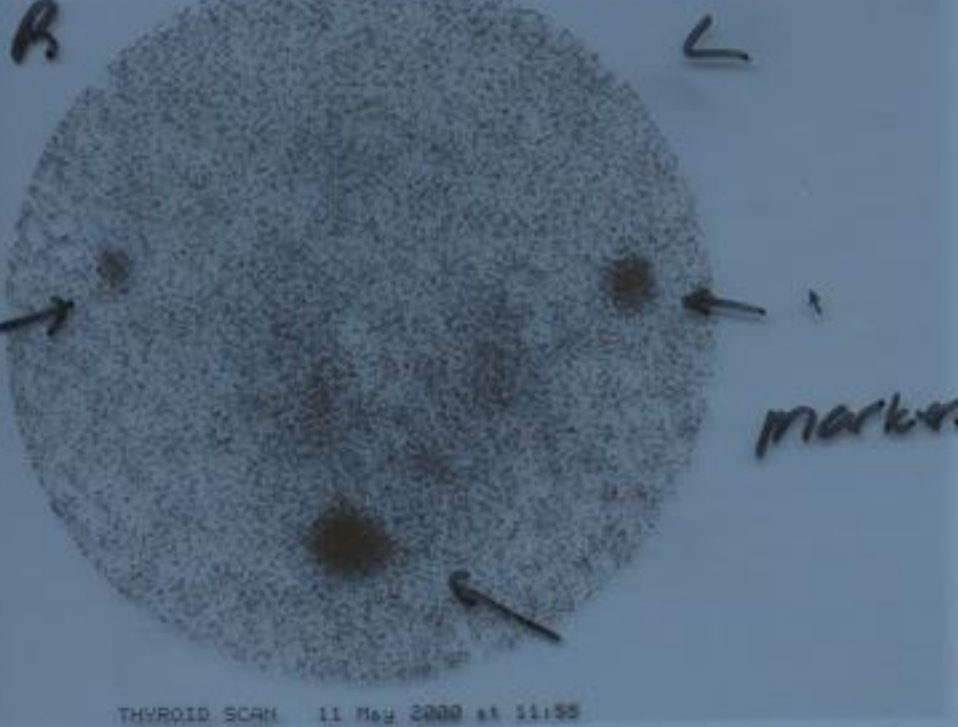
Terminology Thyroiditis

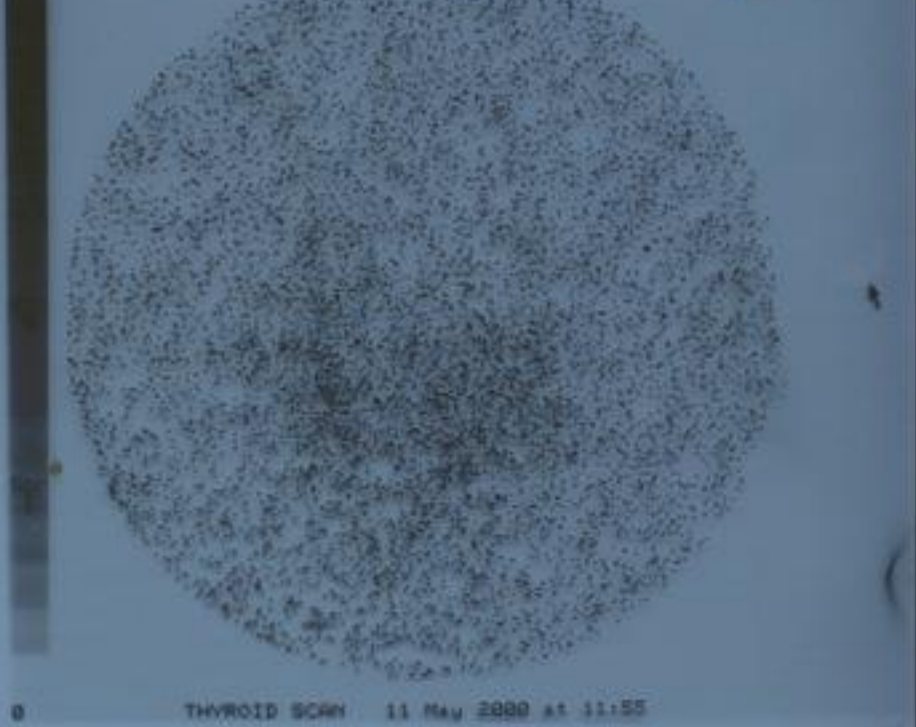
- This terminology is referring to “silent” thyroiditis & “subacute (DeQuervain)” thyroiditis

