Thyroid Ultrasound: When to biopsy

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Learning Objectives

- Review recently published pediatric guidelines for management of thyroid nodules by ultrasound
- Identify who to biopsy and who to leave alone
- Recognize features of thyroid nodules proven to be malignant or benign
- Questions and discussion
Management Guidelines for Children with Thyroid Nodules and Differentiated Thyroid Cancer
The American Thyroid Association Guidelines Task Force on Pediatric Thyroid Cancer

Gary L. Francis,1,* Steven G. Waguespack,2,* Andrew J. Bauer,3,4,* Peter Angelos,5 Salvatore Benvenga,6
Janete M. Cerutti,7 Catherine A. Dinauer,8 Jill Hamilton,9 Ian D. Hay,10 Markus Luster,11,12
Marguerite T. Parisi,13 Marianna Rachmiel,14,15 Geoffrey B. Thompson,16 and Shunichi Yamashita17
Why pediatric guidelines?

- < 1.8% of all thyroid malignancies in the US
- 2\textsuperscript{nd} most common cancer among girls 15-19y
- Female to male 5:1 during adolescence
- 90% PTC:
  - Classic
  - Follicular
  - Diffuse sclerosing
- Follicular uncommon
- MTC and anaplastic tumors rare
Who should be screened?

- History of radiation exposure
- Autoimmune thyroiditis
- Genetic predisposition syndromes
  - APC-associated polyposis
  - Carney complex
  - DICER1
  - PTEN hamartoma tumor syndrome
  - Werner syndrome
FNA not warranted in <1 cm, unless high risk (radiation exposure)

US characteristics and clinical context more relevant than in adults

- Hypoechogenicity
- Irregular margins
- Increased intranodular blood flow
- Microcalcifications
- Abnormal cervical nodes

In all children, US evaluation of cervical lymph nodes should be performed
<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 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&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Recommend FNA at ≥1 cm</td>
</tr>
<tr>
<td>Intermediate suspicion</td>
<td>Hypoechoic solid nodule with smooth margins without microcalcifications, ETE, or taller than wide shape</td>
<td>10–20</td>
<td>Recommend FNA at ≥1 cm</td>
</tr>
<tr>
<td>Low suspicion</td>
<td>Isoechoic or hyperechoic solid nodule, or partially cystic nodule with eccentric solid areas, without microcalcification, irregular margin or ETE, or taller than wide shape.</td>
<td>5–10</td>
<td>Recommend FNA at ≥1.5 cm</td>
</tr>
<tr>
<td>Very low suspicion</td>
<td>Spongiform or partially cystic nodules without any of the sonographic features described in low, intermediate, or high suspicion patterns</td>
<td>&lt;3</td>
<td>Consider FNA at ≥2 cm. Observation without FNA is also a reasonable option</td>
</tr>
<tr>
<td>Benign</td>
<td>Purely cystic nodules (no solid component)</td>
<td>&lt;1</td>
<td>No biopsy&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

US-guided FNA is recommended for cervical lymph nodes that are sonographically suspicious for thyroid cancer (see Table 7).<sup>a</sup> The estimate is derived from high volume centers, the overall risk of malignancy may be lower given the interobserver variability in sonography. <sup>b</sup>Aspiration of the cyst may be considered for symptomatic or cosmetic drainage. ETE, extrathyroidal extension.
FIG. 2. ATA nodule sonographic patterns and risk of malignancy.
Suspicious nodules

- Evaluation and treatment of thyroid nodules in children the same as in adults
- Exceptions:
  - US characteristics and clinical context > size
  - all FNA in children under US guidance,
- FNA of a hyperfunctioning nodule is not warranted assuming surgery
- Diffusely infiltrative form of PTC may occur
- surgery (lobectomy plus isthmusectomy) favored over repeat FNA for indeterminate cytology
Malignant patterns

