Interventional Head and Neck Ultrasound

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Objectives

- Indications
- Interpretation of Results
- Technical Considerations

Interventional Head and Neck Ultrasound

- Indications
  - Tissue Diagnosis
    - Thyroid
    - Neck mass/metastases
    - Salivary gland
    - Parathyroid
  - Drainage
    - Post-operative complication
    - Infectious/abscess

Evaluation of a Thyroid Nodule

**Clinical Considerations**

- 4-7% have a palpable thyroid nodule
- 25-30% have a thyroid nodule if imaged
  - Highest detection - High Res Ultrasound
  - Significant number of incidentalomas
- < 5% of these nodules are malignant
- FNA biopsy
  - Additional information on the risk of malignancy
  - Selects those that may benefit from surgery
Evaluation of a Thyroid Nodule

- Clinical Features Suggestive of Cancer
  - Age < 20 or > 70
  - Male gender
  - History of low-dose neck irradiation
  - Family history of PTC, MTC, or MEN2
  - Rapid growth
  - Very hard or fixed mass
  - Associated adenopathy
  - Hoarseness/TVC paralysis

- US Features Suggestive of Cancer
  - Borders/halo
  - Internal characteristics/echogenicity
  - Microcalcifications
  - Vascular flow patterns


When to Biopsy a Thyroid Nodule?

- Clinically suspicious for cancer
- High Risk US Appearance
- Lower suspicion for cancer
  - Size criteria > 1 cm suggested
  - Not practical to biopsy all nodules

Benign or Malignant?
Fine Needle Aspiration

- Malignant
  - Papillary Thyroid Carcinoma
  - Medullary Thyroid Carcinoma
  - Anaplastic Carcinoma
  - Lymphoma
  - Metastases
- Suspicious/Follicular lesion
- Benign
- Non-diagnostic aspirate

Fine Needle Aspiration

- High sensitivity and specificity for thyroid
  - Sensitivity (68-98%)
  - Specificity (72-100%)
- Incidence of thyroid cancer in surgical specimens increased from 15 to 45%
- 23% malignant rate for suspicious follicular lesions

Fine Needle Biopsy Results

<table>
<thead>
<tr>
<th>Result</th>
<th>Percentage of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant</td>
<td>4</td>
</tr>
<tr>
<td>Benign</td>
<td>69-74</td>
</tr>
<tr>
<td>Non-diagnostic or Suspicious</td>
<td>22-27</td>
</tr>
</tbody>
</table>


Non-Diagnostic

Courtesy of Chris Jensen - UIHC


Benign

Follicular Neoplasm

Papillary Thyroid CA

FNA Algorithm

* Figures 70-2. Algorithm outlining evaluation and management of nodular thyroid disease using fine needle aspiration (FNA) biopsy, as utilized in the initial diagnostic procedure and therapeutic guidance. It is applied to only 5% of cases. (From Gaillard R. Fine needle aspiration biopsy of thyroid nodules: Advances, limitations and efficacy. Mayo Clin Proc 69:4, 1994).
Thyroid Incidentaloma

- PET
- Cohen et al. Surg 2001;130:941-6
- Kang et al. J Clin Endocrin Metab 2003;88:4100-4

- Focal vs Diffuse
- Focal Lesion
  - Incidence – 1.2 – 4.0%
  - Malignancy – 26.7 – 47.0%
- Caveats
  - Focal uptake without definable lesion – benign
  - SUV higher in malignancy – not applicable to individual cases
- Recommendation
  - Focal uptake should be evaluated with US +/- biopsy taking into account prognosis from other cancer

Surveillance After Thyroid Cancer Therapy

- Ultrasound
  - Major role in post-treatment surveillance
  - US guided FNA utilized:
    - Suspicious lesions
    - Larger lesions (1cm) of unknown significance
    - Sub-centimeter lesions of unknown significance
      - Tumor marker elevations
      - Radioactive iodine avid lesions
      - FDG avid lesions

Interventional Ultrasound in the Evaluation of Parathyroid Disease

- US guided FNA - limited role
  - Suspected intrathyroidal adenoma
    - Cytology and chemical analysis
  - Suspected parathyroid cyst
  - Recurrent or persistent hyperparathyroidism
Interventional Ultrasound in the Evaluation of a Salivary Gland Mass

- Majority will be in parotid
- Majority will be benign
- Regardless of pathology, majority will be excised

- Is there a need for cytologic evaluation prior to surgery?