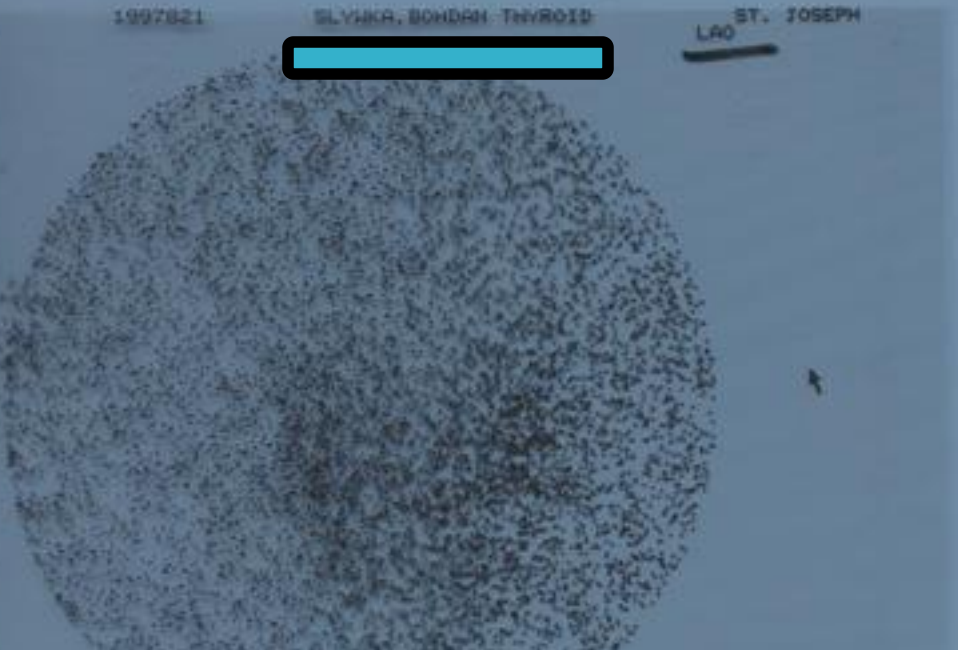
- Hashimoto Thyroiditis is referred to as “Hashimoto” without the designation of the term thyroiditis



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







2hr. uptake = 2.0
24hr uptake = 3.1

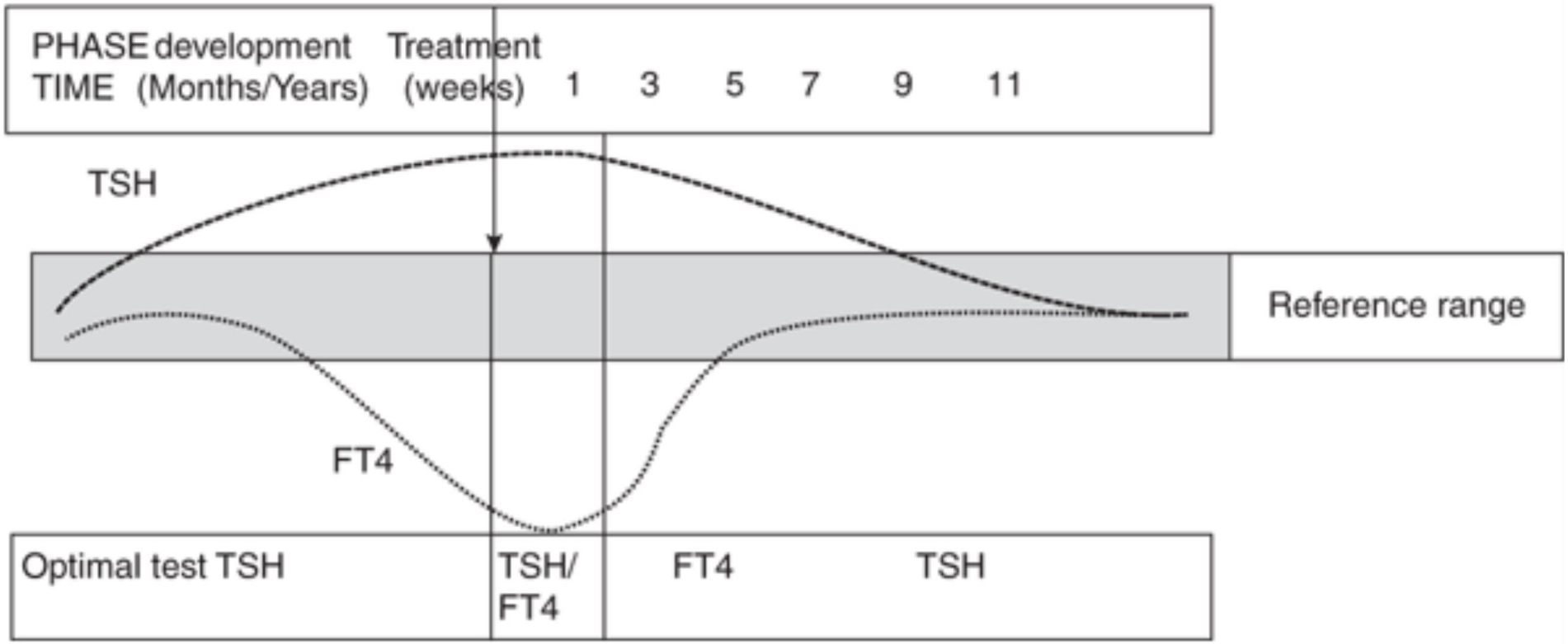
Pin Hole Imaging

5cm SS Marker

Rt Anterior Lt

Rt Anterior Lt

Test changes in primary hypothyroidism during disease and treatatment



Source: Howard M. Reisner: Pathology: A Modern Case Study
www.accessmedicine.com

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 it's 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 (Choose 1)	
Cystic or almost completely cystic	0 points
Spongiform	0 points
Mixed cystic and solid	1 point
Solid or almost completely solid	2 points