- Red Light-hypervascularity
- Hypo or hyperechoic with calcification
- Isoechoic with halo (refractive edge shadow)
- Ring of fire
Benign nodules

- Benign lesions followed by serial US
- Repeat FNA if suspicious features develop or the lesion continues to grow
- Lobectomy may be performed if:
  - compressive symptoms and
  - cosmetic concerns or
  - patient/parent preference
  - should be considered in apparently benign solid thyroid nodules > 4 cm, significant growth, or other clinical concerns for malignancy
Classically benign patterns

- Spongiform or honeycomb
- Predominantly cystic or Cyst with colloid clot
- Giraffe/leopard skin pattern or diffuse small hypoechoic nodules
- Colloid nodule with comet-tail
Indeterminate patterns

- Solid with cystic component or cystic with mural nodule
- Solid, homogeneous with thin halo, small cysts

Charboneau W, Reading C, Mayo Clinic, Rochester MN
Reporting

ORIGINAL ARTICLE    CLINICAL PRACTICE MANAGEMENT

Thyroid Ultrasound Reporting Lexicon: White Paper of the ACR Thyroid Imaging, Reporting and Data System (TIRADS) Committee

Edward G. Grant, MD, Franklin N. Tessler, MD, Jenny K. Hoang, MBBS, Jill E. Langer, MD, Michael D. Beland, MD, Lincoln L. Berland, MD, John J. Cronan, MD, Terry S. Desser, MD, Mary C. Frates, MD, Ulrike M. Hamper, MD, William D. Middleton, MD, Carl C. Reading, MD, Leslie M. Scoutt, MD, A. Thomas Stavros, MD, Sharlene A. Teefey, MD

Children’s Healthcare of Atlanta
Categories

- Composition: cystic/solid/mixed
- Echogenicity
- Shape
- Size:
- Margins
- Echogenic foci
Whether or not we use the scoring and TI-RADS level assignment, the terminology is the same.
Case 1: 12 yo female

Children’s Healthcare of Atlanta
**Benign Colloid nodule**

*Teaching Point: Predominantly cystic nodule with avascular septations is almost certainly benign*
Case 2: 12 yo female
Pathology: PAPILLARY CANCER

Note: hypoechoic nodule with intense peripheral vascularity (ring of fire).
Case 3: 5 yo female
Case 3

Pathology: Follicular Carcinoma

*Teaching Point: relatively homogeneous echogenicity but with hypervascularity; Thin capsule, “halo” can be seen in both follicular carcinoma and adenoma. Needs biopsy.
Pathology: Follicular carcinoma

*Teaching point: When recommending further imaging, try to avoid CT with contrast. If the patient has cancer, this will delay the timing of future I-131 ablation.
Case 4: 17 yo female
Case 4

Pathology: Papillary Carcinoma with metastatic nodes; note calcifications

*Teaching point: Keep heightened alert for suspicious nodes at US
Case 5: 7 yo female
Case 5

Pathology: Conventional papillary carcinoma

*Teaching points:
1. Dominant cyst with solid nodule: indeterminate, but doppler and thick wall add to level of suspicion.
2. At FNA, take care to target suspicious areas.
Case 6: 13 yo female
Pathology:
- colloid nodular goiter with hyperplastic changes
- no evidence of malignant changes

US findings: INDETERMINATE predominantly solid nodule with small cysts.

*Teaching Point: Scintigraphy is typically reserved for:
- characterizing functioning nodules (suppressed TSH)
- staging follicular and papillary carcinomas post thyroidectomy (whole body)
Suppressed TSH associated with a thyroid nodule warrants thyroid scintigraphy.

Surgical resection, most commonly lobectomy, is the recommended approach for most autonomous nodules in children.
Case 7
4 HR uptake = 9.9%
24 HR uptake = 5.2%
What about the nodes?

