UNIVERSITY OF ALBERTA

Thyroid Ultrasound

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Disclosure

- I am a body and breast radiologist with Medical Imaging Consultants
- I work full-time predominantly at the RAH, but also at UAH and MIC clinics

Objectives

- Understand the indications for thyroid ultrasound
- Appreciate the appropriate management of thyroid nodules, with particular emphasis on ACR TI-RADS
- Know the pathway to request a thyroid FNA
- Learn how a thyroid biopsy is performed and what the pathology results indicate

Indications for thyroid ultrasound

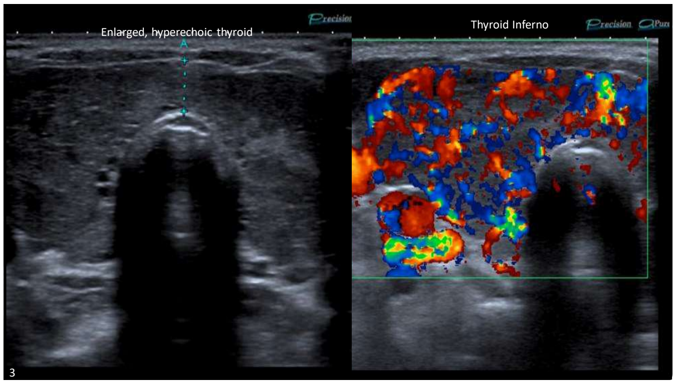
- Clinically you palpate a thyroid nodule, or the patient subjectively feels a nodule/fullness in the neck
- To follow thyroid nodules seen on prior US, as per ACR TI-RADS recommendations
- To identify a thyroid incidentaloma seen on CT/MR/NM
- Hyperthyroidism/Hypothyroidism workup
- Screening for mets/recurrent disease after thyroidectomy

Diffuse Thyroid Diseases

Graves Disease (1,2)

- Hyperthyroidism, TSH receptor AB+
- Middle aged female

- Why order thyroid US?
  - Not typically required for diagnosis
  - Detect nodules – higher risk of thyroid cancer
    - Poor clinical palpation in Graves
  - Fail medical therapy and searching for an alternative dx
  - Thyroid volume estimation prior to radioactive iodine ablation



Enlarged, hyperechoic thyroid

Thyroid Inferno

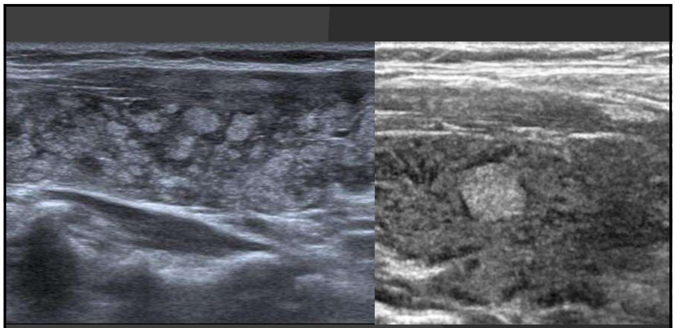
3

Hashimotos Thyroiditis(4)

- Hypothyroidism (typically)
- Anti TPO Ab + (90%); Anti thyroglobulin Ab+ (70%)
- Middle aged females
- Why order thyroid US?
  - Increases both sensitive and specificity of diagnosis with biochemical tests
    - Autoantibodies may be absent in 13%-17%
    - Autoantibodies may be present in 2-20% of general population
  - Can lead to thyroid lymphoma and papillary thyroid Ca

Hashimotos Thyroiditis(5,6)

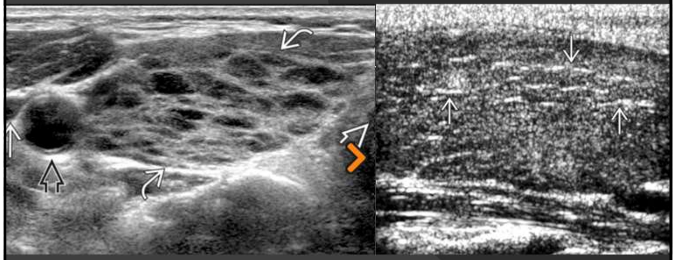
- Thyroid US
  - Early phase: Diffuse enlargement with heterogenous echotexture
    - Multiple discrete nodules or micronodules
  - End stage: Atrophic thyroid
  - Can be hypervascular, but not to the same degree as Graves



