Management and diagnosis of thyroid nodules

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Agenda

- Review thyroid anatomy and histology
- Learn the differential diagnosis for a thyroid nodule
- Become familiar with the management and follow-up for a patient with a thyroid nodule
- Recognize the various appearances of thyroid nodules on ultrasound
- Understand the technique of ultrasound-guided Fine Needle Aspiration (FNA)
- Understand the use and results of radioactive iodine scans
Normal thyroid anatomy
Normal Thyroid histology

- Follicular cells make thyroglobulin
- Colloid stores thyroglobulin
- C cells make calcitonin

biology.clc.uc.edu/Fankhauser/Labs/Anatomy___Physiology/A&P202/Endocrine_System/Endocrine_Histology.htm
Epidemiology of Thyroid Nodules - an “epidemic”?

- By age 30, about 20% of the population has a thyroid nodule (women > men)
- Lifetime likelihood is around 60%

Mazzaferri, EL. N Engl J Med 1993;328:553

• Detected by ultrasound/autopsy
• Detected by palpation
Modes of detection of thyroid nodules

- Incidentalomas on head/neck CTs and MRIs, carotid ultrasound, PET scans.
- Palpated by primary care physician
- Noticed by patient
- With symptoms of hypo/hyperthyroid

As more radiologic tests are done, more nodules are discovered.
DDx for Thyroid Nodules

- Primary Thyroid cancer (5%)
- Benign adenoma
- Colloid cyst
- Simple thyroid cyst
- Metastasis from distant site (rare)

Role of follow-up is to rule out cancer
Patients at Increased Risk for Thyroid Cancer

- Family history of thyroid cancer or other endocrine cancers (MEN syndromes)
- Previous radiation to the neck (malignancy rates 20-50% in palpable nodules)
- Chernobyl fallout victims (age <14 at the time)
- Male sex (i.e., if a nodule is present, it is more likely to be cancer)
- Age < 30, > 60
- Compressive symptoms (i.e., hoarseness, dysphagia)
Management Guidelines for Patients with Thyroid Nodules and Differentiated Thyroid Cancer. Thyroid Association Guidelines Taskforce. 2006.

Depending on the skill and comfort of the clinician, some obviously benign nodules may not receive FNA right away.

FNA = Fine Needle Aspiration
Our Patient JF: History

- 73-year-old female
- PMH includes GERD, osteopenia, and palpitations.
- Noticed a mass in her neck, and a cervical lymph node was palpable.
- Referred for CT where a thyroid nodule was seen.
Our patient JF: additional history

- Received radiation to her face and neck for acne treatment when she was a teenager.
- Family history notable for a first cousin and aunt with thyroid cancer.
Our patient JF: Workup

With her personal and family history, as well as her clinical symptoms of a noticeable mass, we have a high clinical suspicion for thyroid cancer.

Still, we start her workup the same way as everyone else’s - thyroid hormone functions.
JF’s thyroid function

- TSH = 1.7 (0.5 - 5)
- Free T4 = 1.4 (0.93 - 1.7)
- Suggests normal thyroid function.

Next step: thyroid imagining
Menu of Radiologic Tests

- **Radioactive Iodine Scans**
  - Thyroid scintigraphy with I-123
  - Whole-body I-123 scan

- **Thyroid Ultrasound, +/- fine needle aspiration (FNA)**

- **CT occasionally used to evaluate compressive symptoms and spread of thyroid cancer**
Thyroid Scintigraphy

- Scintigraphy determines thyroid activity by measuring uptake of radioactive iodine.
- Indicated only in patients who are hyperthyroid or have indeterminant FNA results.
Comparison patient #1: Normal Thyroid Scintigraphy

- Equal uptake in both lobes
- No focal areas of increased or decreased uptake
Comparison Patient #2: “Cold” Thyroid nodule on Scintigraphy

NORMAL scan

/DDx for a “cold” nodule
- Thyroid cancer
- Benign adenoma
- Cyst (colloid or simple)

“Cold”/hypofunctioning nodule in left lobe (Pink arrow)

www.radiologyinfo.org/en/photocat/photos_pc.cfm?image=thyroid-nm5-nrml.jpg&pg=thyroiduptake
Comparison Patient #3: “Hot” Thyroid nodule on Scintigraphy

“Hot”/hyperfunctioning nodule in right lobe (Pink arrow)

NORMAL scan

DDx for a “Hot” Nodule

- Autonomous adenoma
- Focal thyroiditis

NOTE: A hyperfunctioning nodule is always benign and is a “don’t touch” radiologic finding. May have malignant features on biopsy.

www.endotext.org/aging/aging8/aging8.htm
Our patient JF: recommended imaging

- Ultrasound and Fine Needle Aspiration (FNA) is indicated as the next step.