- Neck US to interrogate all regions of the neck is required
- **FNA of suspicious lateral neck lymph nodes is recommended**
- MRI or CT with contrast when:
  - large or fixed thyroid masses
  - vocal cord paralysis
  - bulky metastatic lymphadenopathy
How aggressive is surgery?

- **CND** for malignant cytology extrathyroidal invasion and/or locoregional metastasis
- PTC and no evidence of gross invasion and/or locoregional metastasis-> prophylactic CND **selectively** considered
- Routine prophylactic lateral neck dissection (levels III, IV, anterior V, and II) is **not** recommended
- LND performed on patients with cytologic evidence of metastases to the lateral neck
Who should operate?

- Should have full spectrum of pediatric specialty care available

- Ideally by a surgeon who performs at least 30 or more cervical endocrine procedures annually (‘high-volume’)

- Associated with lower complications rates, decreased hospital stay, and lower cost
<table>
<thead>
<tr>
<th><strong>Primary tumor (T)</strong></th>
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<tbody>
<tr>
<td>TX</td>
<td>Size not assessed, limited to the thyroid</td>
</tr>
<tr>
<td>T1</td>
<td>≤ 1 cm, limited to the thyroid</td>
</tr>
<tr>
<td>T1a</td>
<td>&gt; 1 cm but ≤ 2 cm, limited to the thyroid</td>
</tr>
<tr>
<td>T1b</td>
<td>&gt; 2 cm but ≤ 4 cm, limited to the thyroid</td>
</tr>
<tr>
<td>T2</td>
<td>&gt; 4 cm, limited to the thyroid or any tumor with minimal extrathyroid extension</td>
</tr>
<tr>
<td>T4</td>
<td>Tumor extends beyond the thyroid capsule to invade subcutaneous soft tissues, larynx, trachea, esophagus, or recurrent laryngeal nerve</td>
</tr>
<tr>
<td>T4a</td>
<td>Tumor invades prevertebral fascia or encases carotid artery or mediastinal vessels</td>
</tr>
<tr>
<td>T4b</td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th><strong>Lymph nodes (N)</strong></th>
<th></th>
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<tbody>
<tr>
<td>NX</td>
<td>Regional lymph nodes not assessed</td>
</tr>
<tr>
<td>N0</td>
<td>No regional lymph node metastasis</td>
</tr>
<tr>
<td>N1</td>
<td>Metastasis to level VI (pretracheal, paratracheal, and prelaryngeal/ Delphian lymph nodes)</td>
</tr>
<tr>
<td>N1a</td>
<td>Metastasis to unilateral, bilateral, or contralateral cervical levels I, II, III, IV, or V) or retropharyngeal or superior mediastinal lymph nodes (level VII)</td>
</tr>
<tr>
<td>N1b</td>
<td></td>
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</tbody>
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<thead>
<tr>
<th><strong>Distant metastasis (M)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MX</td>
<td>Distant metastasis not assessed</td>
</tr>
<tr>
<td>M0</td>
<td>No distant metastasis</td>
</tr>
<tr>
<td>M1</td>
<td>Distant metastasis</td>
</tr>
</tbody>
</table>

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*Pediatric patients are considered to have stage II disease if distant metastases are identified (M1); otherwise, all pediatric patients are considered to have stage I disease.*

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DTC classification of stage:

- ATA Pediatric Low-Risk: grossly confined to thyroid No or NX

- ATA Pediatric Intermediate-Risk: Extensive N1a or minimal N1b disease

- ATA Pediatric High-Risk: Regionally extensive disease (extensive N1b) or locally invasive (T4 tumors) with or without distant mets
Why classify? To direct therapy!

- ATA Pediatric Low-Risk:
  - Initially assessed
  - Follow with a TSH-suppressed Tg alone

- ATA Pediatric Intermediate- and High-Risk patients:
  - TSH-stimulated Tg and
  - I\textsuperscript{123} DxWBS to assess for persistent disease

- Neck US and/or hybrid imaging using SPECT/CT conjunctively to localize