ECHOGENICITY (Choose 1)	
Anechoic	0 points
Hyperechoic or isoechoic	1 point
Hypoechoic	2 points
Very hypoechoic	3 points

SHAPE (Choose 1)	
Wider-than-tall	0 points
Taller-than-wide	3 points

MARGIN (Choose 1)	
Smooth	0 points
Ill-defined	0 points
Lobulated or irregular	2 points
Extra-thyroidal extension	3 points

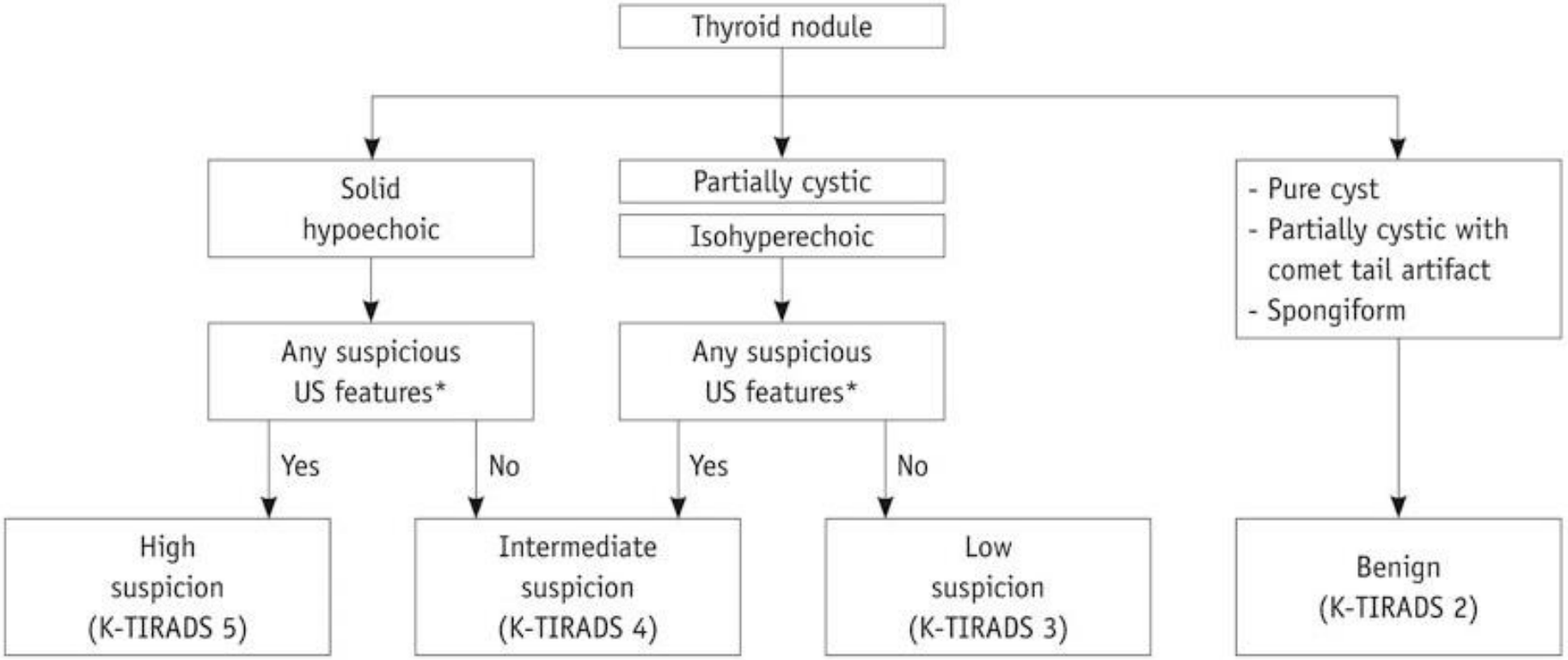
ECHOGENIC FOCI (Choose All That Apply)	
None or large comet-tail artifacts	0 points
Macrocalcifications	1 point
Peripheral (rim) calcifications	2 points
Punctate echogenic foci	3 points