- NOTE: for some patient populations (i.e. middle aged women, no suggestive history), FNA would only be undertaken if the nodule looked suspicious on ultrasound, but due to her clinical history JF’s FNA will be done regardless of the features of the nodule.
Comparison patient #4: Normal thyroid ultrasound

Thyroid tissue (yellow arrows)  Internal Jugular Vein (blue arrow)
Trachea (pink arrow)          Common Carotid Artery (star)
Interpretation of nodule features on ultrasound (US)

**GOOD**
- Anechoic/cystic
- “Spongy”
- Ring of vascularization

**BAD**
- Hypoechoic/solid
- Well-vascularized
- Microcalcifications
- Irregular margins
Companion patient #5: Benign cyst on US

- Well-defined anechoic/cystic mass, likely colloid (yellow arrows)
- Hyperechoic dots with "comet-tailing" artifacts, suggested condensed colloid masses (pink arrows)
- Internal jugular vein (blue arrow)
- Common carotid artery (star)

Companion patient #6: Benign “spongy” cyst on US

- Well-defined nodule (yellow arrows)
- Several anechoic/cystic regions (pink triangles)
- Well demarcated by septations (blue arrows)

Companion patient #7: Suspicious nodule on US

- Ill-defined border (yellow arrows)
- Hypoechoic, but non-cystic
- Many dense microcalcifications (pink triangles)

Our patient JF: Thyroid ultrasound

Two fairly well-defined nodules, > 1cm
Hypoechoic texture

Rim calcification
No cystic areas
Our patient JF: Thyroid ultrasound with doppler

Nodule 1 shows some vascularity penetrating the nodule, nodule 2 shows rim vascularity.

Thyroid nodule #1

Thyroid nodule #2

BIDMC PACS

Nodule 1 shows some vascularity penetrating the nodule, nodule 2 shows rim vascularity.
Our patient JF: follow-up to ultrasound

- Several suspicious features on ultrasound, plus older age, family history of thyroid cancer and history of radiation

- Next step is a Fine Needle Aspiration (FNA) to collect cells from the nodules.
A 25-27 gauge needle is used (yellow arrow), and several samples are collected until the pathologist has enough cellular material to examine.
Method of FNA, continued

- Large, easily palpable nodules are sometimes done without ultrasound guidance.
- Benefits of ultrasound guidance include being able to locate small and unpalpable nodules and targeting the solid area of cystic nodules.
- Local anesthesia is used at the discretion of the practitioner and the patient.
Ultrasound guided FNA

Needle inserted perpendicular to the transducer is easiest to see, because more of the signal is bounced back and received by the transducer.
Possible FNA results

Pathology reports fall into 1 of 4 categories (incidences):

- **Non-diagnostic (15%)** → Repeat FNA
- **Malignant (5%)** → Lobectomy or thyroidectomy
- **Indeterminant (10%)** → Close follow-up or surgery
- **Benign (70%)** → No follow-up or repeat ultrasound in 1 year
Our patient JF: FNA result

- Indeterminant
- “Follicular cells with enlarged and crowded nuclei with rare nuclear grooves.”
- “There is slight nuclear membrane irregularity but no inclusions.”

*Bsuggestive of thyroid malignancy*

BIDMC cytology detail, careweb
Our patient JF: Treatment

- JF underwent a right lobectomy.
- Pathology results showed papillary thyroid carcinoma, follicular variant, with no lymph node involvement.
- JF underwent subsequent completion thyroidectomy 2 weeks later, which showed a small papillary carcinoma in the left lobe.
Our patient JF: Post-surgical follow-up

- 2 months later she underwent a total-body radioactive I-123 scan to look for remaining thyroid tissue.

- Reminder: CT, MRI, or PET scans are not recommended for following thyroid cancer, except CT to investigate compressive symptoms.
Radioactive I-123 Scan

- Thyroid tissue takes up the radioactive iodine isotope, I-123. The radiation released does not damage the thyroid tissue and is picked up on film.
- Uses are to look for remaining thyroid tissue or exogenous uptake, indicating possible metastasis.
- Patient Preparation: patients must stop taking their thyroid replacement hormone for a week prior to the scan and eat a low iodine diet.
Our patient JF: Results of I-123 scan

- No exogenous uptake on full body scan, suggests no spread of the cancer.
- Uptake in thyroid confirms remaining tissue and the need for radioactive ablation.
I-131 Radioiodine ablation

- Radioactive iodine taken up by thyroid tissue.
- Short-distance beta emissions result in thyroid tissue damage.
- Minor amounts of long-distance gamma emissions require that patients are isolated for 24 hours after treatment.
Post-thyroidectomy and ablation therapy ultrasound showed scar tissue with no recurrent nodules (yellow boxes) and no enlarged lymph nodes (not shown).
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References

- Management Guidelines for Patients with Thyroid Nodules and Differentiated Thyroid Cancer. Thyroid Association Guidelines Taskforce. THYROID. Volume 16, Number 2, 2006.