Use of Office Ultrasound in the Thyroid Surgery Practice

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Thyroid US

• Diagnosis of thyroid nodules
• Measure and characterize nodules (cystic v. solid, size, echogenicity, vascularity, calcifications,…) 
• Objective monitoring over time
• Characterize thyroid disease (thyroiditis, Graves)
• Guide biopsy (and procedures)
• Assess extrathyroidal neck
• Follow up of thyroid cancer
• Dynamic assessment of function

Office-based Head and Neck US

• Real-time study: image interpretation, static vs. moving/pulsating structures
• Knowledge of patient history and physical exam
• Familiarity with anatomy
• Correlate studies (*I scan, CT, MRI, etc.)
• Single appointment for patient
• USGFNA possible during same appt
• Simultaneous patient education
• Facilitate surgical planning
• Ability to use intraoperative US

Background: Thyroid/Neck US

• Operator dependent
• The more you know, the more you see
• The more you suspect, the more you see
• The more time you spend, the more you see
• The more territory you cover, the more you see
• Dynamic assessment invaluable
• Still, US findings are not pathognomonic…
Definitions

"thyroid nodule": A discrete lesion in the thyroid that is radiographically distinct from the surrounding parenchyma.

PTMC: a papillary cancer primary tumor that is < 10 mm in diameter (or ≤ 10 mm...)

Truly incidental PTMC: a PTC that was undetected by preoperative imaging but was identified by pathological examination of surgical specimens resected for benign thyroid diseases.

Concordance between US and Pathology

Tumors ≤ 1 cm by US:
Concordance with pathologic size = 78.5%
(and overall concordance for tumors >1cm was only 35-56%!)

Only 2% of nodules were ≤ 1 cm by US, but 15.5% were ≤ 1 cm by pathology

Deveci MS et al, Diagn Cytopathol 2007
N=664 nodules

Textbook Ultrasound Characteristics

Benign v. Malignant Thyroid Nodules

Benign
- Isoechoic/hyperechoic
- (Coarse calcifications)
- Thin, well-defined halo
- Regular margin
- Hypovascular
- No lymphadenopathy

Malignant
- Hypoechoic
- Microcalcifications
- Thick or absent halo
- Irregular margin
- Increased vascularity
- Lymphadenopathy

What about nodules < 1 cm?

- “…a subset of subcentimeter nodules that may be more clinically relevant are those >5mm in diameter with suspicious US features (hypoechoic, hypervascular, irregular borders, microcalcifications...) AND one or more” of the following:
  - FHx thyroid cancer (1st degree relative)
  - FDG-PET + nodules
  - History of hemithyroidectomy showing cancer
  - History of childhood XRT/ radiation exposure
  - Associated suspicious cervical lymphadenopathy

2009 ATA Guidelines
2009 ATA Guidelines Summary:
Consider FNA if:

<table>
<thead>
<tr>
<th>Features</th>
<th>Threshold size</th>
<th>Level recommendation</th>
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<tbody>
<tr>
<td>High risk history + suspicious US</td>
<td>&gt;5 mm</td>
<td>A</td>
</tr>
<tr>
<td>High risk history but NON-suspicious US</td>
<td>&gt;5mm</td>
<td>I</td>
</tr>
<tr>
<td>Abnormal lymph nodes</td>
<td>Any size (or LN)</td>
<td>A</td>
</tr>
<tr>
<td>Microcalcifications OR solid AND hypoechoic</td>
<td>≥ 1 cm</td>
<td>B</td>
</tr>
<tr>
<td>Solid and iso- or hyperechoic</td>
<td>≥1-1.5 cm</td>
<td>B</td>
</tr>
<tr>
<td>Mixed solid/cystic and ANY suspicious US chx</td>
<td>≥1.5-2 cm</td>
<td>B</td>
</tr>
<tr>
<td>Predominantly spongiform</td>
<td>≥2 cm</td>
<td>C</td>
</tr>
<tr>
<td>Purely cystic</td>
<td>None (but for therapeutic)</td>
<td>B</td>
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PTMC: Influence of preoperative US imaging

If your approach to PTC is TTx, then US findings (e.g. bilaterality) may have little influence on management of the primary

However, recognition of ETE / multifocal dz/ LN mets may influence surgical planning

PTMC: Preoperative Staging

- US is more accurate than CT in predicting ETE and bilateral thyroid involvement
- US has greater sensitivity than CT in predicting lateral neck metastases (CT has greater sensitivity in predicting central neck mets.)

- N=299 pts with PTC (subgroups PTMC and PTC)
Thyroid Ultrasound

Examples

Toxic Nodular Goiter

Colloid Nodules

Comet tail echoes

Follicular adenoma (retrospective dx)
Microcalcifications

Microcalcifications AND hypervascularity

PTC: Aggressive Features

Peripheral vs. Internal blood flow

ETE

Benign

Malignant (Hurthle cell)
Solid lesion with well-defined halo

Follicular Adenoma (with hemorrhage)

Ultrasound Characteristics
Benign v. Malignant Lymph Nodes

**Benign**
- Oval
- Small
- Hilum visible
- Isoechoic/hyperechoic
- No calcifications
- Regular margin
- Hilar vascular pattern
- Single
- Distinct from surrounds

**Malignant**
- Round
- Large
- Hilum not visible
- Hypoechoic/heterogeneous
- Microlcifications
- Irregular margin
- Disordered vascular pattern
- Multiple
- Invasion of surrounds

Benign level III lymph node

Oval (L:W ratio > 2:1)
Visible hilum
Solitary
Well-defined

Metastatic Papillary CA
Metastatic PTC

L Level 3

R Level 4

Recurrent PTC in thyroid bed

USGFNA

- Seiberling KA et al: Office-based USGFNA with on-site cytology review:
  - 81% satisfactory/10% unsatisfactory/9% “limited”
  - Comparable to the Radiology literature
    (Laryngoscope 2008;118(2):228.)
- Bhatki AM et al: Office-based USGFNA without on-site cytology review:
  - 93% adequacy of specimens/7% nondiagnostic or suboptimal
  - Experience, capillary & aspiration techniques, 3-4 passes
    (OHNS 2008;139(1):27.)