Giraffe/pseudonodular pattern

“white knight"

5,6



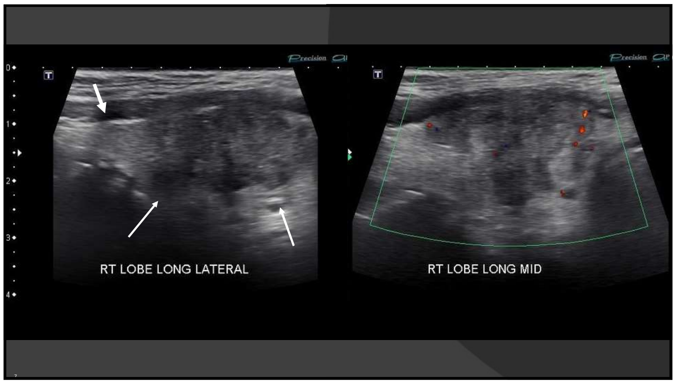
Swiss cheese/leopard appearance

Diffusely hypoechoic with echogenic fibrous bands

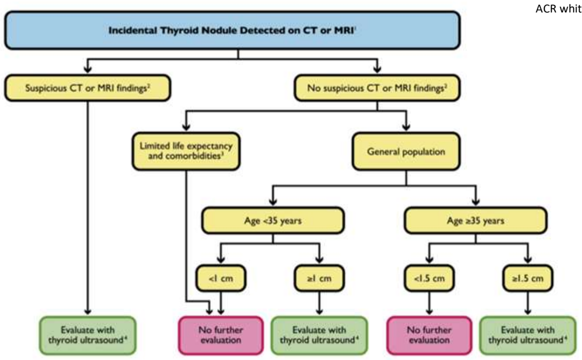
5,6

De Quervian Thyroiditis(7)

- Painful neck after a URTI
- Hyperthyroid initially then hypothyroid
- Thyroid US
  - Focal areas of decreased echogenicity and hypovascularity



Incidental Thyroid nodule detected on other imaging



ACR white paper

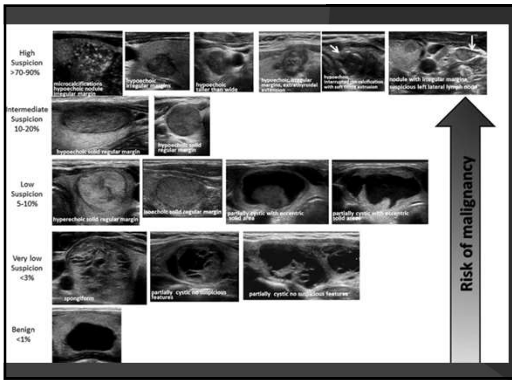
Thyroid nodule

Thyroid nodules

- Two classification systems
  - ACR TI-RADS
  - ATA
- We typically follow ACR TI-RADS
- In our reports, we won’t mention all nodules!
- Will report and follow only a maximum of 4 nodules as per ACR TI-RADS
- Maximum biopsy 2 most suspicious nodules as per ACR TI-RADS

Briefly…

- American Thyroid Association guidelines
  - High suspicion pattern (> 70-90% risk): Solid hypoechoic nodule (or solid hypoechoic component of cystic nodule) with one of:
    - Microcalcifications, irregular margins, extrathyroidal extension, taller than wide, rim calcifications with extrusive ST component, LNs
    - Biopsy > 1cm
  - Intermediate suspicion pattern (10-20% risk): hypoechoic solid nodule with smooth margins
    - Biopsy > 1cm
  - Low suspicion pattern (5-10% risk): Isoechoic/hyperechoic nodule or partially cystic with peripheral solid component
    - Biopsy > 1.5cm
  - Very low suspicion pattern (<3% risk): Spongiform nodules
    - Biopsy > 2 cm; or ultrasound follow up



- Biopsy > 1 cm
- Biopsy > 1 cm
- Biopsy > 1.5 cm
- Biopsy > 2 cm ; or US F/U

ACR TI-RADS

- 5 key categories, adding points up to give a TI-RADS score
- These categories are:
  - Composition (0-2 points)
  - Echogenicity (0-3 points)
  - Shape (either 0 or 3 points)
  - Margin (0, 2 or 3 points)
  - Echogenic foci (0 to 3 points AND ADDITIVE!)

