Advanced Thyroid Ultrasound

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Objectives

• Fine needle aspiration
• Lymph node evaluation
• Parathyroid ultrasound
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- Fine needle aspiration
- Lymph node evaluation
- Parathyroid ultrasound
### Nodule Sonographic / Clinical Features

<table>
<thead>
<tr>
<th>Clinical Features</th>
<th>Recommended nodule size for FNA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High risk history with suspicious sonographic features</strong></td>
<td>&gt;5-9mm</td>
</tr>
<tr>
<td><strong>High risk history without suspicious sonographic features</strong></td>
<td>&gt;5-9mm</td>
</tr>
<tr>
<td>Abnormal cervical lymph nodes</td>
<td>All***</td>
</tr>
<tr>
<td>Microcalcifications present OR Solid and hypoechoic</td>
<td>≥1cm</td>
</tr>
<tr>
<td>Solid and iso- or hyperechoic</td>
<td>≥1-1.5cm</td>
</tr>
<tr>
<td>Mixed cystic/solid and any suspicious ultrasound feature**</td>
<td>≥1.5-2.0cm</td>
</tr>
<tr>
<td>Predominantly cystic or spongiform nodule without suspicious ultrasound features</td>
<td>≥2cm</td>
</tr>
<tr>
<td>Purely cystic lesion</td>
<td>FNA not indicated</td>
</tr>
</tbody>
</table>

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**American Thyroid Association 2009**
Indications for US guided FNA

• Difficult to palpate nodules
  – Nonpalpable (‘other’) nodules found on US that meet FNA criteria
  – POSTERIOR nodules EVEN if palpable
• Predominantly cystic nodules
• Nodules with nondx cytology from prior FNA
• Nodules with prior benign FNA that have grown
Posterior but palpable

Posterior NOT palpable
Predominantly cystic nodules

Target vascular areas for FNA

sagittal

viable tissue

avascular debris
# False Negative Rates of Palpation FNA and US FNA

Retrospective reviews of clinical experience

<table>
<thead>
<tr>
<th></th>
<th>Palpation FNA</th>
<th>US FNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danese, 1998</td>
<td>2.3% (7/535)</td>
<td>0.6% (2/540)</td>
</tr>
<tr>
<td>Carmeci, 1998</td>
<td>0.5% (2/47)</td>
<td>0% (0/21)</td>
</tr>
</tbody>
</table>

False negative specimens due to sampling error (cystic lesions or nodule was not sampled)

Carmeci, Thyroid 1998; Danese, Thyroid 1998
US Guided FNA
Real time visualization of needle during FNA

- **One person**: hold US probe in one hand and needle in the other hand while watching the US monitor
- **Two people**: one person holds US probe, the other person performs the FNA while watching the US monitor
US-guided FNA

Materials

- Special “echogenic” needles are NOT required, a 1.5 inch 23-27 gauge needle is used (B-D)
- Needle is attached to a 10 cc Luer lock syringe containing 2-3 cc of air, or free needle without syringe
- A probe cover and sterile gel should be used if the technique chosen requires that the needle is inserted adjacent to the probe footprint
- Alcohol is used to clean the needle entry site
- Free hand technique, guide not required
- US-guided FNA is a 3D process
Parallel technique

Perpendicular technique

Courtesy of Endocrine University
FNA with a curvilinear probe

45° clockwise rotation of top of screen

Neck anterior surface
Objectives

• Fine needle aspiration
• Lymph node evaluation
• Parathyroid ultrasound
Lymph Node Metastases at Diagnosis

- 42% of patients present with LN mets at diagnosis
- 21% of patients present with macroscopic LN mets at diagnosis
- 22% of PTC patients in the SEER database with LN mets at diagnosis

Preoperative LN Evaluation

Preoperative neck US for the contralateral lobe and cervical (central and especially lateral neck compartments) lymph nodes is recommended for all patients undergoing thyroidectomy for malignant cytologic findings on biopsy. US-guided FNA of sonographically suspicious LNs should be performed to confirm malignancy if this would change management.

Recommendation rating: B
US of normal cervical LNs

- **Shape**
  - Oval

- **Echogenic hilus**
  - Consists of fatty tissue, sinuses, intranodal vessels

- **Vascularity**
  - Hilar vascularity or avascular
Normal Lymph Node
US of abnormal cervical LNs

- **Shape**
  - Round

- **Echogenicity**
  - Metastatic PTC LNs may be hyperechoic compared to surrounding strap muscles

- **Absence of Hilus**
  - Tumor infiltration of sinuses

- **Cystic change**

- **Calcifications**

- **Vascularity**
  - Increased vascularity in both peripheral and central zones
Suspicious thyroid nodule with abnormal LN on US

Lymph Node is Round, Hyperechoic, lacks fatty hilus

Sagittal Left lobe

Transverse left lateral neck

Papillary carcinoma
Suspicious thyroid nodule with abnormal cervical lymph node
Suspicious thyroid nodule with abnormal cervical lymph node

**Lymph Node:**
Round
Lacks fatty hilus
Microcalcifications
Peripheral vascularity
What do we do when US detects an abnormal LN?

If a positive result would change management, ultrasonographically suspicious LNs greater than 5-8mm in the smallest diameter should be biopsied for cytology with thyroglobulin measurement in the needle washout fluid.

Recommendation A

Cooper, Thyroid 2009
Objectives

• Fine needle aspiration
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Primary Hyperparathyroidism: 
Indications for Surgery

<table>
<thead>
<tr>
<th>measurement</th>
<th>1990</th>
<th>2002</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum calcium</td>
<td>1-1.6mg/dl</td>
<td>1.0 mg/dl</td>
<td>1.0 mg/dl</td>
</tr>
<tr>
<td>24 hr urine calcium</td>
<td>&gt;400 mg/d</td>
<td>&gt;400 mg/d</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Creatinine clearance</td>
<td>Reduced by 30%</td>
<td>Reduced by 30%</td>
<td>Reduced to &lt;60 ml/min</td>
</tr>
<tr>
<td>BMD</td>
<td>Z-score&lt;-2.0 in forearm</td>
<td>T-score&lt;-2.5 at any site</td>
<td>T-score&lt;-2.5 at any site and/or previous fracture</td>
</tr>
<tr>
<td>Age</td>
<td>&lt;50</td>
<td>&lt;50</td>
<td>&lt;50</td>
</tr>
</tbody>
</table>

Bilezikian, JCEM 2009
Minimally Invasive Parathyroidectomy

• Unilateral targeted excision of parathyroid adenoma with intraoperative PTH monitoring

• **Benefits**
  – Shorter surgery time
  – Smaller incisions
  – Fewer complications
    • Post-op hypocalcemia

• **Disadvantages**
  – Requires accurate preoperative localization of parathyroid adenoma
  – May miss multiglandular disease
Typical Parathyroid Adenoma

Transverse

Longitudinal
Transverse Parathyroid Ultrasound

Vessels

Trachea

parathyroid
Transverse Parathyroid Ultrasound
Longitudinal Parathyroid Ultrasound
Longitudinal Parathyroid Ultrasound

- Superior
- Inferior
- Thyroid
- Inferior parathyroid
Polar Vascular Pattern

Longitudinal
Polar Vascular Pattern

Longitudinal
Keys to Parathyroid Ultrasound

- **Appearance**
  - Oval, homogeneous, hypoechoic

- **Location**
  - Superior: posterior to the midportion of thyroid
  - Inferior: inferior to the lower pole of thyroid

- **Vascularity**
  - Polar vascularity

- **Experience**