Interpreting the Thyroid Ultrasound Report

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Goals

• Review indications for thyroid ultrasound
• Review the role of ultrasound in evaluation of thyroid nodules
• Describe ultrasound findings which are associated with malignancy
• Introduce the ACR TI-RADS guidelines for risk stratification
Indications for Thyroid Ultrasound

• Palpable anterior neck mass
• Pressure, fullness, difficulty swallowing
• Incidental thyroid mass on imaging
Incidental Thyroid Nodule Detected on CT or MRI

- Suspicious CT or MRI findings
  - Limited life expectancy and comorbidities
    - Age <35 years
      - <1 cm: Evaluate with thyroid ultrasound
      - ≥1 cm: No further evaluation
    - Age ≥35 years
      - <1.5 cm: Evaluate with thyroid ultrasound
      - ≥1.5 cm: No further evaluation
- No suspicious CT or MRI findings
  - General population
    - Age <35 years
      - <1 cm: No further evaluation
      - ≥1 cm: Evaluate with thyroid ultrasound
    - Age ≥35 years
      - <1.5 cm: No further evaluation
      - ≥1.5 cm: Evaluate with thyroid ultrasound
Incidental Thyroid Nodule Detected on $^{18}$FDG-PET and Other Nuclear Medicine Scans

- **Focal activity**
  - Limited life expectancy and comorbidities
    - No further evaluation
  - General population
    - Evaluate with thyroid ultrasound

- **ITN on accompanying PET/CT or PET/MRI without metabolic activity**
  - Refer to Recommendations for ITN on CT and MRI
Role of thyroid ultrasound

• Characteristics of each nodule
  – Composition
  – Shape
  – Echogenicity
  – Margins
  – Echogenic foci
  – Vascularity
Role of thyroid ultrasound

– No single imaging characteristic is sufficiently sensitive or specific to guide management decisions
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– Therefore, numerous guidelines have been developed to look at combinations of imaging characteristics to stratify risk and guide management
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- In general, guidelines suffer from a very low PPV (≈5-10%)
Nodule characteristics

– Composition
– Shape
– Echogenicity
– Margins
– Echogenic foci
Composition:
Cystic or almost completely cystic
Composition: Spongiform
Composition:
Mixed cystic and solid
Composition:
Solid or almost completely solid
Echogenicity: Anechoic
Echogenicity: Hyperechoic
Echogenicity: Isoechoic
Echogenicity: Hypoechoic
Echogenicity: Very Hypoechoic
Shape: Wider-than-tall
Shape: Taller-than-wide
Margin: Smooth
Margin: Ill-defined
Margin: Lobulated
Margin: Irregular
Margin: Extracapsular extension
Echogenic Foci: Large comet tails
Echogenic Foci: Macrocalcifications
Echogenic Foci: Peripheral calcifications
Echogenic Foci: Punctate echogenic foci
Putting it all together

• Multiple guidelines have been developed to help estimate the risk of malignancy and determine the need for fine needle aspiration or follow-up
  – American Thyroid Association 2015
  – AACE
  – American College of Radiology Thyroid Imaging, Reporting, and Data System (TI-RADS)
Putting it all together

• TI-RADS Guidelines
  – Point value assigned to each imaging characteristic
Putting it all together

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  - TI-RADS score triages nodules into 1 of 5 groups (TR1 through TR5)
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  – Point value assigned to each imaging characteristic
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  – TI-RADS score triages nodules into 1 of 5 groups (TR1 through TR5)
  – Combination of TR score and nodule size lead to specific management recommendations
# 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-tail: 0 points
- Taller-than-wide: 3 points

## Margin (Choose 1)
- Smooth: 0 points
- Ill-defined: 0 points
- Lobulated: 2 points
- Irregular: 0 points
- Extra-thyroidal extension: 3 points

## Echogenic Foci (Choose All That Apply)
- None or large comet-tail artifacts: 0 points
- Macrolcalfications: 1 point
- Peripheral (rim) calcifications: 2 points
- Punctate echogenic foci: 3 points

**Add Points From All Categories to Determine TI-RADS Level**

- **0 Points**
  - TR1: Benign
  - No FNA

- **2 Points**
  - TR2: Not Suspicious
  - No FNA

- **3 Points**
  - TR3: Mildly Suspicious
  - FNA if ≥ 2.5 cm
  - Follow if ≥ 1.5 cm

- **4 to 6 Points**
  - TR4: Moderately Suspicious
  - FNA if ≥ 1.5 cm
  - Follow if ≥ 1 cm

- **7 Points or More**
  - TR5: Highly Suspicious
  - FNA if ≥ 1 cm
  - Follow if ≥ 0.5 cm* 

