Medical Management of Thyroid Disorders

- Nancy J. Kane M.D.
- Iowa Diabetes and Endocrinology Center

HYPERTHYROIDISM AND HYPOTHYROIDISM

Clinical Findings

- Skin
  - cool, rough, dry
  - puffy face, periorbital edema
  - yellowish color

- Hair
  - coarse, brittle

- Pulmonary
  - shallow, slow respirations
  - impaired ventilatory response to hypercapnia and hypoxia

- Gastrointestinal
  - intestinal peristalsis markedly slowed
  - chronic constipation, fecal impaction, ileus
Clinical Findings

- Neuromuscular system
  - muscle cramps, paresthesias, weakness

- Central nervous system
  - lethargy, difficulty concentrating
  - altered FSH/LH secretion -- anovulatory cycles, infertility, menorrhagia
  - myxedema madness

Clinical Findings

- Renal function
  - decreased glomerular filtration rate
  - impaired ability to excrete a water load

- Anemia
  - impaired hemoglobin synthesis
  - iron deficiency -- increased loss due to menorrhagia, impaired intestinal absorption
  - folate deficiency -- impaired intestinal absorption
  - pernicious anemia

Etiologies of $1^\circ$ Hypothyroidism

- Surgical
- Ablative, i.e. I-$^{131}$, XRT
- Infiltrative diseases (amyloid, sarcoid, hemochromatosis)
- Autoimmune destruction - Hashimoto's thyroiditis - antibodies directed at TPO
- Congenital, hereditary
- Inflammatory - thyroiditis, usually transient

Etiologies of $1^\circ$ Hypothyroidism

- Drugs:
  - Lithium - impairs release of T4 and T3
  - Amiodarone - Wolff-Chaikoff effect
  - Propylthiouracil, methimazole
  - Interferon - causes a Hashimoto's thyroiditis-like presentation, resolves after drug discontinuation

Etiologies of $2^\circ$ Hypothyroidism

- Central
  - Secondary Hypothyroidism- pituitary adenoma, tumor, infiltration
  - Tertiary Hypothyroidism- hypothalamic dysfunction

- Peripheral resistance to the action of thyroid hormone
Thyroid Function Test Interpretation

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<th>T4/T3</th>
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<td>Central Hyperthyroidism / Resistance</td>
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Hashimoto’s Thyroiditis
- Most common cause of hypothyroidism
- Autoimmune - antibodies to TPO and/or Tgb present
- Occurs in goitrous or atrophic forms
- When goiter present, it is usually firm/ rubbery in consistency

MANAGEMENT

Treatment of Hypothyroidism
- Levothyroxine is the treatment of choice
- Synthetic hormone is preferred ?generic vs brand name
- 80% of the ingested dose is absorbed, mostly in the proximal and mid small bowel
- Peak levels occur 2-4 hours after ingestion
- Dose range 25-300 mcg
- Usual dose (adult) 1.5-2.0 mcg/kg/day

Treatment of Hypothyroidism, cont
- Dose requirements decrease with age, and increase with pregnancy
- Phenytoin (AEDs) can increase thyroid hormone metabolism
- Cholesterol binding resins, sucralfate, ferrous sulfate, calcium, PPIs and soy can decrease GI absorption
- t 1/2 is ~7 days
Treatment of Hypothyroidism

- Adequacy of treatment is assessed by measurement of TSH
- TSH does not stabilize until 6 weeks after a dose change of LT4
- Combination of T4 and T3, and dessicated preparations are not recommended for general use

Treatment of Hypothyroidism, cont.

- Triiodothyronine is available p.o. and I.V.
- Rarely used due to short $t_{1/2}$ of 24 hours
- Most common use is for short term transitional therapy when T4 is stopped for metastatic surveys
- Usual dose is 25-75 mcg/day (given bid or tid)

Treatment of Hypothyroidism, cont.

- Keep a particular patient on one particular brand of levothyroxine (generic vs brand name)
- IV levothyroxine is available for treatment of myxedema coma, and for use in patients who are unable to take oral medications. The dose of IV levothyroxine is 50-75% of the usual oral dose

Special Considerations in Treatment of Hypothyroidism

- Elderly patients
- Patients with coronary artery disease
- Patients with subclinical hypothyroidism
- Myxedema coma
- Hypothyroidism in pregnancy

Myxedema Coma

- An acute medical emergency
  - mental status changes
  - hypothermia
  - respiratory failure
- Most commonly occurs in older women
- Often precipitated by infection, CVA, MI
- Mortality related to the precipitating cause
Mxedema Coma
Treatment
- Ventilatory support
- Fluid therapy
- Give Hydrocortisone 100 mg q 8 hours until adequacy of adrenal cortical function is established
- IV Thyroxine replacement - initial dose 300mcg, then 50 mcg/day
- Treat the precipitating cause !!