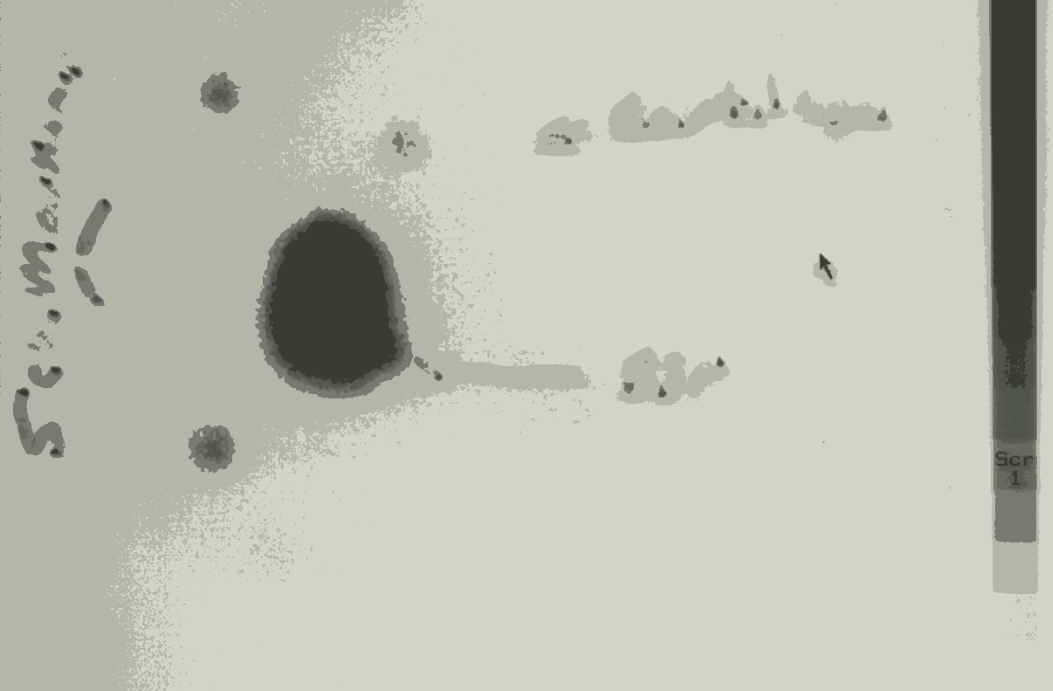
Add Points From All Categories to Determine TI-RADS Level

0 Points	2 Points	3 Points	4 to 6 Points	7 Points or More
TR1 Benign — No FNA	**TR2** Not Suspicious — No FNA	**TR3** Mildly Suspicious — FNA if ≥ 2.5 cm; Follow if ≥ 1.5 cm	**TR4** Moderately Suspicious — FNA if ≥ 1.5 cm; Follow if ≥ 1 cm	**TR5** Highly Suspicious — FNA if ≥ 1 cm; Follow if ≥ 0.5 cm*

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

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


Thyroid nodule
Solid hypoechoic
Partially cystic
Isohyperechoic
- Pure cyst
- Partially cystic with comet tail artifact
- Spongiform
Any suspicious US features*
Any suspicious US features*
Yes
No
Yes
No
High suspicion (K-TIRADS 5)
Intermediate suspicion (K-TIRADS 4)
Low suspicion (K-TIRADS 3)
Benign (K-TIRADS 2)



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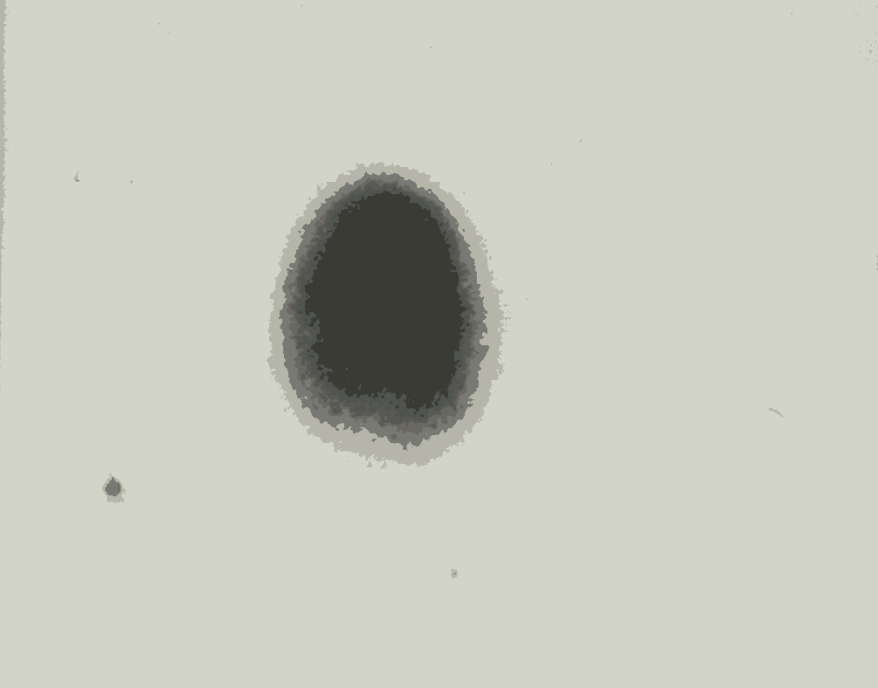