FNA of Salivary Gland Mass

- Fine Needle Aspiration Biopsy (FNAB)
  - Sensitivity and Specificity 95-97%
    - Experienced cytopathologist
    - Appropriate expectations
    - Non-neoplastic, benign vs malignant – YES
    - Basal cell adenocarcinoma vs Adenoid cystic carcinoma – NO

- Limitations
  - FNAB may not be sufficient to discern low-grade from high-grade malignancies
  - Misdiagnosis may occur with FNAB

Interventional Ultrasound in the Evaluation of a Salivary Gland Mass

- Allows more accurate treatment planning
- Allows more accurate pre-operative discussion of surgery with patient
- Allows consideration for non-surgical therapy in certain instances
  - Elderly patient at high surgical risk with parotid mass felt to be Warthin's tumor by FNA
  - Patient with concern for lymphoma by FNA

FNA Misdiagnoses for Salivary Tumors

<table>
<thead>
<tr>
<th>Erroneous FNAB result</th>
<th>Actual diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benign lymphoid tissue</td>
<td>Acinic cell CA, lymphoma, Warthin's tumor</td>
</tr>
<tr>
<td>Non-neoplastic gland</td>
<td>Acinic cell CA, Pleomorphic adenoma, Squamous cell CA, Mucoepidermoid CA, Warthin's tumor</td>
</tr>
<tr>
<td>Pleomorphic adenoma</td>
<td>Adenoid cystic CA</td>
</tr>
<tr>
<td>Adenoid cystic CA</td>
<td>Pleomorphic adenoma, basal cell adenoma</td>
</tr>
<tr>
<td>Basal cell adenoma</td>
<td>Basal cell adenocarcinoma, Adenoid cystic CA</td>
</tr>
</tbody>
</table>
Interventional Ultrasound in the Evaluation of a Neck Mass

- Most commonly evaluating for metastatic carcinoma
- Should always be considered prior to Open Biopsy except ...
  - High suspicion of a paraganglioma
- If infectious etiology in the differential, be prepared to send specimen for cultures and stains

Lymph Node Biopsy

- Suspicious Lymph node

Room Configuration

- Equipment Position
- Examiner Position
- Patient Position

Examiner Position

- Alternative approach with examiner above patients head
**Patient Comfort**

- Head and neck must be supported for adequate immobilization
- Supine
  - Pillow/cervical rest to extend neck
- Upright/Semi-recumbent
  - Adjust head rest to position that supports head and neck

**Ultrasound Equipment**

- 10 MHz linear array transducer

**Supplies**

- Skin Prep
  - Betadine
  - Alcohol
- Gauze
- 1% Xylocaine
  - +/- epi
- US Gel
  - Sterile optional
- Sterile drape
  - optional
- Band-Aid

**Supplies**

- Needles for aspiration
  - 20-30g (most use 25g)
- Syringe system
  - Pistol
  - IV tubing
- Slides
- Cytology fixative
- Cytolyte solution
- Cytology technician if possible
Scanning Technique

- Orient transducer for optimal access
  - maximum dimension
  - shortest needle path
  - avoid vital structures
    - vessels
    - upper aerodigestive tract
    - mandible

Optimize the view

“Ski” to move the lesion from left to right

“Paint” to view the widest diameter of the lesion

Scanning Technique

“Skiing” - moves lesion left or right -

“Painting”

- Brings lesion into view at a given location
- Finds the widest diameter
Performing the Biopsy

- Localize lesion with US in fashion planned for biopsy
- Mark the skin
- Skin prep
- Local infiltration
- Patience!

