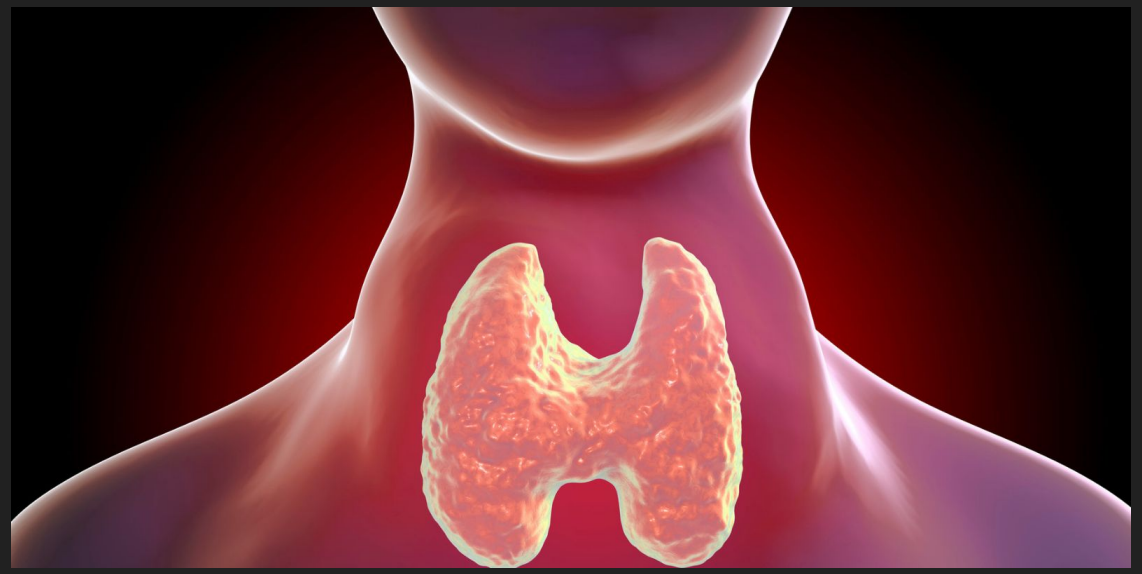
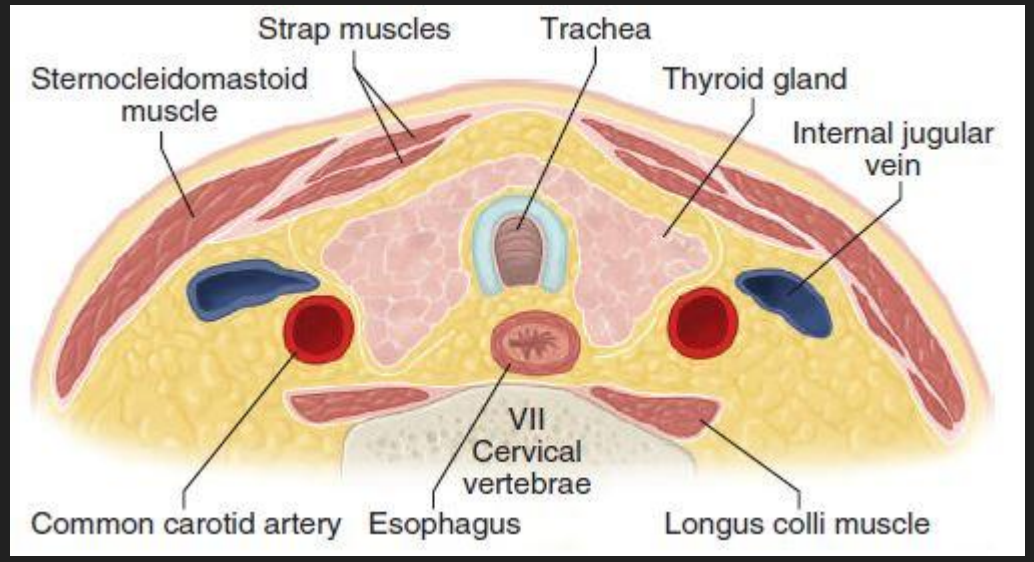
SMALL PARTS ULTRASOUND: THYROID GLAND



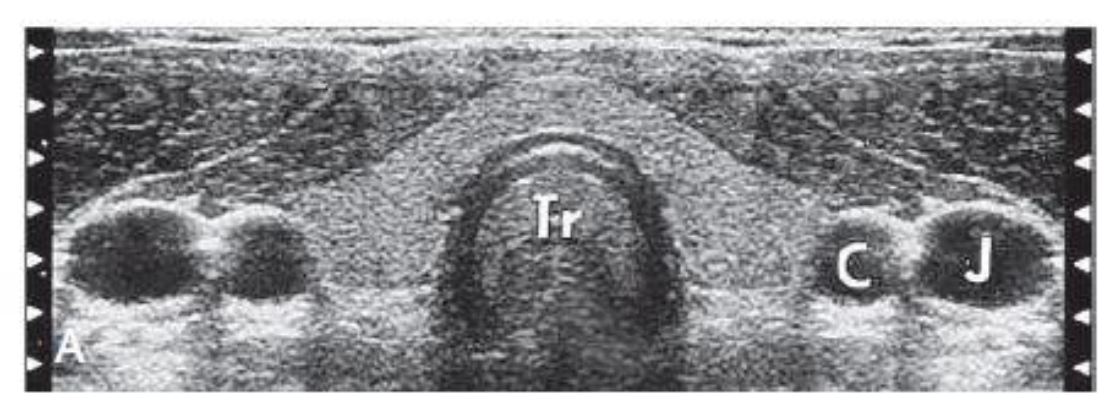
Presented by: Dan Christian K. Bueno, MD, DPBR

Thyroid Anatomy

- Located in the anteroinferior portion of the neck (**infrahyoid compartment**).
- Made up of **two** lobes located along either side of the trachea and connected across the midline by the **isthmus**.