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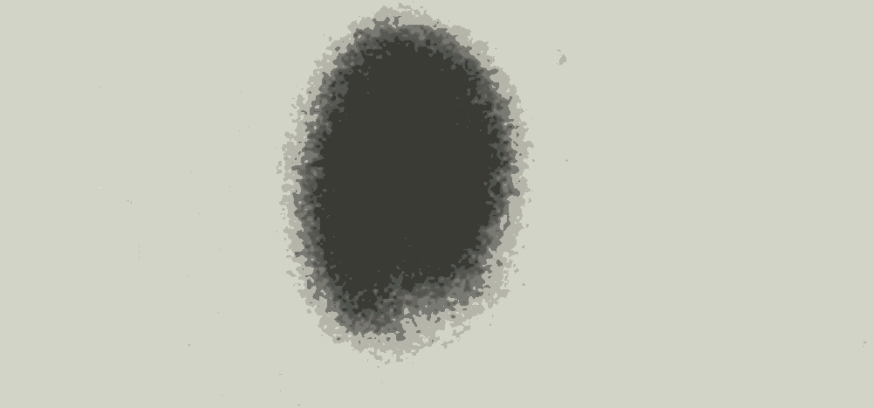


Thyroid Nodules

- 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 hyper-echoic nodules less suspicious
- Absent thin halo/sonolucent rim
- Irregular Border

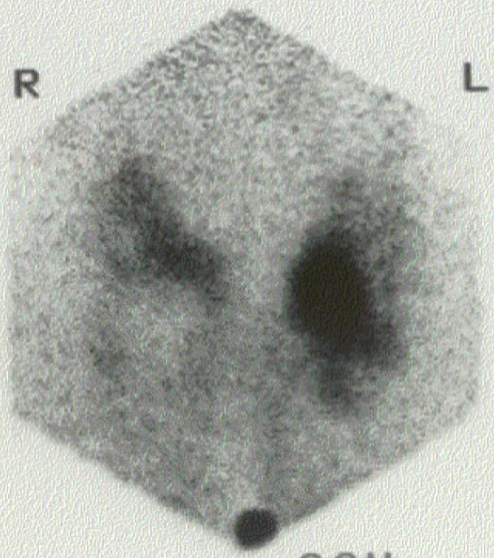
Pathology Classification (Bethesda)

- 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

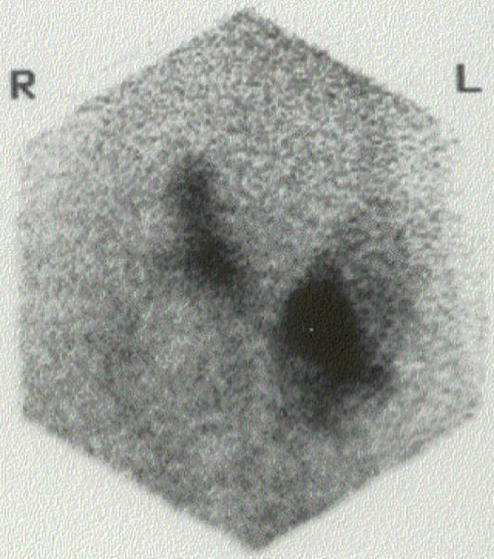
FR 2 M
ROT 270Z 1.0
TCNT= 100K
RATE= 1K
T/FR= 96S

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



SSN

ANT D=1"



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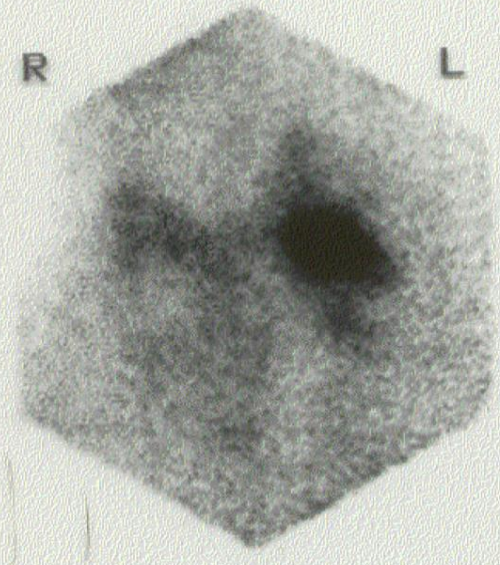


LAO D=1"