Impact of US

- US detected nodal or soft tissue metastases in neck compartments believed to be uninvolved by physical exam in 39% of patients, (thereby altering the surgical procedure and apparently minimizing local-regional recurrence)

Role of preoperative ultrasonography in the surgical management of patients with thyroid cancer. Kouvaraki MA et al, Surgery, 2003; 134(6):946-54. (Dept of Radiol, MDA)
Preop US detected nonpalpable LN mets in 33% of pts with PTC, thereby altering the procedure performed.

Even in pts with palpable LN’s, US helped to guide the extent of lymphadenectomy.

**Comparison of Imaging Modalities at all levels (I – VI)**

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<tr>
<th></th>
<th>Sn</th>
<th>Sp</th>
<th>Accuracy</th>
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<tbody>
<tr>
<td>PET/CT</td>
<td>30%</td>
<td>96%</td>
<td>87%</td>
</tr>
<tr>
<td>US</td>
<td>41%</td>
<td>97%</td>
<td>89%</td>
</tr>
<tr>
<td>CECT</td>
<td>35%</td>
<td>96%</td>
<td>87%</td>
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Jeong HS et al. Integrated 18F-FDG PET/CT for the initial evaluation of cervical node level of patients with papillary thyroid carcinoma: comparison with ultrasound and contrast-enhanced CT. Clin Endocrinol (Oxf). 2006 Sep;65(3):402-7.

**Sensitivity of US**

- US: Sn for central = 52%, lateral = 77%  *(Kouvaraki MA et al., Surgery, 2003; 134(6):946-54.)*

**Sensitivity of CT**

- CT with contrast: Sn = 60% for central and lateral neck, missed on PE.
- PPV = 84% central/73% lateral (NPV 47%/57%)
- Conclusion: CT (like other imaging studies) has a limited ability to detect subclinical mets due to microscopic foci, but a (+) CT predicts with high likelihood that disease will be found in a given compartment during ND.

*Utility of CT in the Detection of Subclinical Nodal Disease in PTC. Soler ZM et al. Arch OHNS 2008;134(9):973. (OHSU)*
Advantages of Office Ultrasound

- Augments physical examination
- Low cost, painless, dynamic, reproducible and repeatable
- No radiation; no preparation/LT4 withdrawal/low-iodine diet/rhTSH injections; no iodine load; no dependence on iodine uptake
- Comprehensive node examination
- Objective comparison of follow-up dimensions
- Accurate needle placement with FNA/sampling
- Best assessment of thyroid and parathyroids together
- US analysis in real time
- Patient convenience and education
- Preoperative planning and Intraoperative procedures

How Well Does Ultrasound Predict Virulence of PTMC Prior to Surgery?

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Bilaterality/multifocality

55 yo M
Pathology:
1.9cm primary (right)
Innumerable bilateral foci + ETE
27/61 nodes with ENE

Intranodular Vascularity

- Presence of intranodular vascularity is a predictor of unfavorable outcome irrespective of size
- Older age and TNM stage III had worst px

Intranodular vascularity

Tumor attached to thyroid capsule

- US findings of tumor site attached to thyroid capsule was an independent predictor of ETE
- PET prediction of ETE in PTMC?
  - SUV only correlated with tumor SIZE and NOT ETE

Capsular Attachment

Capsular Attachment

32 yo M

72 yo Male
**PTMC: Extrathyroidal Extension (ETE)**

- Most accurate US factor predicting ETE in PTMC:
  - >25% contact with adjacent capsule


**PTMC: Lateral Lymph Node Mets (LNM)**

- Independent US factors predicting L(lateral)NM in PTMC:
  - upper pole location
  - >25% contact with adjacent capsule
  - Presence of calcification

- Pathologic features predicting LNM: presence of C(entral)NM


>25% contact with capsule (video)

>25% contact with capsule (video)
PTMC with LN Mets

37 yo F
Unifocal, 1.0 cm
No ETE
Multiple LN mets with ENE, Adherent to R RLN

Pathology: CNM correspond with LNM

37 yo F

PTMC with visible CNM

37 yo F

Aggressive Multifocal PTMC

24 yo M
Primary tumor not clearly identified
15 microfoci, largest 0.6 cm
+ETE
Multiple bilateral nodal mets +ENE
Benefits of US in Thyroid Cancer (including PTMC)

- Raise awareness/suspicion of ETE
- Raise awareness/suspicion of LN mets
- Guide preoperative counseling
- NOT supplant intraoperative assessment, use of frozen section
- Dictate whether LATERAL ND should be planned at the outset
- Suggest whether CND should be planned, but never rule out the possibility (based on intraop findings)
- Although not perfect, US is more accurate than any other imaging modality for predicting ETE and multifocality and should obviate need for routine CT

Thank you