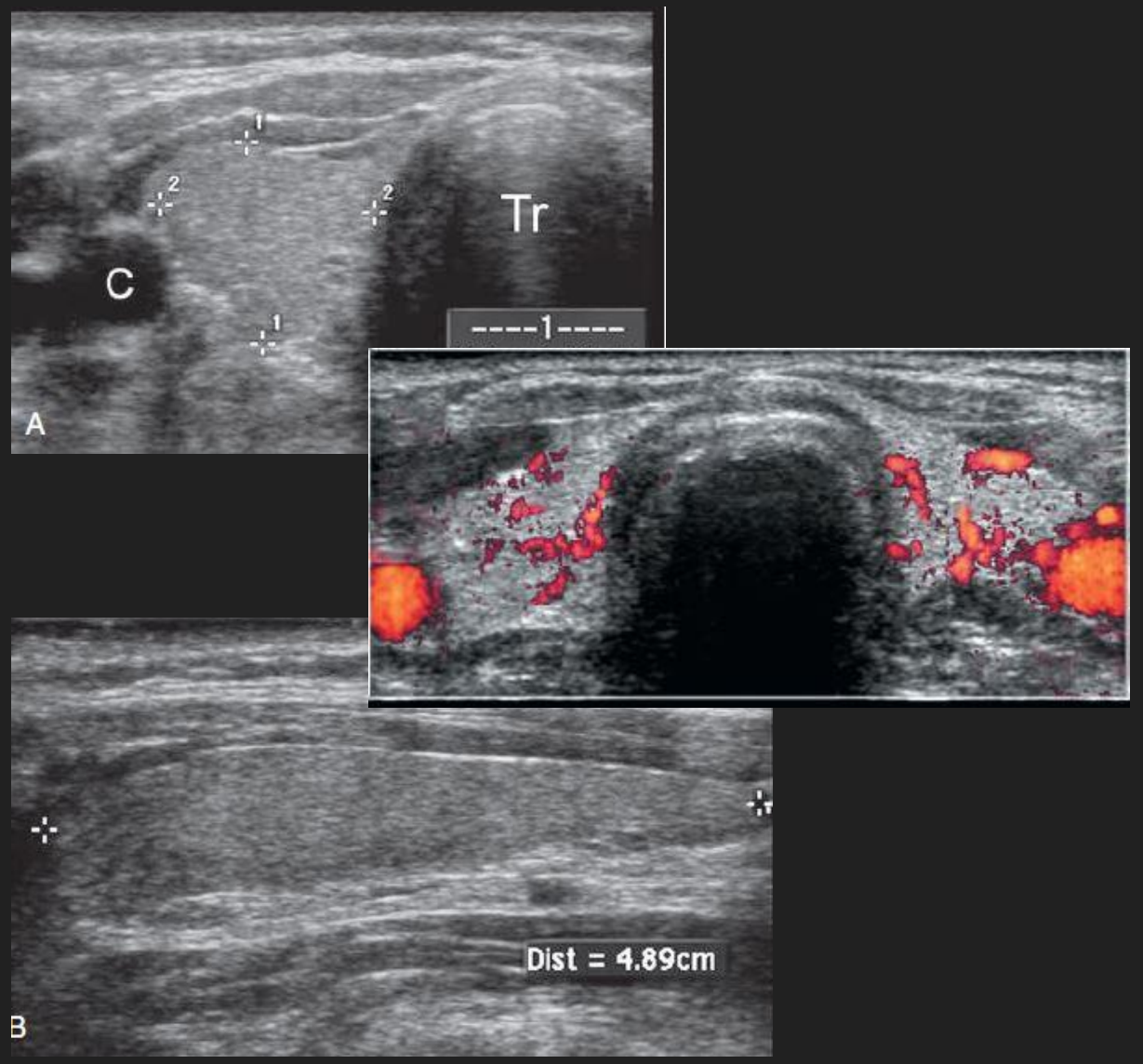
Thyroid Anatomy



- On US: Normal thyroid parenchyma is homogeneous, medium- to high-level echogenicity.
- Size:
  - In newborns, 18-20 mm long & 8-9 mm in AP diameter.
  - For adults, 40-60 mm long & 13-18 mm in AP diameter.
  - Mean thickness of isthmus is 4-6 mm
  - *Among linear parameters, AP diameter is most precise. When AP diameter is >2 cm, the gland maybe considered “enlarged”

Instrumentation and Technique

- High-frequency transducers (7.5 to 15.0 Mhz)
- Patient is typically scanned in the **supine position** with **neck extended.**
  - A small pad or pillow maybe placed under the shoulders.
- The gland must be examined thoroughly in both **transverse** and **longitudinal** planes.
- Assessment of the lower poles can be enhanced by asking the patient to **swallow**, momentarily **raising the gland** in the neck.

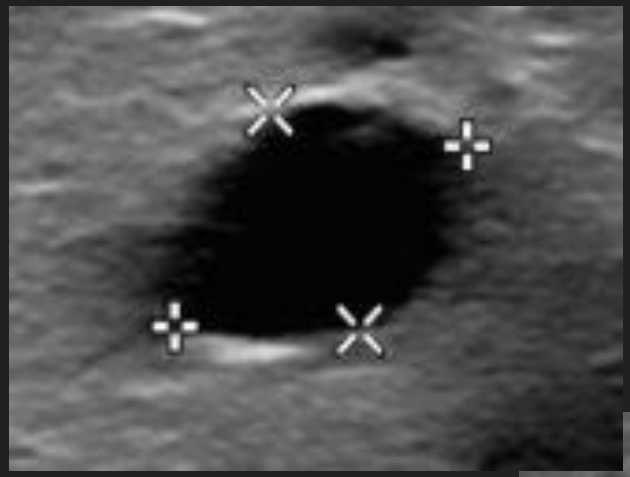


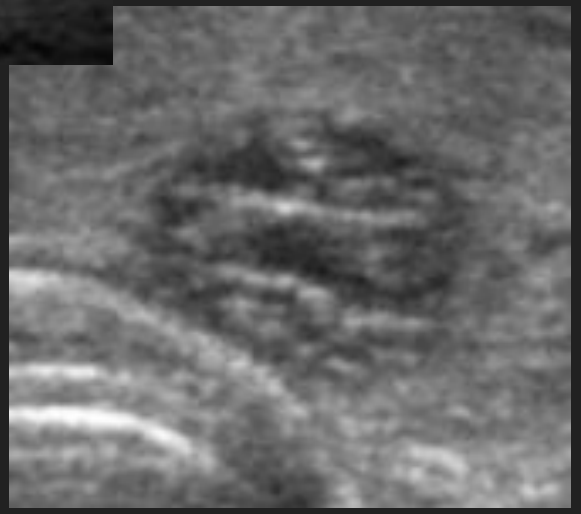
TIRADS Scoring

- **C**omposition
- **E**chogenicity
- **S**hape
- **M**argins
- **E**chogenic foci

TIRADS: Composition

- Cystic (0 points) - composed of entirely fluid components.
- Spongiform (0 points) - composed of predominantly tiny cystic spaces



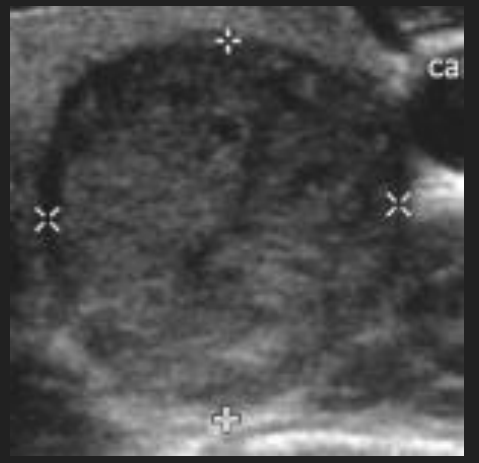


TIRADS: Composition

- Mixed cystic/solid (1 point) - composed of cystic and solid components
- *the echogenicity of solid component adds to the TIRADS score

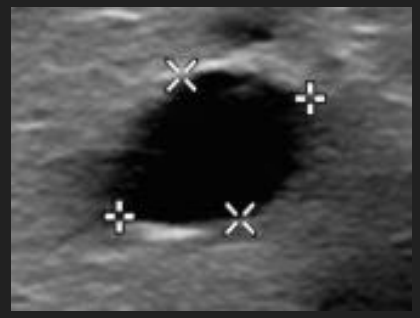
TIRADS: Composition

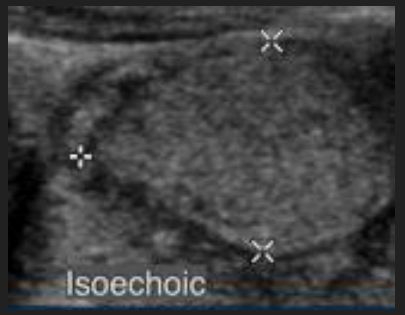
- Solid (2 points) - composed of nearly entirely soft tissue with only few cystic spaces.