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

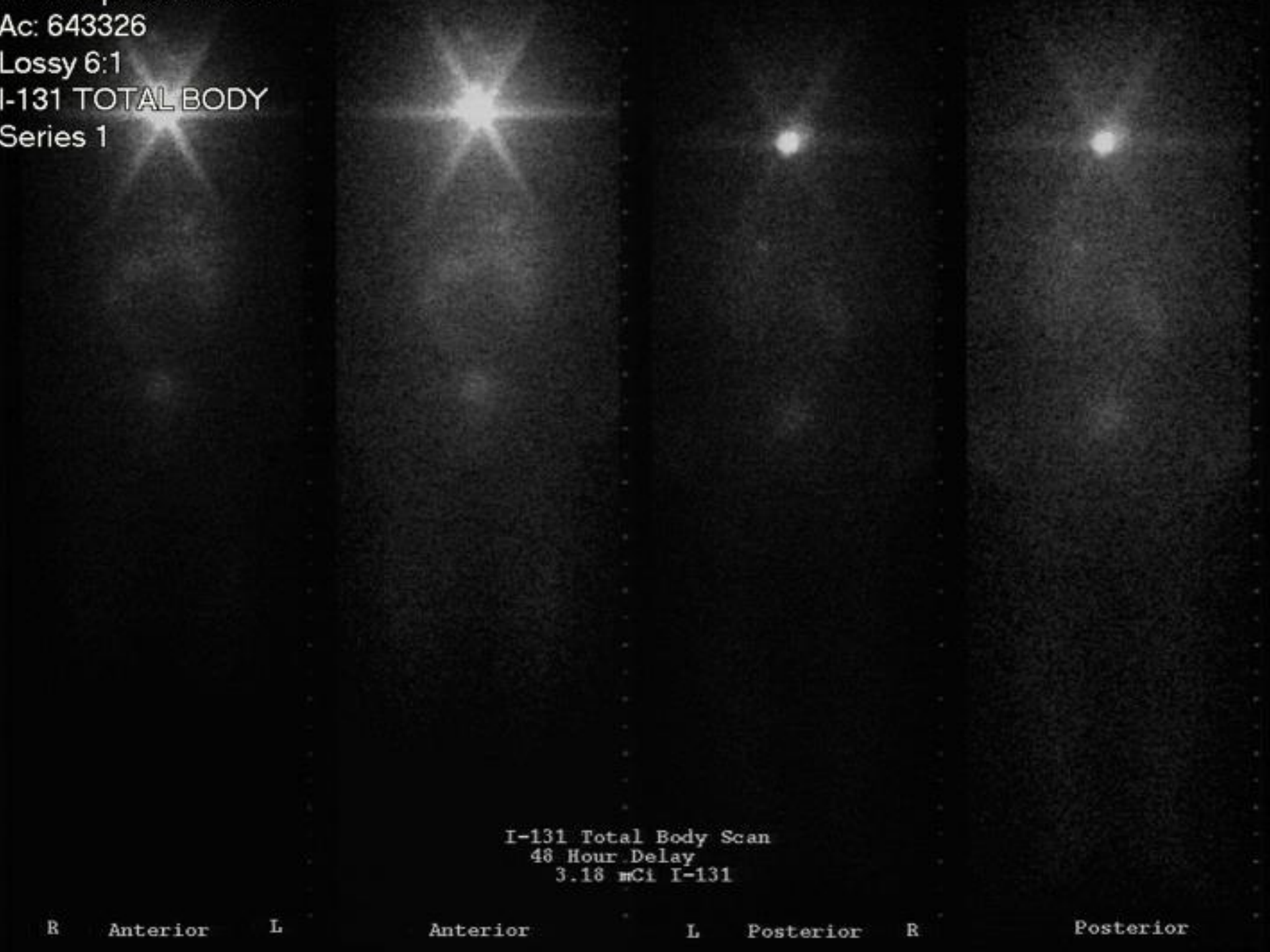
- Papillary (Well differentiated)
- Follicular/Hurthle Cell (Well differentiated)
- Medullary
- Lymphoma
- Poorly differentiated/Anaplastic