Thyroid nodules

- Add the points up and you get a TI-RADS Score!

- TI-RADS 1 and 2 nodules are essentially benign: 0.3%; 1.5%
- TI-RADS 3: ~5%
- TI-RADS 4: ~9%
- TI-RADS 5: ~35%

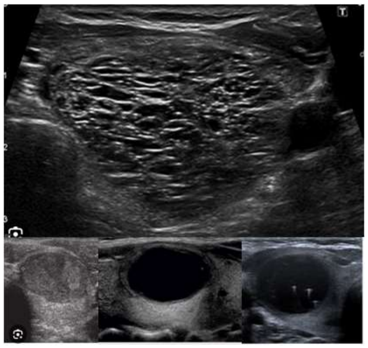
Composition

- Cystic or nearly completely cystic – 0
- Spongiform - 0

Automatically TI-RADS 1, no more points added!

- Mixed cystic and solid - 1
- Solid or predominantly solid - 2

Composition



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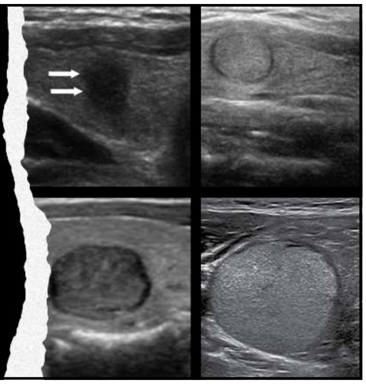
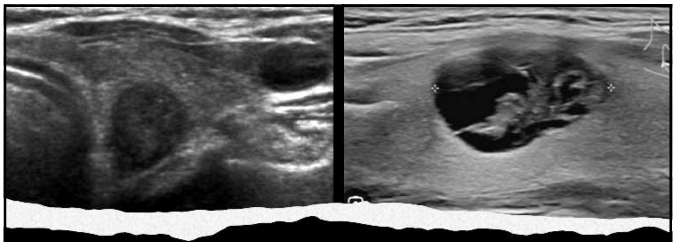
Echogenicity

- Anechoic – 0
- Hyperechoic/Isoechoic - 1
- Hypoechoic - 2
- Very hypoechoic - 3



12-15



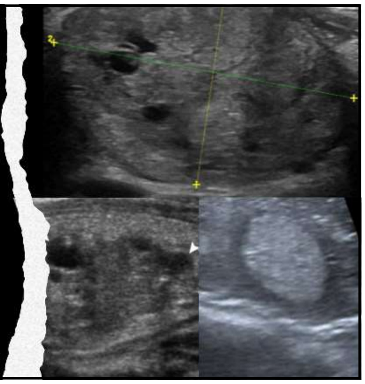
Shape

- Wider than Tall – 0
- Taller than Wide - 3

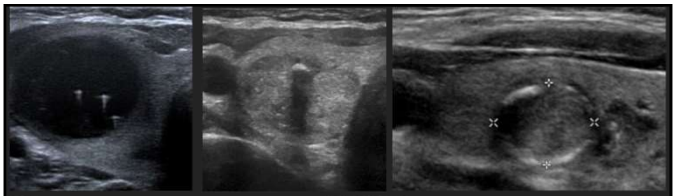
16,17

Margin

- Smooth – 0
- Ill defined - 0
- Lobulated/Irregular - 2
- Extra-thyroidal extension - 3



18-20

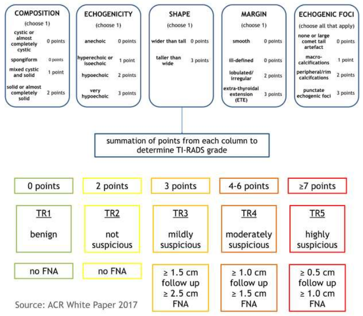


Echogenic Foci

- None or comet tail artifact – 0
- Macrocalcifications - 1
- Peripheral/rim calcifications- 2
- Punctate echogenic foci - 3

10,21,22

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/ irregular 2 points
extra-thyroidal extension (ETE) 3 points