TIRADS: Echogenicity

- Anechoic (0 point) - cystic.
- Hyperechoic (1 point) - increased echogenicity relative to thyroid tissue.
- Isoechoic (1 point) - similar echogenicity relative to thyroid tissue.



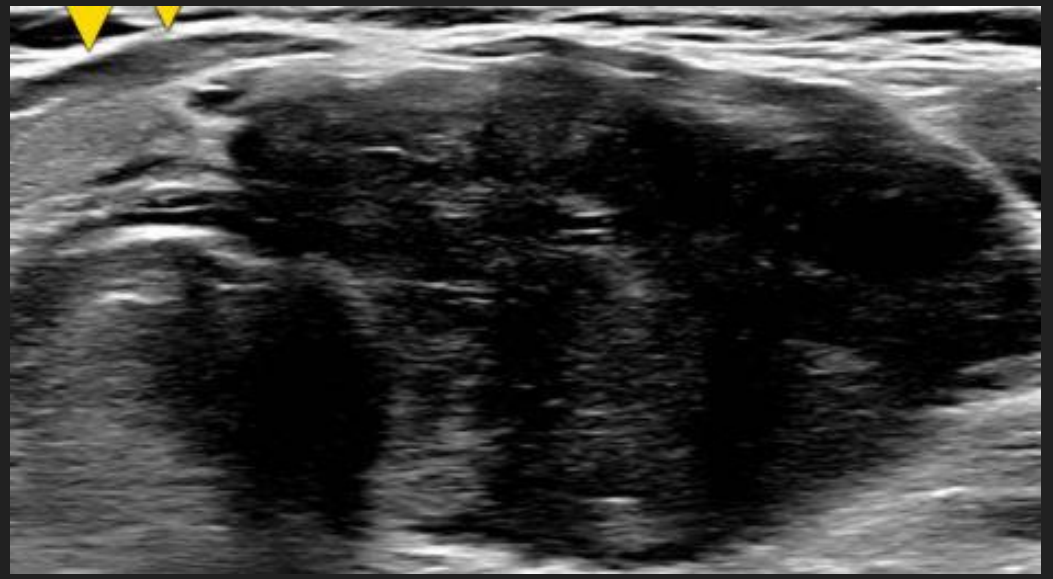


TIRADS: Echogenicity

- Hypoechoic (2 points) - decreased echogenicity relative to the thyroid tissue.
- *Echogenicity is cannot be assessed due to calcification (1 point).

TIRADS: Echogenicity

- Very hypoechoic (3 points) - decreased echogenicity relative to the adjacent neck musculature.

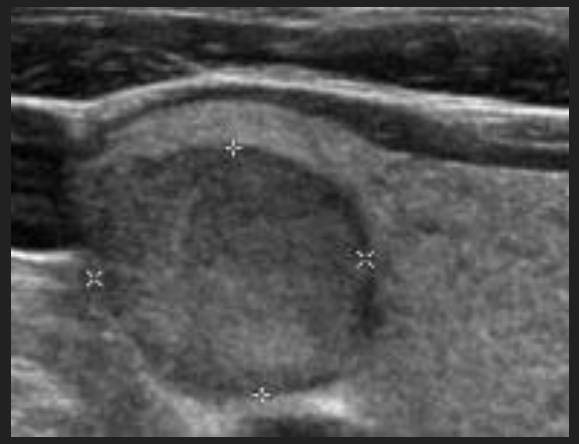


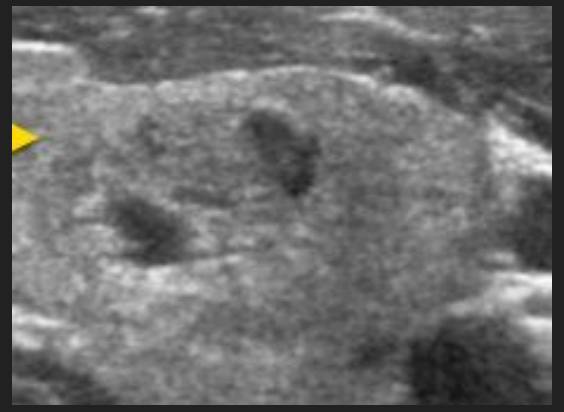
TIRADS: Shape

- Taller-than-wide (3 points) - defined as a ratio of >1 in the AP diameter to the horizontal diameter, measured in the transverse plane.
- Wider-than-tall (0 points) - defined as a ratio of <1 in the AP diameter to horizontal diameter, measured in the transverse plane.

TIRADS: Margin

- Smooth (0 points) - uninterrupted, well-defined, curvilinear edge
- Ill-defined (0 points)- border is difficult to distinguish from thyroid parenchyma