Thyroid Hormone Replacement During Pregnancy
- Dose requirements typically increase during pregnancy by approximately 30%
- Contributing factors
  - weight gain, increased TBG, increased deiodinase activity in the placenta, reduced GI absorption due to iron in prenatal vitamins
- TSH measurements 4-6 weeks after conception, 4-6 weeks after any dose change, and at least once per trimester
- ? Increase LT4 dose by 25% at diagnosis

Side Effects of Thyroid Hormone Therapy
- None, if dose is appropriate (TSH is in the normal range)
- Excessive thyroid hormone therapy (TSH suppressed) can result in:
  - hyperthyroid symptoms
  - accelerated bone mineral loss
  - enhanced protein catabolism
  - risk of cardiac arrhythmia

When To Treat Subclinical Hypothyroidism
- TSH > 10- treat (this will probably change with improving TSH test sensitivity)
- TSH high to 10
  - Check TPO Ab
    - If positive, replace with low dose
    - If negative, repeat in 2-3 months

  Presence of goiter

HYPERTHYROIDISM
Thyroid Function
- Beware of total thyroid hormone measurements, as deficiencies or excesses of binding proteins can lead to the appearance of abnormality, when in fact thyroid function is normal:
  - Estrogen increases total T4 and T3 due to increased TBG
  - Illness decreases total T4 and T3 due to decreased protein levels

Hyperthyroidism
Signs and Symptoms
- Fatigue
- Nervousness, agitation, irritability
- Heat intolerance, increased perspiration, dehydration
- Weight loss
- Tremor, muscle weakness
- Insomnia
- Palpitations, tachycardia, arrhythmia

Hyperthyroidism, cont.
- Exertional dyspnea
- Hyperdefecation
- Decreased menstrual flow, infertility, increased spontaneous abortion rate
- Lid lag/stare
- Goiter
- Onycholysis
- Graves’ disease: Orbitopathy, dermopathy, Thyroid bruit

Lid Lag

Onycholysis

Palmar Erythema
Etiologies of Hyperthyroidism

- High iodine uptake
- Low iodine uptake
  - I-131 or I-123 is used to differentiate causes of hyperthyroidism, but should not be used to confirm hyperthyroidism

Etiologies of Hyperthyroidism

- High iodine uptake:
  - Primary
    - Graves’ disease
    - TMNG
  - Central
    - TSH secreting tumor
    - Thyroid hormone resistance syndromes

Etiologies of Hyperthyroidism

Low iodine uptake

- Thyroiditis
  - Silent
  - Subacute
  - Postpartum
- Ingestion of thyroid hormone
- Iodine induced
  - Amiodarone

Graves’ Disease

- an auto-immune disorder
- production of a circulating antibody, TSI, which binds to and activates the TSH receptor, causing clinical manifestations of thyroid hormone excess
- this antibody may also cause orbitopathy and dermopathy

Graves’ Disease

- Graves’ disease occurs more commonly in younger individuals, and 8-9X more common in women
- Can be associated with other auto-immune endocrine disorders including type 1 DM, Addison’s disease, pernicious anemia and premature ovarian failure
Graves’ Ophthalmopathy

Peri Orbital Edema

Graves’ Dermopathy
Graves’ Dermopathy

Graves’ Dermopathy Mimicking Erythema Nodosum

Thyroid Scan

NODULAR THYROID DISEASE

Hyperthyroidism
High Iodine Uptake

- Toxic multinodular goiter (TMNG)/Solitary hyperfunctioning nodule
- More commonly seen in older individuals
- May present as “apathetic” thyrotoxicosis
- On nuclear imaging studies, one sees “hot” and “cold” areas within the thyroid gland
- May be due to activating mutations of the TSH receptor

Toxic Multinodular Goiter
**Etiologies of Hyperthyroidism**

- **High iodine uptake:**
  - Primary
    - Graves’ disease
    - TMNG
    - Toxic Nodule
  - Central
    - TSH secreting tumor
    - Thyroid hormone resistance syndromes

- **TSH secreting tumors** - usually large and may present with visual field defects. These tumors are rare, and should be suspected when a patient is thyrotoxic clinically, has a normal or elevated TSH, and an elevated T4.