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<table>
<thead>
<tr>
<th>COMPOSITION</th>
<th>ECHOGENICITY</th>
<th>SHAPE</th>
<th>MARGIN</th>
<th>ECHOGENIC FOCI</th>
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</thead>
<tbody>
<tr>
<td><strong>Spongiform:</strong> Cystically dominated (&gt;50%) of small cystic spaces. Do not add further points for other categories.</td>
<td><strong>Anechoic:</strong> Applies to cystic or almost completely cystic nodules.</td>
<td><strong>Taller-than-wide:</strong> 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.</td>
<td><strong>Lobulated:</strong> Protrusions into adjacent tissue.</td>
<td><strong>Large comet-tail artifacts:</strong> V-shaped, &gt;1 mm, in cystic components.</td>
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<tr>
<td><strong>Mixed cystic and solid:</strong> Assign points for predominant solid component.</td>
<td><strong>Hyperechoic/isoechoic/hypoechoic:</strong> Compared to adjacent parenchyma.</td>
<td><strong>Irregular:</strong> Jagged, spiculated, or sharp angles.</td>
<td><strong>Macrocalcifications:</strong> Cause acoustic shadowing.</td>
<td><strong>Peripheral:</strong> Complete or incomplete along margin.</td>
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<tr>
<td><strong>Solid or almost completely solid:</strong> Assign 2 points if composition cannot be determined because of calcification.</td>
<td><strong>Very hypoechoic:</strong> More hypoechoic than strap muscles.</td>
<td><strong>Extrathyroidal extension:</strong> Obvious invasion = malignancy.</td>
<td><strong>Punctate echogenic foci:</strong> May have small comet-tail artifacts.</td>
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*Refer to discussion of papillary microcarcinomas for 5-9 mm TR5 nodules.*
Putting it all together

- TI-RADS score correlates with cancer risk
  - TR1: <2%
  - TR2: <2%
  - TR3: 5%
  - TR4: 5-20%
  - TR5: >20%
59 year old man with enlarged thyroid on PE
59 year old man with enlarged thyroid on PE

**Left lobe nodule**
Composition: solid (3 pts)
Shape: wider-than-tall (0 pts)
Echogenicity: hypoechoic (2 pts)
Margins: irregular (2 pts)
Echogenic foci: macrocalcifications and peripheral calcifications (3 pts)

Total score: 10 pts
59 year old man with enlarged thyroid on PE

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Impression:
Left lobe nodule #1
TI-RADS 5
Recommended follow-up: Fine needle aspiration
Putting it all together

• TI-RADS Guidelines: Advantages
  – Reproducible
Putting it all together

• **TI-RADS Guidelines: Advantages**
  – Reproducible
  – Helps guide consistent management recommendations
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• TI-RADS Guidelines: Advantages
  – Reproducible
  – Helps guide consistent management recommendations
    • Each nodule gets its own clear, concise action plan
    • Eases your communication with patient
    • Takes the guesswork out of thyroid ultrasound
Putting it all together

• TI-RADS Guidelines: Advantages
  – Reproducible
  – Helps guide consistent management recommendations
  – May decrease the number of fine needle aspirations performed for benign nodules and indolent microcarcinomas
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  – Reproducible
  – Helps guide consistent management recommendations
  – May decrease the number of fine needle aspirations performed for benign nodules and indolent microcarcinomas
    • Study currently in print shows 29% reduction in number of biopsies with no significant change in sensitivity
    • In this study, accuracy was significantly higher than ATA guidelines
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• **TI-RADS Guidelines: Concerns**
  – Long term stability of a nodule and patient comorbidities are not considered in TI-RADS recommendations (but should be)
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  – Long term stability of a nodule and patient co-morbidities are not considered in TI-RADS recommendations (but should be)
  – Use of the word “suspicious” for TR3, TR4, and TR5 nodules is problematic
Putting it all together

• **TI-RADS Guidelines: Concerns**
  – Long term stability of a nodule and patient co-morbidities are not considered in TI-RADS recommendations (but should be)
  – Use of the word “suspicious” for TR3, TR4, and TR5 nodules is problematic
    • It is possible to have a “suspicious” nodule with follow-up recommendation of “no follow-up is needed” based on the size of the nodule below the threshold for follow-up
Putting it all together

• TI-RADS Guidelines: Concerns
  – Use of the word “suspicious” for TR3, TR4, and TR5 nodules is problematic
    • It is possible to have a “suspicious” nodule with follow-up recommendation of “no follow-up is needed” based on the size of the nodule below the threshold for follow-up
    • To avoid this confusion, we will report the TI-RADS category without the accompanying verbiage
Conclusion

- Thyroid ultrasound remains the best imaging modality for evaluating thyroid nodules
- Thyroid ultrasound suffers from low specificity
- TI-RADS guidelines are now being utilized to help standardize interpretation, with clearer recommendations
- TI-RADS may improve specificity without significant loss of sensitivity
Acknowledgement

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• Compiled by Jenny K. Hoang
Questions

Please email me at:
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References

• Haugen, et al. 2015 ATA Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer. Thyroid 2016;26(1):1-133.


• Reduction in Biopsies and Improved Accuracy for Thyroid Nodule Evaluation: ACR TI-RADS. Radiology, in print.