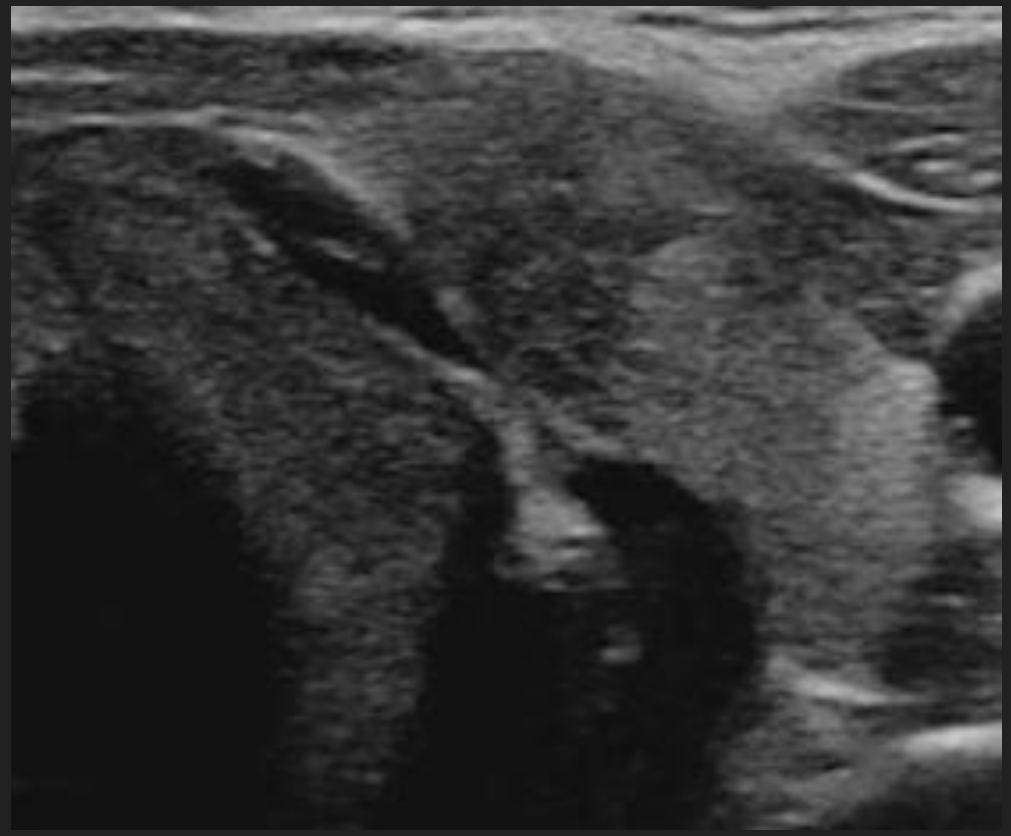


TIRADS: Margin

- Irregular margin (2 points) - spiculated, jagged, sharp angles
- Lobulated (2 points) - focal rounded soft tissue protrusions

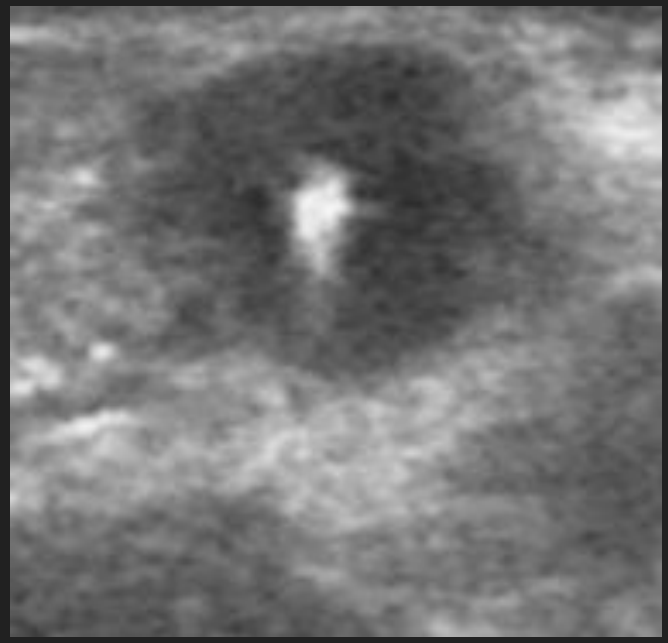
TIRADS: Margin

- Extra-thyroidal extension (3 points) - nodule extend through the thyroid capsule.



TIRADS: Echogenic Foci

- Comet-tail artifacts (0 points) - type of reverberation artifact.

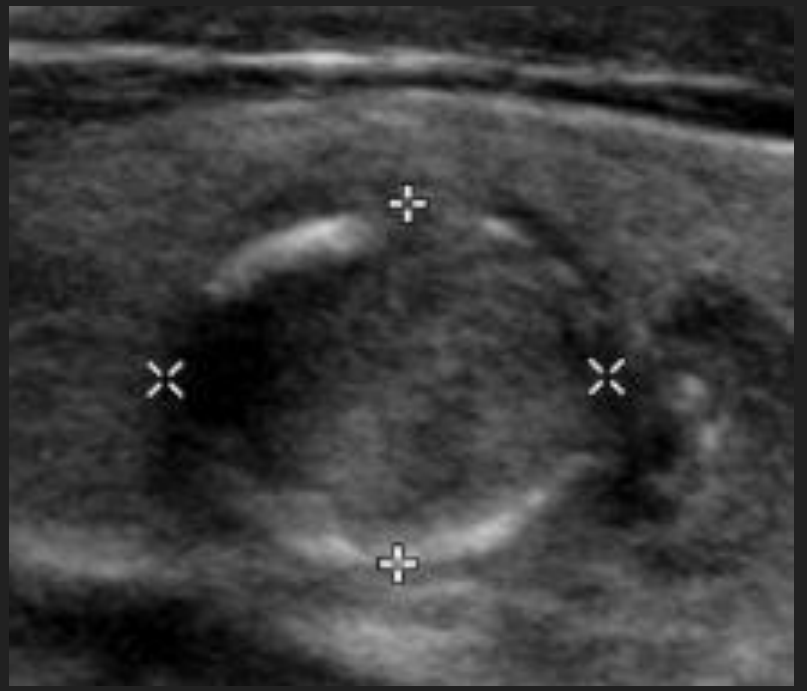


TIRADS: Echogenic Foci

- Macrocalcifications (1 point) - large enough calcifications that result in posterior acoustic shadowing.

TIRADS: Echogenic Foci

- Peripheral calcifications (2 points) - occupy the periphery of a nodule



TIRADS: Echogenic Foci

- Punctate echogenic foci (3 points) - “dot-like” foci having no posterior acoustic artifacts

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

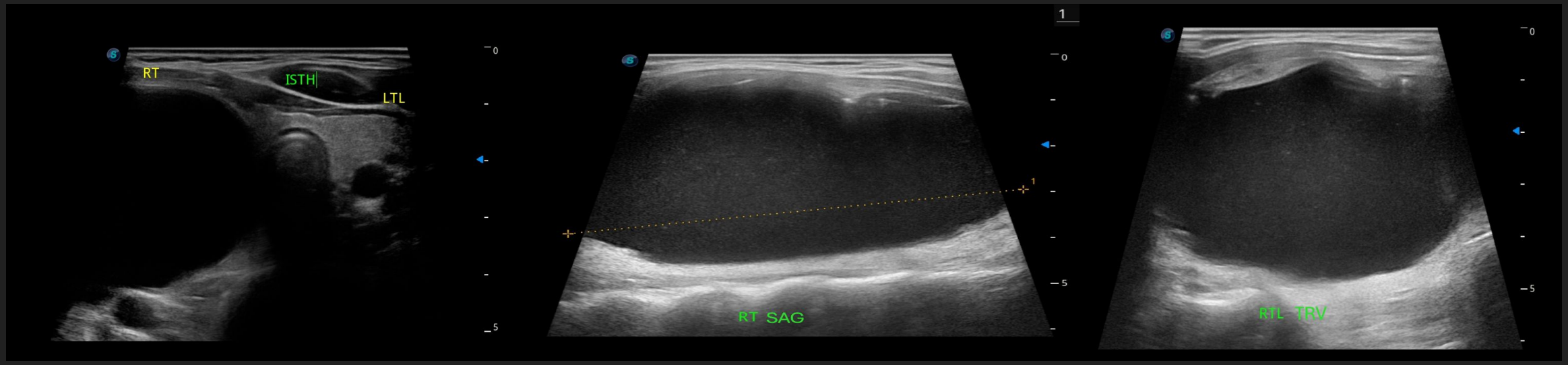
0 Points	2 Points	3 Points	4 to 6 Points	7 Points or More
TR1 Benign No FNA	**TR2** Not Suspicious No FNA	**TR3** Mildly Suspicious FNA if ≥ 2.5 cm Follow if ≥ 1.5 cm	**TR4** Moderately Suspicious FNA if ≥ 1.5 cm Follow if ≥ 1 cm	**TR5** Highly Suspicious FNA if ≥ 1 cm Follow if ≥ 0.5 cm*

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.