Performing the Biopsy

- Localize lesion with US
- Needle placement with US guidance
- Complete aspiration
  - 3 passes per site
- Slide and cell block preparation

Needle Placement

Long-Axis Technique
- AIM - Line up needle parallel to the long axis probe
- Enter skin in the center of short axis of probe
  - WRONG WAY

Long-Axis Technique

Short-Axis Technique
**Long- Axis Technique**

**AIM - Line up needle parallel to the long axis probe**
- Enter skin in the center of short axis of probe

**RIGHT WAY**

**Advantages**
- Working in only one plane
- Better visualization of entire needle

**Disadvantages**
- Needle must travel longer distance in tissue
- Adjacent structures more likely to obstruct access to lesion
- May require one to work in planes other than axial plane

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**Short Axis Technique**

**AIM - Line up needle parallel to the handle of probe**
- Enter skin in the center of long axis of probe

**WRONG WAY**
Short Axis Technique

AIM - Line up needle parallel to the handle of probe
- Enter skin in the center of long axis of probe

RIGHT WAY

Superior view

Anterior View

Lateral View

Wrong Angle

Lateral View

Correct Angle

Short Axis Technique

Lateral View
Short Axis Technique

➢ Advantages
  • Needle travels shorter distance in tissues
  • Especially for thyroid pathology, it is less likely other structures will obstruct access to lesion
    - Lesion immediately adjacent or partially under bony structure
    - Mandible or sternoclavicular unit
    - Lesion deep to vessels

➢ Disadvantages
  • More complex 3-D - working in 2 planes
  • Needle more difficult to visualize since less of it is in the field of view and angle of needle can result in less echo back to transducer

Performing the Biopsy

➢ Needle placement
  • Left vs right hand
Performing the Biopsy

- Advance needle in and out of lesion
- Apply suction
- Oscillate needle tip
- Fan needle tip
- Release suction and remove needle

Handling the Aspiration

- Immediately expel aspirate onto slide
- Place second slide against specimen and smear by sliding apart
  - Paper clip
- Place in fixative
- Rinse needle/syringe with fixative into same jar for cell block

Handling the Aspiration

- Cytolyte solution for cell block

FNA-Tg Assessment

- Clinical Scenarios
  - Suspected recurrent neck disease
  - Suspected recurrent primary disease
  - Uncertain status of lymph node at initial dx
- Technique
  - Perform standard FNA with cytology slide prep
  - Aspirate 1cc saline in same syringe/needle
  - Place specimen in appropriate blood tube
- Outcome
  - Increase sensitive of aspiration by 10-20%
  - Greatest benefit
    - Cystic masses
    - Hypocellular aspirates

The Medical Record

Photodocumentation

The Finishing Touch

- Compression for 5 minutes
- Band-Aid

FNA vs Core Needle

Core Needle Biopsy

- 14g automated core biopsy needle
- Use with large matted nodes (e.g. lymphoma)
- Length of travel is critical for safe use near vital structures
Pitfalls of FNA

- Inexperienced cytologist interpreting specimen
  - Failure declare specimen inadequate
  - Failure to commit to a diagnosis
  - Failure to give accurate assessment
- Cystic lesions
  - US to access the solid component
- Follicular/Hurthle Cell Neoplasm
- Non-diagnostic specimen
  - Appropriate technique
  - Cytotech preparation
  - Immediate cytologic evaluation for adequacy

Novel US guided interventions in the near future?

- Samples for molecular analysis to predict malignancy or aggressiveness in thyroid pathology
- US Guided ablation by ethanol injection, radiofrequency, or high-intensity focused ultrasound (HIFU)

Interventional Head and Neck Ultrasound

- Getting started with a natural progression—easy...more difficult
- Control view of lesion and needle through proper technique
- No substitute for judgement