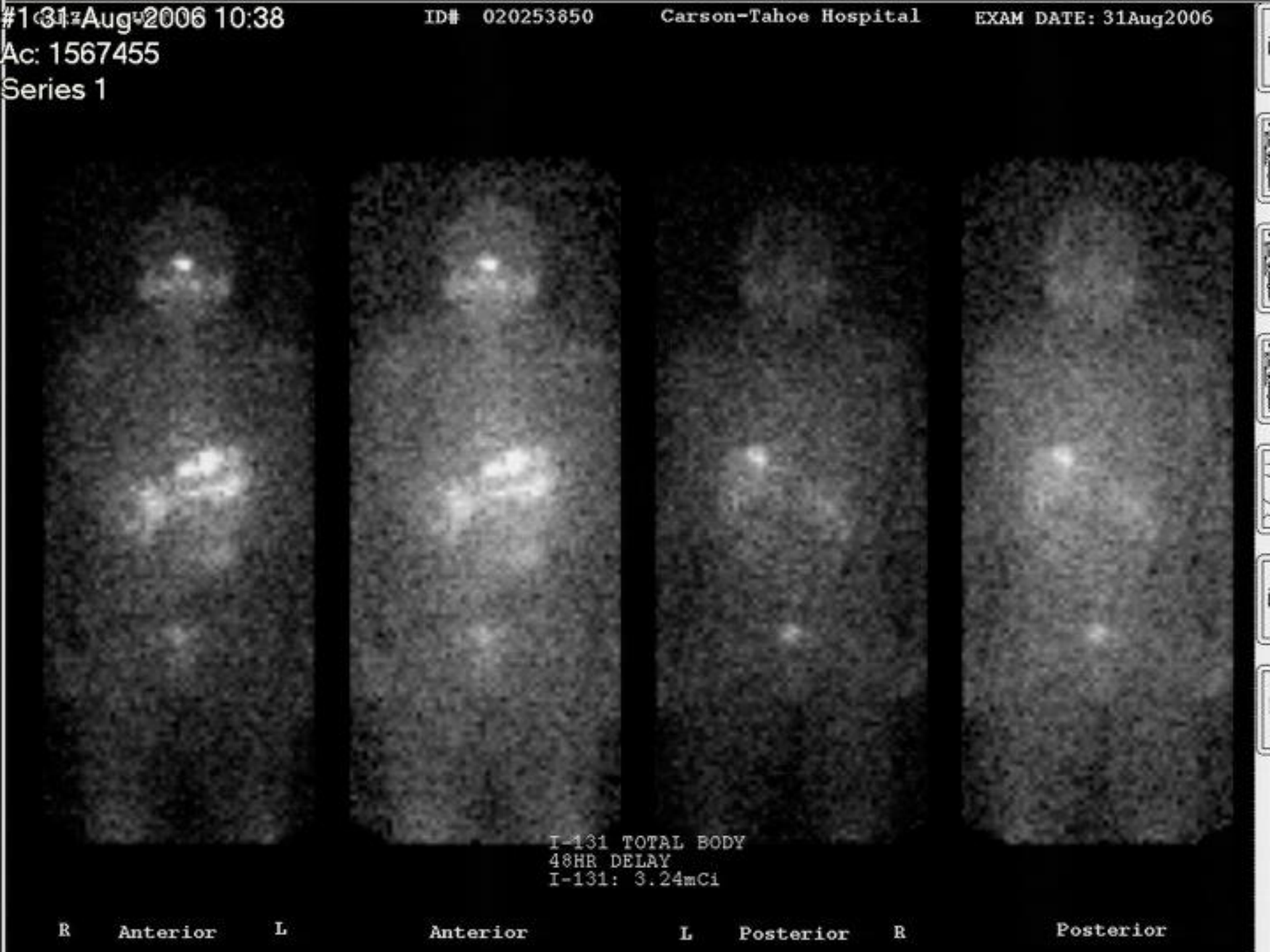
Prognosis

- 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
I-131 Total Body Scan
48 Hour Delay
3.18 mCi I-131
R Anterior L
Anterior L Posterior R
Posterior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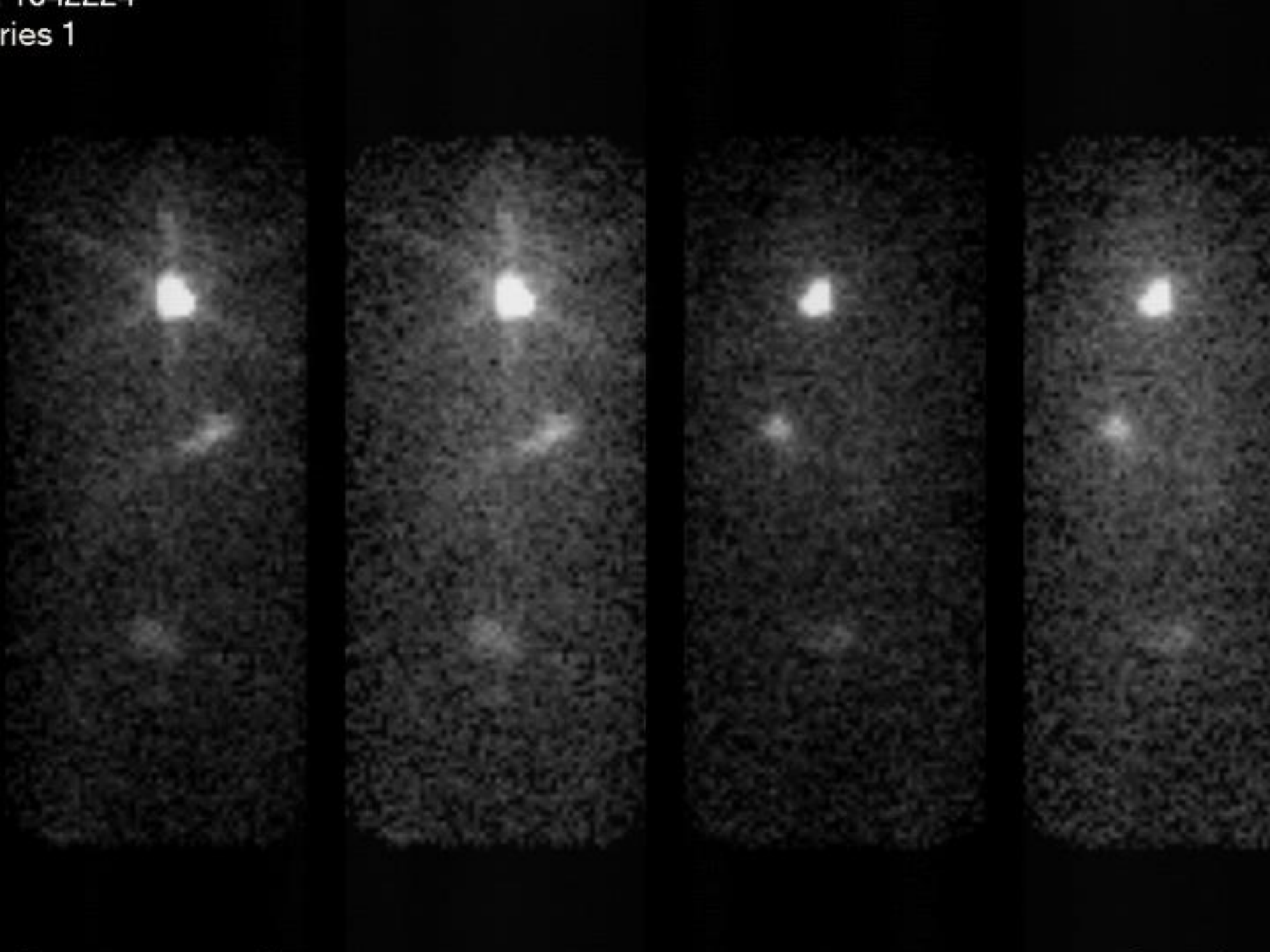
ID# 020253850
Carson-Tahoe Hospital
EXAM DATE: 31Aug2006
Ac: 1567455
Series 1
I-131 TOTAL BODY
48HR DELAY
I-131: 3.24mCi
R Anterior L
Anterior L Posterior R