Tessler F.N., Middleton W.D., Grant E.G., et al. ACR Thyroid Imaging, Reporting and Data System (TI-RADS): White Paper of the ACR TI-RADS Committee. JACR. 2017;14(5):587–595. 10.1016/j.jacr.2017.01.046

Case 1

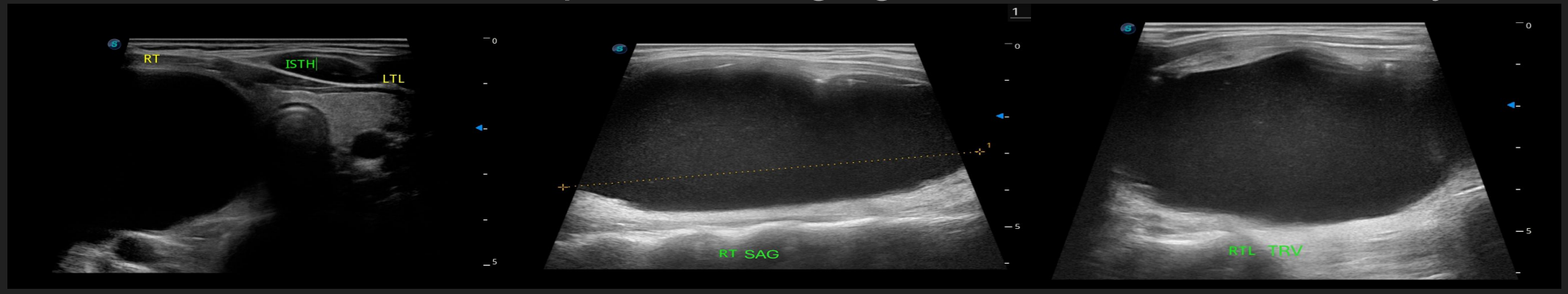
- 40 years old /Female
- Chief complaint: enlarging anterior neck mass for 4 years



- Enlarged RIGHT thyroid lobe. Cystic, anechoic, wider than tall mass with smooth margins is seen almost completely occupying the right lobe, measuring approximately 7 x 5.3 x 3.6 cm or about 68 cc. No evident intraluminal solid nodules or calcifications. No vascularity on color Doppler interrogation.
- LEFT thyroid lobe and isthmus are unremarkable. No evident enlarged cervical lymph nodes.

Case 1

- 40 years old /Female
- Chief complaint: enlarging anterior neck mass for 4 years



ACR TI-RADS

COMPOSITION (Choose 1)		ECHOGENICITY (Choose 1)		SHAPE (Choose 1)		MARGIN (Choose 1)		ECHOGENIC FOCI (Choose All That Apply)	
Cystic or almost completely cystic	0 points	Anechoic	0 points	Wider-than-tall	0 points	Smooth	0 points	None or large comet-tail artifacts	0 points
Spongiform	0 points	Hyperechoic or isoechoic	1 point	Taller-than-wide	3 points	Ill-defined	0 points	Macrocalcifications	1 point
Mixed cystic and solid	1 point	Hypoechoic	2 points			Lobulated or irregular	2 points	Peripheral (rim) calcifications	2 points
Solid or almost completely solid	2 points	Very hypoechoic	3 points			Extra-thyroidal extension	3 points	Punctate echogenic foci	3 points

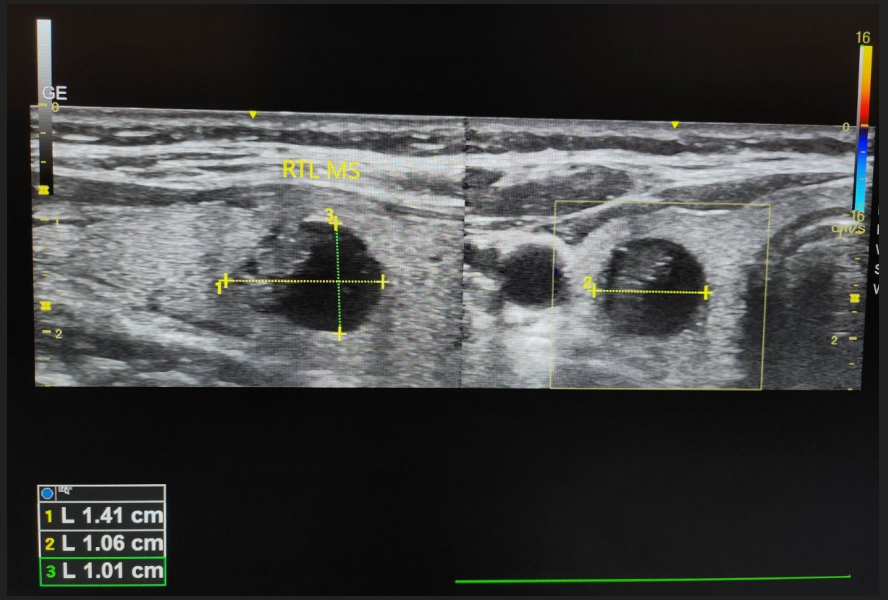
Add Points From All Categories to Determine TI-RADS Level

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*

- Points: **0**
- TIRADS score: **1 – BENIGN**
- Recommendation: **No FNA**

Case 2

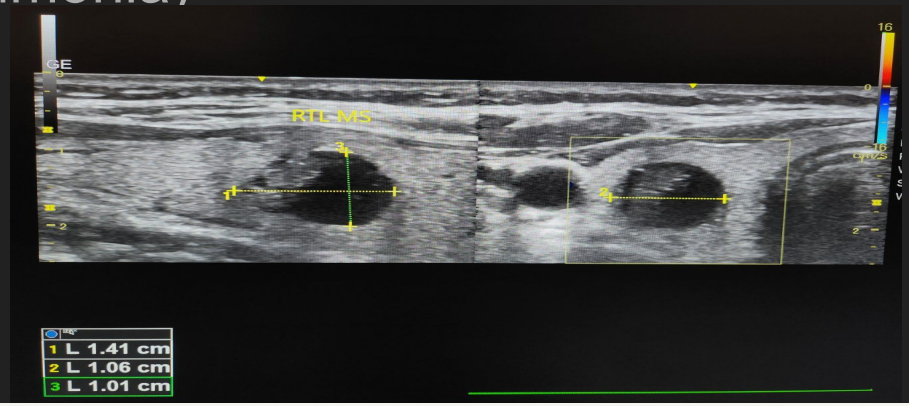
- 35 years old /Female
- Chief complaint: incidental note on Chest CT scan (admitted for pneumonia)



- Normal sized thyroid gland
- A mixed cystic and solid, with isoechoic solid component, wider than tall nodule with smooth margins is in the midsegment of the RIGHT lobe. No calcifications. No vascularity on color Doppler interrogation.
- No evident enlarged cervical lymph nodes.