ECHOGENIC FOCI (choose all that apply)
none or large comet tail artefact 0 points
macro-calcifications 1 point
peripheral/rim calcifcations 2 points
punctate echogenic foci 3 points

summation of points from each column to determine TI-RADS grade

0 points	2 points	3 points	4-6 points	≥7 points
TR1 benign	TR2 not suspicious	TR3 mildly suspicious	TR4 moderately suspicious	TR5 highly suspicious
no FNA	no FNA	≥ 1.5 cm follow up ≥ 2.5 cm FNA	≥ 1.0 cm follow up ≥ 1.5 cm FNA	≥ 0.5 cm follow up ≥ 1.0 cm FNA

Source: ACR White Paper 2017

Thyroid nodules

- ACR TI-RADS
  - TR-5 (> 7 points): highly suspicious (35% malignancy)
    - Biopsy > 1 cm; US follow-up > 0.5 cm (annual for 5 years)
  - TR-4 (4-6 points): moderately suspicious (9.1% malignancy)
    - Biopsy > 1.5 cm; US follow-up > 1 cm (at 1, 2, 3, 5 years)
  - TR-3 (3 points): mildly suspicious (4.8% malignancy)
    - Biopsy > 2.5 cm; US follow-up > 1.5 cm (at 1, 3, 5 years)

So, you would like a thyroid biopsy done?

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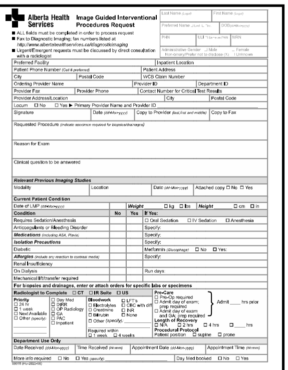
So, you would like a thyroid biopsy?

- Fax to hospital you want procedure done at:
  - RAH: 780-735-5414
  - UAH: 780-407-6658
- Or order in connect-care



Alberta Health Services **Image Guided Interventional Procedures Request**

- ALL fields must be completed in order to process request
- Fax to Diagnostic Imaging; fax numbers listed at *http://www.albertahealthservices.ca/diagnosticimaging*
- Urgent/Emergent requests must be discussed by direct consultation with a radiologist

Last Name *(Legal)* | First Name *(Legal)*
Preferred Name ☐ Last ☐ First | DOB *(dd-Mon-yyyy)*
PHN | ULI ☐ Same as PHN | MRN
Administrative Gender ☐ Male ☐ Female ☐ Non-binary/Prefer not to disclose (X) ☐ Unknown

Preferred Facility | Inpatient Location
Patient Phone Number *(Cell # preferred)* | Patient Address
City | Postal Code | WCB Claim Number
Ordering Provider Name | Provider ID | Department ID
Provider Fax | Provider Phone | Contact Number for Critical Test Results
Provider Address/Location | City | Postal Code
Locum ☐ No ☐ Yes ▶ Primary Provider Name and Provider ID ____________
Signature | Date *(dd-Mon-yyyy)* | Copy to Provider *(last,first and middle)* | Copy to Fax
Requested Procedure *(indicate specimen required for biopsies/drainages)*
Reason for Exam
Clinical question to be answered

Relevant Previous Imaging Studies
Modality | Location | Date *(dd-Mon-yyyy)* | Attached copy ☐ No ☐ Yes

Current Patient Condition
Date of LMP *(dd-Mon-yyyy)* | ***Weight*** ______ ☐ kg ☐ lbs | ***Height*** ______ ☐ cm ☐ in

Condition	No	Yes	If Yes:
Requires Sedation/Anesthesia			☐ Oral Sedation ☐ IV Sedation ☐ Anesthesia
Anticoagulants or Bleeding Disorder			Specify:
Medications *(including ASA, Plavix)*			Specify:
Isolation Precautions			Specify:
Diabetic			Metformin *(Glucophage)* ☐ No ☐ Yes:
Allergies *(include any reaction to contrast media)*			Specify:
Renal Insufficiency			
On Dialysis			Run days:
Mechanical lift/transfer required			

For biopsies and drainages, enter or attach orders for specific labs or specimens

Radiologist to Complete ☐ **CT** ☐ **IR Suite** ☐ **US**

Priority
☐ 24 hr
☐ 1 week
☐ Next Available
☐ Other *(specify)*:

☐ Day Med
☐ DIRR
☐ OP Radiology
☐ GA
☐ PAC
☐ Inpatient

Bloodwork
☐ Electrolytes ☐ LFT's
☐ Creatinine ☐ CBC with diff
☐ Bilirubin ☐ INR
☐ None
☐ Other *(specify)*: ____________
Required within
☐ 1 week ☐ 4 weeks

Pre-Care
☐ Pre-Op required
☐ Admit day of exam; prep required
☐ Admit day of exam and GA; prep required
Admit ____ hrs prior
Length of Recovery
☐ N/A ☐ 2 hrs ☐ 4 hrs ☐ ____ hrs
Procedural Protocol
Patient position ☐ supine ☐ prone

Department Use Only
Date Received *(dd-Mon-yyyy)* | Time Received *(hh:mm)* | Appointment Date *(dd-Mon-yyyy)* | Appointment Time *(hh:mm)*
More info required ☐ No ☐ Yes *(specify)*: ____________ | Day Med booked ☐ No ☐ Yes

09015 (Rev2022-08)

Referral pathway

- Urgent?
- Give us a call!!
- Can page ultrasound radiologist at required hospital
  - UAH Radiology switchboard: 780-407-3225
  - RAH switchboard: 780-735-4111
- Can call US department directly to talk to clerk:
  - UAH: 780-735-3225
  - RAH: 780-735-4310

Referral pathway

- Have a question about a procedure and want to talk to a specialist radiologist?
  - ConnectMD
    - Run through PCN's (https://pcnconnectmd.com/)
    - 1-844-633-2263
- Want to talk to a radiologist about a specific report?
  - 1-844-MIC-4RAD

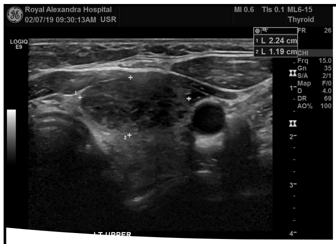
Thyroid FNA

- What do you tell your patient about what's going to happen?

- Quick day procedure
- At RAH or KEC
- Only FNA with local anesthetic
- Neck will be pink afterwards
- 2 or 4 FNA samples
- Pathology typically in 1 week

Biopsy

- Low bleeding risk
- No routine blood work
  - if done - INR < 3; plt > 20
- Do not withhold meds
- Risks: very rare; infection, bleeding/hematoma, pain, injury to surrounding structures
- We scan the patient's neck, find nodule, mark skin entry point
- Clean skin – chlorhexidine
- Freeze skin/deeper tissues to nodule (1% lidocaine)
- 2 x 25G needle FNA - ?adequate
- 2 more?



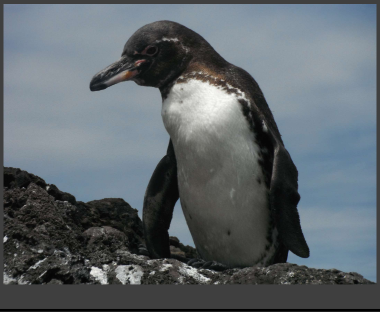
Thyroid Biopsy

Results

- What do the results mean?

- Benign – Follow up?
- Papillary carcinoma – surgery
- Follicular NEOPLASM – surgery
- Atypical cells of undetermined significance – Repeat? Follow? Core?
- Non-diagnostic – repeat? Follow? Core?

Questions?



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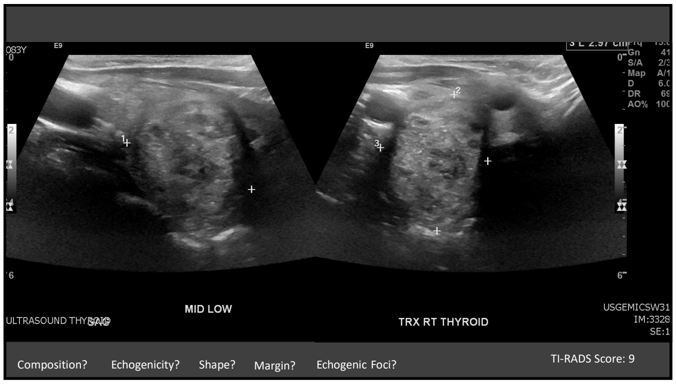
A couple real life cases (time permitting)



Composition? Echogenicity? Shape? Margin? Echogenic Foci?

