THYROID IMAGE SCREENING

Endocrinologist vs Radiologist

ACOI 2019 Phoenix
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NO DISCLOSURES
USPSTF
THYROID CANCER SCREENING 2017

• Rising thyroid cancer cases, without associated mortality

• Risk and benefit of screening by physical exam and ultrasound

• Asymptomatic patients

• Recommendation: Against screening, not likely a benefit or harm outweigh benefit
THYROID CANCER INCIDENCE

- 1975 = 4.9 cases per 100,000 people
- 2013 = 15.3 cases per 100,000 people
- Increased 6.7% per year 1997 to 2009
- Increased 2.1% per year 2009 to 2013
- Mortality increased only 0.7 people per 100,000/Year
SYMPTOMATIC PATIENT

- Hoarseness
- Dysphagia
- Pain
- Lumps
- Neck asymmetry
ADVERSE HISTORY

• Radiation history
• Inherited genetic syndrome
• Familial thyroid cancer 1st degree
• Low iodine diet
INCIDENTAL THYROID LESIONS RADIOLOGY

- CT & MRI: check for abnormal nodes, include invasion and size
- 1 to 1.5 cm short axis nodes suspicious
- Thyroid cancer nodes level IV and VI
- Thyroid ultrasound for suspicious thyroid lesions
- Age < 35 yrs eval nodules 1 cm & greater
- Age 35 yrs and older eval nodules 1.5 cm & greater
- Consider limited life expectancy and comorbid conditions
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INCIDENTAL THYROID LESIONS RADIOLOGY

- FDG-PET: Metabolism uptake in lesions of thyroid suggest malignancy, even if ultrasound not suspicious
- Need thyroid ultrasound and biopsy
- Consider comorbid issues and life expectancy
- Other nuclear med studies may also have thyroid uptake
- MIBI studies should have thyroid ultrasound
- Only 1 in 5 lesions reported in the impression section undergo additional evaluation but usually lesser age and size related
INCIDENTAL THYROID LESIONS RADIOLOGY

• Ultrasound of non thyroid structures may see thyroid lesions: Look for microcalcification, irregular border, hypoechoic, taller than wide
• Adverse ultrasound features obtain thyroid ultrasound, but consider life expectancy and comorbid status
INCIDENTAL THYROID LESIONS RADIOLOGY

- Nodule size by CT, MRI, PET-CT underestimate size of lesion not significant
- Reduces number of thyroid ultrasounds by 24%
AMERICAN THYROID ASSOCIATION
THYROID CANCER SCREENING

• ATA Guidelines indicate no recommendation for or against screening in relatives of well differentiated thyroid cancer with no clear reduction mortality or morbidity
• If nodule identified, check TSH. If TSH is below normal, obtain nuclear thyroid scan by $^{123}$I
AMERICAN THYROID ASSOCIATION
THYROID CANCER SCREENING

• Thyroglobulin and calcitonin should not be ordered in these patients by routine
• Focal uptake on FDG-PET should biopsy ≥1cm nodules associated on ultrasound
• Diffuse uptake in chronic thyroiditis no biopsy suggested
AMERICAN THYROID ASSOCIATION
THYROID CANCER GUIDELINES

• Diagnostic ultrasound for known or suspected thyroid lesions with neck ultrasound for nodes

• FNA suspicious nodules ≥ 1 cm
• FNA unsuspicious nodules ≥ 1.5 cm
• FNA low suspicion nodules ≥ 2 cm
• Purely cystic nodules: No biopsy
ATA GUIDELINES
THYROID NODULE FEATURES

- Suspicious: Hypoechoic, microcalcifications, irregular border, taller than wide
- Microcalcification, irregular border and taller highest specificity for thyroid cancer
- Most benign thyroid nodules are hypoechoic
- Less suspicious: spongiform, hyperechoic, isoechoic
- Suspicious features primarily associated with Papillary Thyroid Cancer
<table>
<thead>
<tr>
<th>Sonographic pattern</th>
<th>US features</th>
<th>Estimated risk of malignancy, %</th>
<th>FNA size cutoff (largest dimension)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High suspicion</td>
<td>Solid hypoechoic nodule or solid hypoechoic component of a partially cystic nodule \textit{with} one or more of the following features: irregular margins (infiltrative, microlobulated), microcalcifications, taller than wide shape, rim calcifications with small extrusive soft tissue component, evidence of ETE</td>
<td>&gt;70–90\textsuperscript{a}</td>
<td>Recommend FNA at $\geq$1 cm</td>
</tr>
<tr>
<td>Intermediate suspicion</td>
<td>Hypoechoic solid nodule with smooth margins \textit{without} microcalcifications, ETE, or taller than wide shape</td>
<td>10–20</td>
<td>Recommend FNA at $\geq$1 cm</td>
</tr>
<tr>
<td>Low suspicion</td>
<td>Isoechoic or hyperechoic solid nodule, or partially cystic nodule with eccentric solid areas, \textit{without} microcalcification, irregular margin or ETE, or taller than wide shape.</td>
<td>5–10</td>
<td>Recommend FNA at $\geq$1.5 cm</td>
</tr>
<tr>
<td>Very low suspicion</td>
<td>Spongiform or partially cystic nodules \textit{without} any of the sonographic features described in low, intermediate, or high suspicion patterns</td>
<td>&lt;3</td>
<td>Consider FNA at $\geq$2 cm</td>
</tr>
<tr>
<td>Benign</td>
<td>Purely cystic nodules (no solid component)</td>
<td>&lt;1</td>
<td>No biopsy\textsuperscript{b}</td>
</tr>
</tbody>
</table>
FIG. 2. ATA nodule sonographic patterns and risk of malignancy.
High Suspicion >70-90%