- **Thyroid hormone resistance syndromes** have a similar laboratory picture, but no evidence of tumor on MRI scan of the sella. This syndrome shows AD inheritance.

**Etiologies of Hyperthyroidism**

- **Low iodine uptake**
  - Thyroiditis
    - Silent
    - Subacute
    - Postpartum
  - Ingestion of thyroid hormone
  - Iodine induced
    - Amiodarone
**Thyroiditis**

- Results from inflammation of the thyroid gland
- Typically self-limited
- Patient may pass through a hypothyroid phase before returning to normal
- Nuclear medicine uptake and scan usually shows low or no uptake

**Subacute Thyroiditis**: presents after URI, usually neck pain is present

**Silent thyroiditis**: related to Hashimoto’s thyroiditis, no neck pain

**Post-partum thyroiditis**
  - usually occurs within 6 months after delivery
  - tends to recur with subsequent pregnancies

**Hyperthyroidism**

- **Low Iodine Uptake**

**Treatment**

- Treatment to reduce symptoms
  - Beta blockers

- Treatment to reduce hormone levels:
  - Antithyroid drugs
  - Radioactive iodine
  - Subtotal thyroidectomy
  - Steroids
**Beta Blockers**
- Used as adjunctive therapy to control symptoms
- Choice between selective versus non-selective Beta blockers
  - Selective beta blockers are usually preferred
  - Propranolol inhibits T4 to T3 conversion and thus preferred in thyroid storm

**Antithyroid Drugs**
- Antithyroid drugs are reversible, effective in most patients, and generally safe
- They principally block oxidation of iodine and its incorporation into tyrosine residues
- Do not affect iodine trapping or release of stored thyroid hormone
- Two principal drugs: Methimazole and Propylthiouracil (PTU)
- PTU inhibits conversion of T4 to T3
- Initial dosage depends on the thyroid hormone levels: Propylthiouracil 100 mg every eight hours, or methimazole: 10-20 mg qd

**Antithyroid Drugs**
- Usual duration of therapy is 6-12 months
- Remission rates 30-60%
- Favorable prognostic signs for permanent remission include a short history, mild disease, and a small goiter (best factor)
- Methimazole is preferable to propylthiouracil for most patients because:
  - can be administered once a day
  - produces fewer adverse reactions
  - REDUCED RISK OF LIVER DISEASE
- Propylthiouracil is preferable during FIRST trimester of pregnancy and possibly for treating thyroid storm

**Side Effects of Thiocarbamides**
- Minor or major skin reactions
- Arthralgias
- Hepatitis
- Thrombocytopenia or Agranulocytosis – a potentially serious but rare occurrence.
- CAUTION PATIENTS REGARDING SIDE EFFECTS

**Radioactive Iodine**
- I-131 is the preferred treatment for non-pregnant adults with Graves' disease
- Convenient oral administration
- May see flare in symptoms 1-2 weeks after treatment
- Effect may not be apparent before 6 weeks
- Antithyroid drugs should be stopped 5-7 days before the use of RAI

**Radioactive Iodine, cont.**
- Contra-indicated in pregnancy or children or breastfeeding mothers
- 70-80% treated effectively with 1 dose
- Permanent hypothyroidism may occur in majority of patients
- No increased risk of malignancy in treated patients
**Surgery - Subtotal Thyroidectomy**
- Requires pre-treatment with antithyroid drugs
- Effective > 90%, may see late recurrence
- Complications:
  - recurrent laryngeal nerve injury
  - hypoparathyroidism
  - permanent hypothyroidism
  - may precipitate thyroid storm

**Subtotal Thyroidectomy**
- Much less often used now
- For reasons that remain obscure, extensive but incomplete removal induces remission in most patients with Graves’ disease
- Rapid preparation for surgery with beta blockers alone seems to work well in patients who have mild to moderate hyperthyroidism
- In more severe cases, the addition of iodide for 10 days preoperatively reduces the elevated thyroxine level to the normal range

**Treatment of TMNG/ Toxic Nodule**
- Can control symptoms with Beta blockers and anti-thyroid drugs, but will not result in permanent remission
- **I-131 is effective, and preferred treatment**
- Surgery is effective but may be limited by the underlying health