Posterior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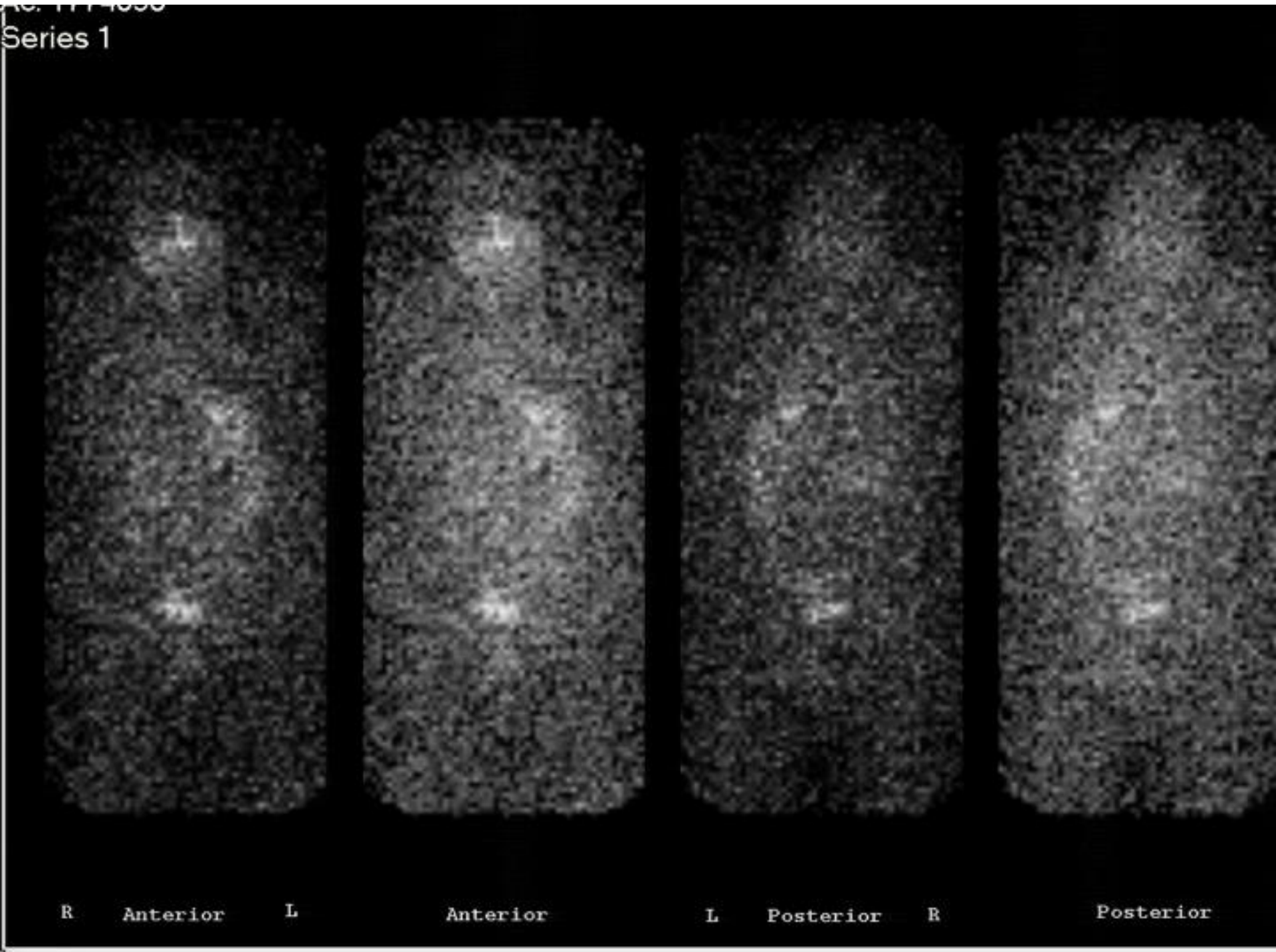
Series 1
R Anterior L
Anterior
L Posterior R
Posterior

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: uncommmon neoplasms

Multiple Endocrine Neoplasia 2

- Signal tumor: Medullary Thyroid Carcinoma (MTC)
- MEN 2a: MTC, Hyperparathyroidism, pheochromocytoma
- MEN 2b: MTC, pheochromocytoma, marfanoid, multiple mucosal neuromas