Case 2

- 35 years old /Female
- Chief complaint: incidental note on Chest CT scan (admitted for pneumonia)



ACR TI-RADS

COMPOSITION (Choose 1)		ECHOGENICITY (Choose 1)		SHAPE (Choose 1)		MARGIN (Choose 1)		ECHOGENIC FOCI (Choose All That Apply)	
Cystic or almost completely cystic	0 points	Anechoic	0 points	Wider-than-tall	0 points	Smooth	0 points	None or large comet-tail artifacts	0 points
Spongiform	0 points	Hyperechoic or isoechoic	1 point	Taller-than-wide	3 points	Ill-defined	0 points	Macrocalcifications	1 point
Mixed cystic and solid	1 point	Hypoechoic	2 points			Lobulated or irregular	2 points	Peripheral (rim) calcifications	2 points
Solid or almost completely solid	2 points	Very hypoechoic	3 points			Extra-thyroidal extension	3 points	Punctate echogenic foci	3 points

Add Points From All Categories to Determine TI-RADS Level

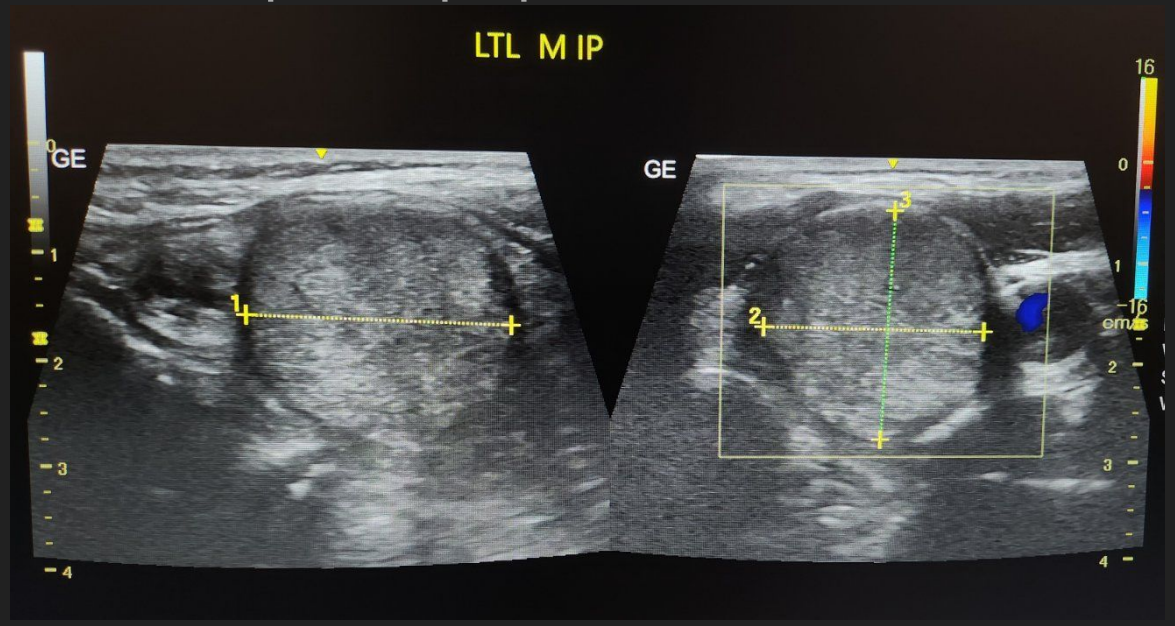
0 Points	2 Points	3 Points	4 to 6 Points	7 Points or More
TR1 Benign No FNA	TR2 Not Suspicious No FNA	TR3 Mildly Suspicious FNA if ≥ 2.5 cm Follow if ≥ 1.5 cm	TR4 Moderately Suspicious FNA if ≥ 1.5 cm Follow if ≥ 1 cm	TR5 Highly Suspicious FNA if ≥ 1 cm Follow if ≥ 0.5 cm*

- Points: **2**
- TIRADS score: **2 – NOT SUSPICIOUS**
- Recommendation: **No FNA**

COMPOSITION
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.

Case 3

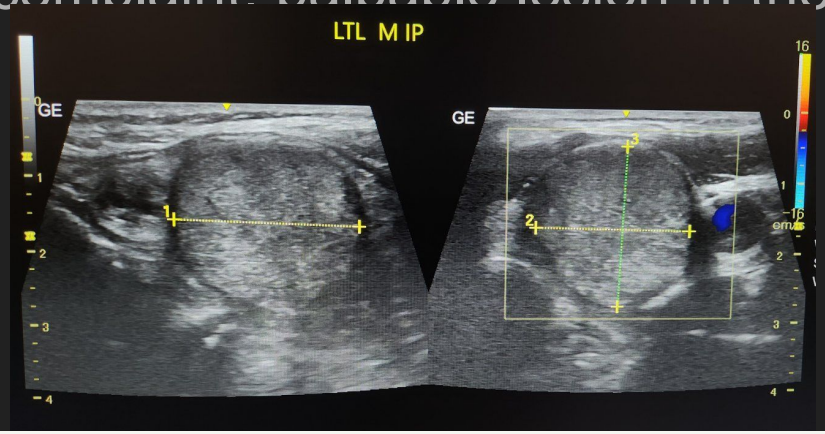
- 49 years old /Female
- Chief complaint: palpable lesion in the anterior neck, more in the left



- Enlarged thyroid gland, with coarsened parenchymal echopattern
- A solid, isoechoic, wider than tall nodule with smooth margins is in the midsegment to inferior pole of the LEFT lobe, measuring 2.5 x 2.3 x 2.3 cm (CCWAP). No calcifications. No vascularity on color Doppler interrogation.
- No evident enlarged cervical lymph nodes.

Case 3

- 49 years old /Female
- Chief complaint: palpable lesion in the anterior neck, more in the left



ACR TI-RADS

COMPOSITION (Choose 1)		ECHOGENICITY (Choose 1)		SHAPE (Choose 1)		MARGIN (Choose 1)		ECHOGENIC FOCI (Choose All That Apply)	
Cystic or almost completely cystic	0 points	Anechoic	0 points	Wider-than-tall	0 points	Smooth	0 points	None or large comet-tail artifacts	0 points
Spongiform	0 points	Hyperechoic or isoechoic	1 point	Taller-than-wide	3 points	Ill-defined	0 points	Macrocalcifications	1 point
Mixed cystic and solid	1 point	Hypoechoic	2 points			Lobulated or irregular	2 points	Peripheral (rim) calcifications	2 points
Solid or almost completely solid	2 points	Very hypoechoic	3 points			Extra-thyroidal extension	3 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*