TI-RADS Score: 9

Composition?

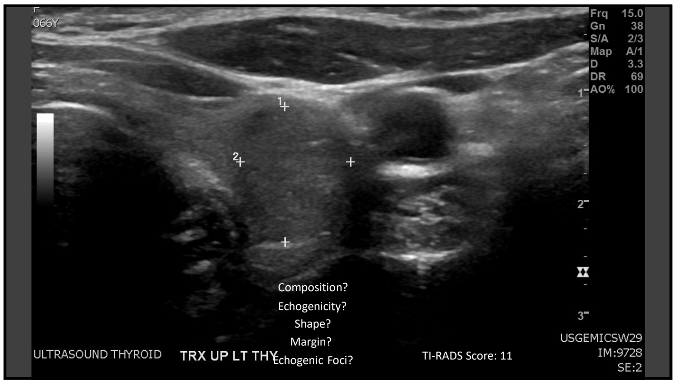
Echogenicity?

Shape?

Margin?

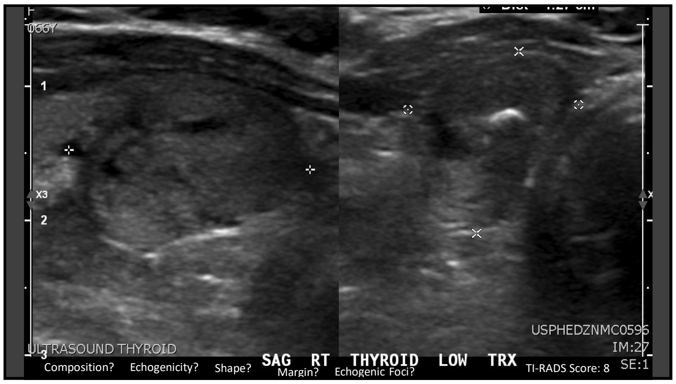
Echogenic Foci?

TI-RADS Score: 4



Composition?
Echogenicity?
Shape?
Margin?
Echogenic Foci?

TI-RADS Score: 11

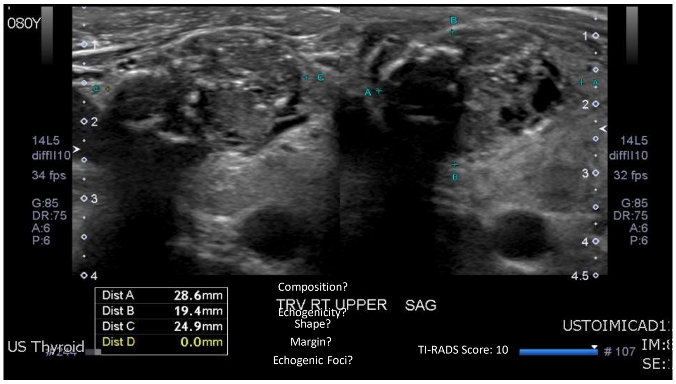


Composition? Echogenicity? Shape? Margin? Echogenic Foci?

TI-RADS Score: 8

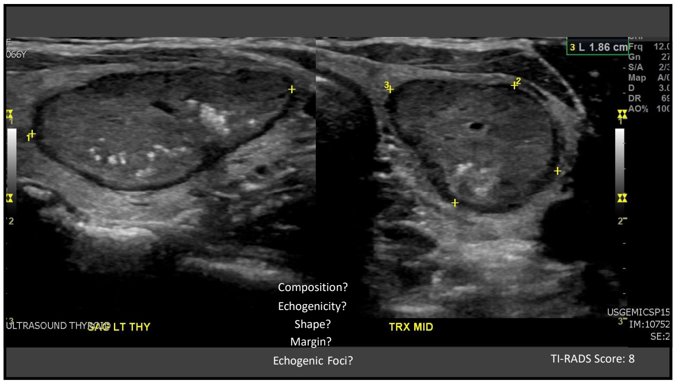
Composition?
Echogenicity?
Shape?
Margin?
Echogenic Foci?

TI-RADS Score: 6



Composition?
Echogenicity?
Shape?
Margin?
Echogenic Foci?

TI-RADS Score: 10



Composition?
Echogenicity?
Shape?
Margin?
Echogenic Foci?

TI-RADS Score: 8