- Microcalcifications
- Hypoechoic nodule
- Irregular margin

Intermediate Suspicion 10-20%

- Hypoechoic, irregular margins, extrathyroidal extension
- Hypoechoic, interrupted rim calcification with soft tissue extrusion
- Nodule with irregular margins, suspicious left lateral lymph node

- Hypoechoic solid regular margin
- Hypoechoic solid regular margin
Low Suspicion 5-10%

- hyperechoic solid regular margin
- isoechoic solid regular margin
- partially cystic with eccentric solid area
- partially cystic with eccentric solid areas

Very low Suspicion <3%

- spongiform
- partially cystic no suspicious features
- partially cystic no suspicious features

Benign <1%

- cyst
ACR THYROID IMAGING, REPORTING AND DATA SYSTEM (TIRADS)
ACR THYROID IMAGING, REPORTING AND DATA SYSTEM (TIRADS) COMPOSITION

• Solid
• Predominately solid
• Predominately cystic
• Cystic
• Spongiform

• Partially cystic nodules low malignancy
ACR THYROID IMAGING, REPORTING AND DATA SYSTEM (TIRADS) ECHOGENDICITY

• Hyperechoic
• Isoechoic
• Hypoechoic
• Very Hypoechoic
ACR THYROID IMAGING, REPORTING AND DATA SYSTEM (TIRADS) SHAPE

- Taller than Wide
- Suspicious for malignancy
- In transverse plain, ratio >1 anteroposterior to horizontal diameter
ACR THYROID IMAGING, REPORTING AND DATA SYSTEM (TIRADS) SIZE

- Maximal longitudinal, anteroposterior and transverse
- Nodule size does not predict malignancy in PTC, subcentimeter nodules can be malignant
- 2013 study showed nodules 1 to 1.9 cm at 10% malignancy, increasing to 15 % in 2 cm nodules with larger nodules more likely to have other than PTC pathology
ACR THYROID IMAGING, REPORTING AND DATA SYSTEM (TIRADS) MARGINS

- Smooth
- Irregular
- Lobulated
- ILL defined
- Halo
- Extrathyroidal extension
ACR THYROID IMAGING, REPORTING AND DATA SYSTEM (TIRADS) ECHOGENIC FOCI

• Punctate
• Macrocalcifications
• Periferal
• Comet-tail
# ACR TI-RADS

## Table of Compartments

### 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
- Tallér-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
- Macrocalkifications: 1 point
- Peripheral (rim) calcifications: 2 points
- Punctate echogenic foci: 3 points

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## 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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## Compartments Details

### 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.**

### Echogenicity
- **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.**

### Shape
- **Wider-than-tall**: 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.**

### Margin
- **Lobulated**: Protrusions into adjacent tissue.
- **Irregular**: Jagged, spiculated, or sharp angles.
- **Extrathyroidal extension**: Obvious invasion = malignancy.
- **Assign 0 points if margin cannot be determined.**

### Echogenic Foci
- **Large comet-tail artifacts**: V-shaped, >1 mm, in cystic components.
- **Macrocalkifications**: 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.*
<table>
<thead>
<tr>
<th>Category</th>
<th>Follow-up recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR1: Benign</td>
<td>No FNA biopsy</td>
</tr>
<tr>
<td>TR2: Not suspicious for malignancy</td>
<td>No FNA biopsy</td>
</tr>
<tr>
<td>TR3: Mildly suspicious for malignancy</td>
<td>FNA biopsy if nodule $\geq 2.5$ cm; follow if $\geq 1.5$ cm</td>
</tr>
<tr>
<td>TR4: Moderately suspicious for malignancy</td>
<td>FNA biopsy if nodule is $\geq 1.5$ cm; follow if $\geq 1$ cm</td>
</tr>
<tr>
<td>TR5: Highly suspicious for malignancy</td>
<td>FNA biopsy if nodule $\geq 1$ cm; follow if $\geq 0.5$ cm</td>
</tr>
</tbody>
</table>
Fig. 2. Strength of indication for fine-needle aspiration (FNA) biopsy of thyroid nodules on the basis of ultrasonography (US) findings.
CLINICAL FEATURES IN THYROID PATIENTS
THYROID FUNCTION & MALIGNANCY

• Most patients with thyroid nodule and thyroid cancer are euthyroid.
• Low thyroid function more likely malignant.
• High thyroid function is less likely malignant.

• Nuclear imaging is not routinely necessary in euthyroid or hypothyroid patients.
NUCLEAR THYROID IMAGING & THYROID CANCER

- Can be used to determine greater or lesser uptake in the entire thyroid thyroid or in a nodule
- Thyroid nodules with decreased uptake (cold), more suggestive of malignancy
- Increased uptake thyroid nodule (hot) less suggestive of malignancy
THYROID SCAN  11 May 2000 at 11:55

markers

2hr. uptake = 2.0%
24hr uptake = 3.07

1997821
ST. JOSEPH
LAO
Thank You

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