- Points: **3**
- TIRADS score: **3**

MILDLY SUSPICIOUS

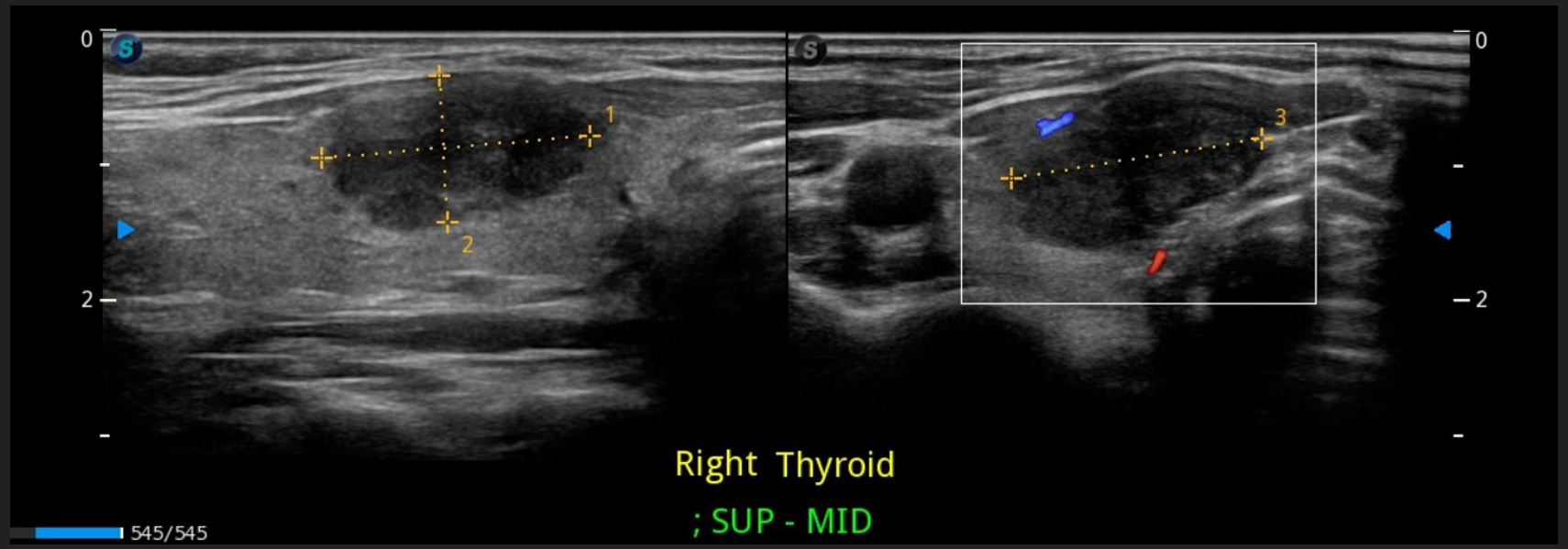
- Recommendation:

FNA IF ≥ 2.5 CM

FOLLOW IF ≥ 1.5 CM

Case 4

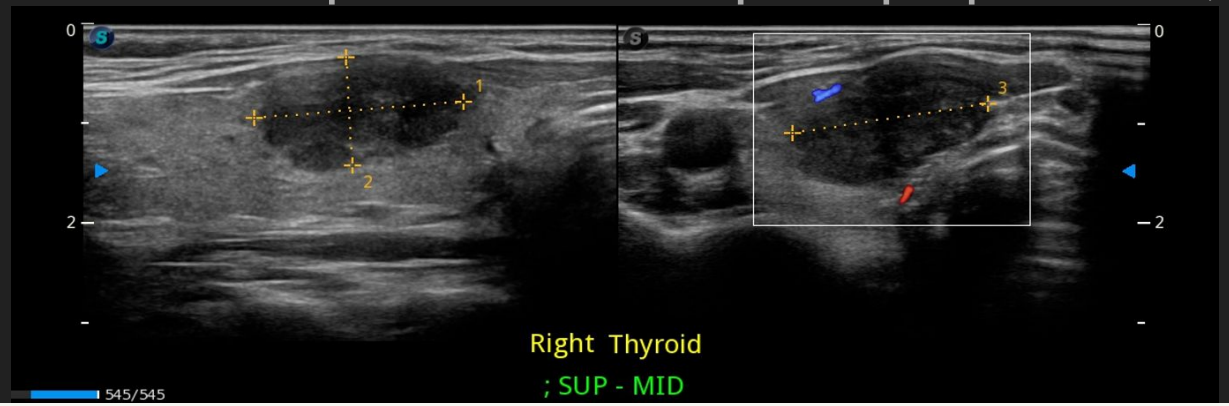
- 48 years old /Female
- Chief complaint: check up for palpitations, elevated FT4



- Normal sized thyroid gland
- A solid, hypoechoic, wider than tall nodule with lobulated margins is in the superior pole to midsegment of the RIGHT lobe, measuring 2 x 1.9 x 1.1 cm (CCWAP). No calcifications. Minimal peripheral vascularity on color Doppler interrogation.
- No evident enlarged cervical lymph nodes.

Case 4

- 48 years old /Female
- Chief complaint: check up for palpitations, elevated FT4



ACR TI-RADS

COMPOSITION (Choose 1)		ECHOGENICITY (Choose 1)		SHAPE (Choose 1)		MARGIN (Choose 1)		ECHOGENIC FOCI (Choose All That Apply)	
Cystic or almost completely cystic	0 points	Anechoic	0 points	Wider-than-tall	0 points	Smooth	0 points	None or large comet-tail artifacts	0 points
Spongiform	0 points	Hyperechoic or isoechoic	1 point	Taller-than-wide	3 points	Ill-defined	0 points	Macrocalcifications	1 point
Mixed cystic and solid	1 point	Hypoechoic	2 points			Lobulated or irregular	2 points	Peripheral (rim) calcifications	2 points
Solid or almost completely solid	2 points	Very hypoechoic	3 points			Extra-thyroidal extension	3 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*

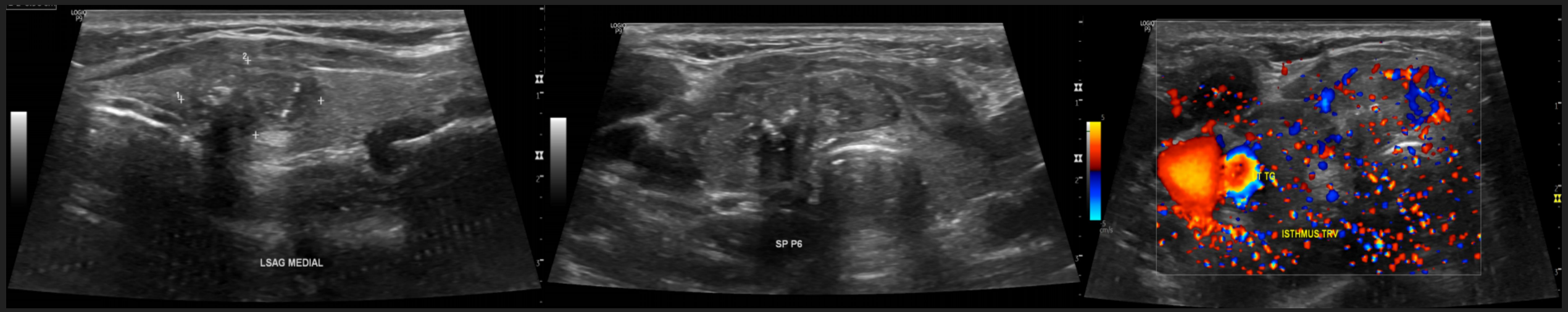
- Points: **6**
- TIRADS score: **4 MODERATELY SUSPICIOUS**
- Recommendation:

FNA IF ≥ 1.5 CM

FOLLOW IF ≥ 1 CM

Case 5

- 36 years old /Female
- Chief complaint: check up for hypertension, low TSH, normal FT4



- Normal sized thyroid gland
- There is a solid, predominantly hypoechoic (especially in the superior aspect of the isthmus), wider-than-tall nodule, with ill- defined margins, macrocalcifications and punctate echogenic foci, occupying the medial aspect of the LEFT lobe extending to most of the isthmus. It measures at least 2.2 x 2.6 x 0.8 cm (CCWAP), and partially indents on the trachea. There is peripheral and internal vascularity on color Doppler interrogation.
- No evident enlarged cervical lymph nodes.

