Thyroid Ultrasound
Basic
ATA Fellow Track 2013

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Objectives

- **Basic Thyroid Ultrasonography**
  - Neck Anatomy
  - Palpation vs US
  - Nodule US characteristics

- **Advanced Thyroid Ultrasonography (Dr. Fish)**
  - Fine needle aspiration
  - Lymph node evaluation
  - Parathyroid ultrasound
Thyroid ultrasound uses high frequency sound waves to make a picture of the thyroid gland.
Thyroid Ultrasonography

- Patient lies supine with neck hyper-extended
- US Gel is applied to facilitate transmission of sound waves from transducer to skin/tissue
- High resolution linear array transducer (7-15mHz), 4-5cm scanning depth
- The neck is scanned in both transverse and longitudinal planes
Thyroid Ultrasonography

Normal Anatomy

- Lobes are oval shaped with rounded superior pole and elongated inferior pole
- Lobe dimensions may vary greatly
  - 4-6cm in length
  - lobe thickness (AP dimension) ≤ 2cm
- Normal adult thyroid volume is ~10-15cc
Transverse US scan of normal thyroid/neck
Longitudinal US scan of normal thyroid/neck
Thyroid Ultrasound in the diagnosis of thyroid nodules
Prevalence of thyroid nodules in the US

Mazzaferri, N Engl J Med 1993

Brander et al Head & Neck Rad. 1991

Prevalence of Echo Abnormalities by Age and Sex

<table>
<thead>
<tr>
<th>Age Group (y)</th>
<th>Sex</th>
<th>n</th>
<th>Subjects with Abnormal Echo Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–29</td>
<td>M</td>
<td>39</td>
<td>6 (15)</td>
</tr>
<tr>
<td>19–29</td>
<td>F</td>
<td>37</td>
<td>11 (30)</td>
</tr>
<tr>
<td>30–39</td>
<td>M</td>
<td>38</td>
<td>5 (13)</td>
</tr>
<tr>
<td>30–39</td>
<td>F</td>
<td>44</td>
<td>14 (32)</td>
</tr>
<tr>
<td>40–50</td>
<td>M</td>
<td>46</td>
<td>13 (28)</td>
</tr>
<tr>
<td>40–50</td>
<td>F</td>
<td>49</td>
<td>20 (41)</td>
</tr>
</tbody>
</table>

Ultrasound/autopsy
Palpation
You may palpate A but not B
Or this 1.5cm

Or this Pseudo-nodule
<table>
<thead>
<tr>
<th>Nodule Size (by US)</th>
<th>N</th>
<th>Missed (palpation)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1cm</td>
<td>16</td>
<td>15</td>
<td>93.8</td>
</tr>
<tr>
<td>1-2 cm</td>
<td>28</td>
<td>14</td>
<td>50</td>
</tr>
<tr>
<td>&gt; 2 cm</td>
<td>33</td>
<td>14</td>
<td>42.4</td>
</tr>
<tr>
<td>Total</td>
<td>77</td>
<td>43</td>
<td>55.8</td>
</tr>
</tbody>
</table>

Brander, J Clin Ultrasound 1992
Thyroid sonography should be performed in all patients with known or suspected thyroid nodules. USPSTF Recommendation A

Revised ATA Management guidelines for patients with thyroid nodules and differentiated thyroid cancer, ATA Task Force, David Cooper, Chair, Thyroid, 2009

In all patients with palpable thyroid nodules or MNG’s US should be performed...........
Grade B, BEL 3

AACE/AME/ETA guidelines for clinical practice for the diagnosis and management of thyroid nodules, Endocrine Pract 2010
US Characteristics of Thyroid Nodules

1. Echogenicity
2. Calcifications
3. Margins/Halo
4. Vascularity
Calcification

Egg-Shell calcification

Coarse Calcification

Punctate Calcification with ‘comet tail’ artifact

Punctate Calcification with ‘comet tail’ artifact

Punctate Calcification

Punctate Calcification with ‘comet tail’ artifact
Sonographically Benign appearing nodules
Iso/hyperechoic, halo, smooth margins, peripheral vascularity
“Spongiform” nodules

‘Spongy’

peripheral vascularity
Graves’ Gland
Sonographically Suspicious appearing nodules
Hypoechoic, irregular margins, punctate microcalcifications, intra-nodular flow
66% of benign nodules have at least one positive US predictor of papillary thyroid cancer\(^1\)

66% of papillary cancers have at least one non-suspicious US feature\(^2,3\)

\(^1\)Wienke J Ultrasound Med 2003; \(^2\)Chan, J Ultrasound Med 2003; \(^3\)Yuan, Clin Imaging 2006
Prediction of Thyroid Cancer by Thyroid Ultrasound characteristics

**TABLE 1**

<table>
<thead>
<tr>
<th>US Feature*</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Positive Predictive Value (%)</th>
<th>Negative Predictive Value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcalcifications (1–5)</td>
<td>26.1–59.1</td>
<td>85.8–95.0</td>
<td>24.3–70.7</td>
<td>41.8–94.2</td>
</tr>
<tr>
<td>Hypoechochogenicity (2–5)</td>
<td>26.5–87.1</td>
<td>43.4–94.3</td>
<td>11.4–68.4</td>
<td>73.5–93.8</td>
</tr>
<tr>
<td>Irregular margins or no halo (2–5)</td>
<td>17.4–77.5</td>
<td>38.9–85.0</td>
<td>9.3–60.0</td>
<td>38.9–97.8</td>
</tr>
<tr>
<td>Solid (4–6)</td>
<td>69.0–75.0</td>
<td>52.5–55.9</td>
<td>15.6–27.0</td>
<td>88.0–92.1</td>
</tr>
<tr>
<td>Intranodule vascularity (3, 6)</td>
<td>54.3–74.2</td>
<td>78.6–80.8</td>
<td>24.0–41.9</td>
<td>85.7–97.4</td>
</tr>
<tr>
<td>More tall than wide (2)</td>
<td>32.7</td>
<td>92.5</td>
<td>66.7</td>
<td>74.8</td>
</tr>
</tbody>
</table>

* Numbers in parentheses are reference numbers.
# Diagnosis of Thyroid Nodules

<table>
<thead>
<tr>
<th>Ultrasound features</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNA</td>
<td>92%</td>
<td>84%</td>
</tr>
</tbody>
</table>

Diagnostic tests require high sensitivity!!
AACE/AME/ETA guidelines for clinical practice for the diagnosis and management of thyroid nodules, Endocrine Pract 2010
THANK YOU