**Treatment of Thyroiditis**
- Self limited problem, requires supportive/symptomatic therapy only
- Beta blockers can be used for control of tachycardia
- Anti-inflammatory agents for thyroid pain
- Occasionally, prednisone is required for pain control

**Thyroid Storm**
- Thyroid storm
  - life threatening medical emergency
  - severe hyperthyroidism, plus mental status changes and fever
  - can occur due to omission of anti-thyroid drug therapy, surgery, MI, CVA, infection in a patient with underlying hyperthyroidism
  - Supportive measure include sedation, fluid replacement, oxygen, cooling.
  - As always, treat the precipitating cause

**Treatment of Thyroid Storm**
- Treatment algorithm:
  - Propranolol 60-80mg po q 6 hr
  - Dexamethasone, 1-2 mg every six hours or Hydrocortisone 100mg IV q 8 hr
  - methimazole 10-20 mg every 4 hours
  - SSKI 5 gtt sp q 8 hr AFTER methimazole has been given

ALWAYS START antithyroid drug BEFORE GIVING IODINE !!!
**Subclinical Hyperthyroidism**

- **Definition:**
  - Low TSH <0.1 mU/L (0.4 - 5.0 mU/L)
  - Normal free T4 and free T3

*Subclinical Hyperthyroidism consequences*

- **Cardiac effects**
  - atrial fibrillation (AF), frequent premature atrial contractions, sinus tachycardia
  - risk of AF is 3x higher if TSH is ≤ 0.1 mU/L
  - increased ventricular mass and contractility

- **Accelerated bone loss**
  - especially in women not receiving estrogen replacement therapy

*Subclinical Hyperthyroidism Management*

- **Asymptomatic patients**
  - recheck TSH, T3 and free T4 and again in 2-3 months, and then every 6 months
  - if TSH is persistently low then obtain 24 hours radioactive iodine uptake scan
  - no uptake - subacute thyroiditis with transient hyperthyroidism
  - high uptake - "hot" nodule (toxic adenoma), toxic diffuse goiter (Graves' disease), and toxic multinodular goiter

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**Thyroid Function Test Interpretation**

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**Hypothyroidism and Pregnancy**
Thyroid Hormones in Pregnancy

Hyperthyroidism In Pregnancy
- Graves’ disease
- Hydatidiform mole
- Transient hyperthyroidism of hyperemesis gravidarum

Treatment
- TSH normalization is not the goal
- Try to maintain high normal Free T₄ or free T₃
- PTU preferred agent first trimester then methimazole
- Beta blockers relatively contraindicated

Conclusions
- Graves’ disease is the most common cause
- Treatment is etiology specific
  - Can choose between RAI and anti thyroid meds for Graves’
  - RAI ablation is preferred for nodular thyroid disease
  - Observation prudent for thyroiditis
  - Probably treat subclinical hyperthyroidism (age?)

The laboratory tests useful in the diagnosis of hyperthyroidism are summarized as follows:
1. Measurement of the TSH level is the simplest and most widely available test. A suppressed TSH level is as sensitive as FT₄ and more specific than FT₃.
2. The serum T₃ level is sometimes elevated when the T₄ is not.
3. When the goal is to exclude hyperthyroidism as the diagnosis, the TSH assay is best. A normal value, combined with a normal FT₄, is adequate to rule out this diagnosis.
4. An FT₄ level is often useful when the patient is taking a medication that alters TBG levels.
5. RAIU is not usually needed to confirm the diagnosis of hyperthyroidism but helps in determining etiology.
THYROID NODULES: EVALUATION AND MANAGEMENT

Nancy J. Kane M.D.
Endocrinologist, Iowa Diabetes & Endocrinology Center

Pretest:

- A 58 year old man is found to have a thyroid nodule on exam. His TSH is normal. Thyroid ultrasound confirms the presence of a 1.8 cm hypoechoic nodule in the right lower thyroid. Next step?
  A. Send for thyroid uptake and scan to see if this is a cold or hot nodule
  B. Send for ultrasound guided FNA
  C. Start Levothyroxine 50 mcg to shrink the nodule
  D. Send for CT scan of neck to better assess nodule

Learning Objectives

- Understand the prevalence of thyroid incidentalomas/nodules
- Review the stepwise evaluation and management of thyroid nodules
- Review the challenges providers and patients face in the management of nodules