Case 5

- 36 years old /Female
- Chief complaint: check up for hypertension, low TSH, normal FT4

ACR TI-RADS

COMPOSITION (Choose 1)		ECHOGENICITY (Choose 1)		SHAPE (Choose 1)		MARGIN (Choose 1)		ECHOGENIC FOCI (Choose All That Apply)	
Cystic or almost completely cystic	0 points	Anechoic	0 points	Wider-than-tall	0 points	Smooth	0 points	None or large comet-tail artifacts	0 points
Spongiform	0 points	Hyperechoic or isoechoic	1 point	Taller-than-wide	3 points	Ill-defined	0 points	Macrocalcifications	1 point
Mixed cystic and solid	1 point	Hypoechoic	2 points			Lobulated or irregular	2 points	Peripheral (rim) calcifications	2 points
Solid or almost completely solid	2 points	Very hypoechoic	3 points			Extra-thyroidal extension	3 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*

- Points: **8**
- TIRADS score: **5**

HIGHLY SUSPICIOUS

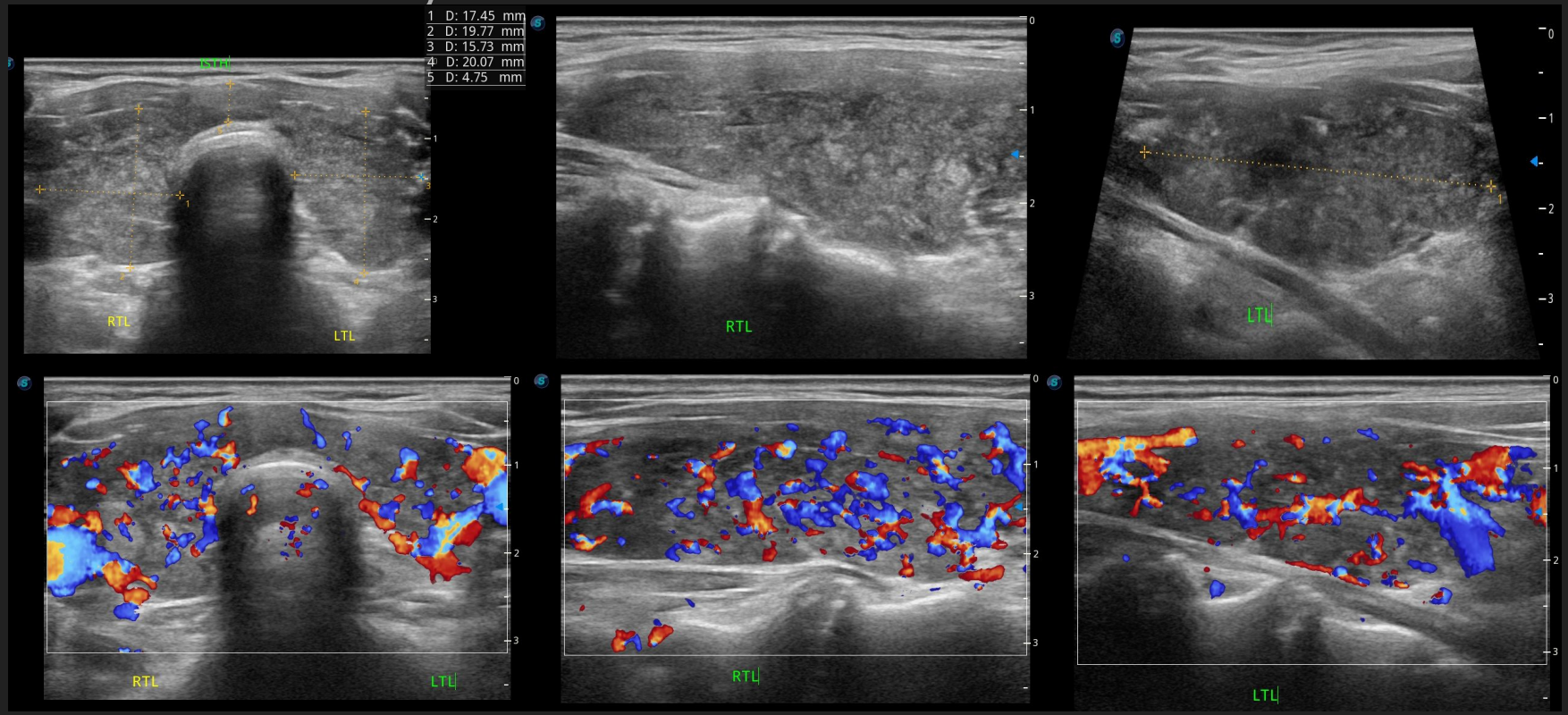
- Recommendation:

FNA IF ≥ 1 CM

FOLLOW IF ≥ 0.5 CM

Case 6

- 27 years old /Female
- Chief complaint: Known case of Hashimoto’s thyroiditis, follow up, on Levothyroxine



- Enlarged thyroid gland, with diffusely heterogenous and coarsened echopattern. There are multiple, discrete hypo and hyperechoic micronodules seen scattered in both lobes. There is increased vascularity on color Doppler interrogation.
- No evident enlarged cervical lymph nodes.

Hashimoto's Thyroiditis or Chronic Autoimmune Lymphocytic Thyroiditis

- The *most common type*
- Typically occurs as a *painless, diffuse enlargement of the thyroid gland* in a young or middle-aged woman often associated with hypothyroidism
- **On ultrasound:**
  - Typical appearance is *diffuse coarsened parenchymal echotexture generally more hypoechoic than a normal thyroid gland*; In most cases, the thyroid gland is enlarged
  - *Micronodulation*
    - Strongly suggestive of chronic thyroiditis
    - Multiple, discrete hypoechoic micronodules from 1-6mm in diameter
  - *Vascularity is normal or decreased*; occasionally, hypervascularity similar to the *"thyroid inferno"* of Grave's disease occurs
  - Cervical lymphadenopathy is present, most evident near the lower pole of the thyroid gland
- End stage: atrophy, when the thyroid gland is *small with poorly defined margins and heterogeneous texture* caused by *progressive fibrosis*; blood flow signals are absent

-End of Presentation-

Thank you for listening!