Epidemiology

- Thyroid nodules are exceedingly common!
- Most patients will be found incidentally, hence name incidentalomas
  - By palpation ~20% of unselected populations
  - Sonographic prevalence up to 76%
  - Increases with age
    - 27% in < 50 year olds
    - ~50% of 50 year olds
  - More common in women

- Most patients will be asymptomatic
  - (though after visiting Google, 99% will describe symptoms!)
  - Unless nodules are large - unlikely to cause compressive issues

- Possible symptoms:
  - Dysphagia - classic solids more than liquids
  - Enlarging mass, sensation of globus
  - Hoarseness
  - Dyspnea
  - Pain is typically absent unless inflammation, bleed
  - Screen for hyperthyroid symptoms
Approach these cases asking these questions:
- Are they cancerous?
  - Clinically relevant
- Are they affecting thyroid function?

Thyroid cancer
- Rare, most nodules are benign
  - ~5% harbor malignancy
- Risk factors
  - Age (< 30 yo or > 60)
  - Male
  - History of childhood irradiation
  - Family history

Case Presentation
- 54 year old female executive undergoes a screening carotid ultrasound
- Noted to have a mass in the thyroid and was instructed to see PCP for further evaluation
- How would you proceed?

History
- Is she symptomatic?
  - Hoarseness, dysphagia, dyspnea, sensation of globus, change in size
- Does she have risk factors for cancer?
  - Family history
  - Radiation exposure

Examination
- Normal thyroid 15-20 g, just inferior to cricoid
- Assess from front, compare sides, ask patient to swallow
  - Presence of asymmetrical ‘push’ may suggest presence of nodule
  - Tenderness
  - Consistency
  - Mobility
- Adenopathy

Investigation
- All patients with thyroid nodules should have biochemical and imaging studies
- Bloodwork for thyroid function important in triaging and determining next step
  - TSH +/- Free T4
  - Need to consider the possibility that nodule may be autonomous/hot
  - This can be easily ruled out by finding a normal TSH
Laboratory Tests

- Important in triaging and determining next step
  - **TSH +/- Free T4**
  - Need to consider the possibility that nodule may be autonomous/hot
    - This can be easily ruled out by finding a normal TSH
    - If TSH is low, thyroid I-123 uptake and scan is necessary to prove that the nodule is indeed the source of hyperthyroidism
    - Hot nodules are much less likely to be cancerous so FNA is usually not necessary
      - Treat the biochemical issue

Imaging

- Simple ultrasonography
  - Best imaging test for thyroid
  - Cheap, no radiation
  - Useful information on size, vasculature, solid vs cystic
  - Sonographic risk factors
    - Hypoechoic nodules
    - Irregular margins
    - Increased vascularity
    - Microcalcifications
  - Cervical adenopathy

- MRI, CT not recommended for nodule evaluation
  - Expensive, little additional information compared to US
  - May have a role in some situations:
    - Large goiters
    - Subternal extension
    - Pre-operative planning
    - Cervical adenopathy

Gharib H. Endocrinol Metab Clin N Am 2007

Reading C. US Quarterly 2005
**Next Steps?**

- If TSH is normal, and ultrasound confirms presence of a solid nodule that is large enough, consider FNA of the nodule.
- Generally >1 cm though guidelines are evolving:
  - >3 cm if sonographically high or intermediate suspicion
  - >1.5 cm if low suspicion
  - >2 cm even, if very low suspicion

Haugen BR. ATA Guidelines 2015

- Concern: overdiagnosis and overtreatment of clinically insignificant nodules:
  - Some cancers can be clinically insignificant
  - There remains a degree of ‘false positive’ results that leads to unnecessary surgery
- If FNA is necessary, US-guided FNA is the next step:
  - Palpation-guided no longer routine
  - Core needle biopsies not recommended: does not increase diagnostic yield

Khoo TK. Endocr Prac 2008

**Ultrasound-guided Thyroid Biopsy**

- Fine-needle aspiration - Gold standard
  - Core needles not necessary
- Should be ultrasound guided:
  - Simple office procedure
    - Small 25 ½ G needle
    - No anesthesia
    - Anticoagulation possible
    - Quick: usually <10 mins
    - Safe

Khoo TK. Endocr Prac 2008

AACE/AME Task Force on Thyroid nodules. Endocr Prac 2006

**Results and Implications**

- Diagnostic (6 clusters, >10 cells each):
  - Benign
  - Malignant
  - Suspicious for malignancy
  - Indeterminate (Suspicious for follicular neoplasm, atypia of unclear significance)
  - Nondiagnostic

Cibas ES. Arch Pathol Lab Med 2009

AACE/AME Task Force on Thyroid nodules. Endocr Prac 2006

- FNA generally performed for nodules > 1 cm:
  - Diagnostic accuracy if too small
  - Small nodules likely less significant
  - In situation of multiple nodules: tend to biopsy the one with highest sonographic suspicion
  - FNA remains the gold standard: however this is a cytological evaluation
  - No histological data

Khoo TK. Endocr Prac 2008

AACE/AME Task Force on Thyroid nodules. Endocr Prac 2006

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Cibas ES. Arch Pathol Lab Med 2009

AACE/AME Task Force on Thyroid nodules. Endocr Prac 2006
The Challenges (1)

- Thyroid nodules are exceedingly common!

The Challenges (2)

- The gold standard test is not absolute
  - One limitation of cytology-follicular adenoma vs carcinoma often requires histological data
  - Analogy: looking at separate bricks (cytology) versus looking at part of the wall (histology)
  - Nodules classified as indeterminate usually require surgery
  - However most of these ultimately come back benign

Correspondence of Initial Cytopathology Diagnosis vs Post-Op results

- To minimize unnecessary surgery in indeterminate nodules, testing for molecular markers are becoming routine
- Afirma Gene Expression Classifier
- 4-5 samples taken- half sent for cytology and rest for GEC testing if needed
- If cytology is indeterminate, triggers another tier of tests to reclassify nodules to benign (NPV >95%) vs suspicious (PPV >70%)

Monitor US-Guided FNA

- Thyroid nodule
- Surgery
- Radioiodine
- Thyroid scan
- Cold nodule
  - Ablate, resect, treat medically
- Hot nodule
- Indeterminate
- Suspicious
- Benign
- Suspicious for Follicular Neoplasm
- Malignant
- AUS-FLUS
- Suspicious for Malignancy
- Gene Expression Classifier Profile
- Low TSH level
- Cytopathological examination
- Unsatisfactory result
- Adapted from NEJM
Thyroid Cancer

- Most common type: papillary thyroid cancer
  - >80% of all thyroid cancers
  - Most are microcarcinomas
- Prognosis excellent
  - Cancer-related mortality only 6% over 16 years
  - Autopsy series showing microcarcinomas in up to 36% (Finnish population)
  - Probability that many thyroid cancers, even if left undiagnosed, may not cause harm

The challenge then is deciding how aggressive to be:

- Is surgery more risky to life than the potential threat of the nodule, even if this is cancerous
- Not all cancers are slow-growing
  - Anaplastic thyroid cancer has a ~100% disease-specific mortality
  - Median survival 4–5 months

Subsequent Management of Nodules

- If FNA is suspicious or positive for malignancy—surgery is necessary
- If FNA is benign—watchful waiting
  - Generally repeat US in a year
  - Preferable at same center to allow for comparison, and to minimize operator variables
  - If there is significant growth, consider rebiopsy versus surgical referral
    - Significant growth: >20% increase in 2-axes

Levothyroxine and Thyroid Nodules

- Levothyroxine is frequently used to shrink goiters and thyroid nodules
- However data suggests minimal or no benefits, and may cause harm of hyperthyroidism
- Therefore not recommended
Aspiration of Cystic Nodules

- The FNA is purely a diagnostic procedure
- To obtain cells to better define the nature of a nodule
- Is not meant to be a therapeutic procedure
- While can easily decompress the fluid component of nodules
  - However the fluid reaccumulates in 50-75% of nodules
  - Therefore do not do this purely to shrink the nodule

Possible Future Directions

- Ethanol ablation
  - Fluid is aspirated, followed by injection of 99% ethanol (withdrawn after 5 mins)
  - Shown to reduce recurrence rates
  - Complications: moderate to severe pain, RLN damage
  - Not gained widespread use in USA

Possible Future Directions

- Laser ablation
- Radiofrequency ablation

Summary

- Thyroid nodules are common
  - Usually benign
  - FNA usually necessary if >1 cm and not ‘hot’
- PTC is most common thyroid cancer
  - Excellent prognosis

QUESTIONS?????