Competency Assessment

Thyroid Cytopathology

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The 6 ACGME Competencies
Medical Knowledge
Practice Based Learning
System based practice
Interpersonal and communication skills
Patient care
Professionalism
1. **Normal Gland and Nodules**
   a. **Normal Anatomy and Cytology**
      i. **Medical Knowledge**
         1. Recognize the normal anatomy of thyroid gland and its relationship to other vital structures in the neck
         2. Recognize the normal cellular and non-cellular elements visible in a thyroid FNA specimen and their histologic correlates
            a. Colloid
            b. Macrophages
            c. Follicular cells
            d. Blood components (red blood cells, inflammatory cells, platelet clumps)
            e. Mesenchymal cells
         3. Recognize various forms of normal thyroid follicular cells and their key cytoplasmic and nuclear features
            a. Follicular cells
            b. Oncocytic follicular cells (AKA Hurthle cells)
         4. Recognize various architectural arrangements of thyroid follicular cells
            a. Monolayer sheets
            b. Micro-follicle
            c. Macro-follicle
         5. Identify and recognize the significance of various forms of colloid
   ii. **Practice Based Learning**
      1. Understand the histologic correlates of various cellular and non-cellular components seen in thyroid cytology specimens
      2. Identify the various architectural patterns formed by thyroid cells
      3. Recognize forms of colloid and its patterns seen in smears, monolayer and cell block preparations
      4. Recognize artifacts that might obscure or mimic cellular elements
         a. Air-drying artifact
         b. Platelet clumps vs. follicular cell groups
         c. Poor fixation artifact leading to loss of nuclear chromatin details

b. **Thyroid Nodule Presentation, thyroid function tests and key ultrasound features**
   i. **Medical Knowledge**
      1. Recognize the basic principles of thyroid function tests
      2. Recognize the basic elements of clinical history pertinent to thyroid nodule
         a. Duration
         b. Stable in size or growth
         c. History of thyroid disease
         d. Family history of thyroid cancer
         e. Exposure to radiation during childhood
         f. History of other cancers especially endocrine tumors
      3. Understand the clinical presentation of thyroid nodules
         a. Palpable vs. non-palpable
         b. Single vs. multiple
         c. Firm vs. soft
d. Fixation to surrounding structures  
e. Associated lymphadenopathy  
f. Causing swallowing or breathing difficulties  
g. Associated hypothyroidism or hyperthyroidism  

4. Recognize the Key Ultrasound Features of Thyroid Nodules  
a. Location  
b. Single vs. multiple  
c. Solid vs. complex vs. cystic  
d. Vascularity  
e. Echogenecity  
   i. Hypoechoic  
   ii. Hyperechoic  
   iii. Isoechoic  
f. Presence of absence of halo around nodule  
g. Nodule margins  
   i. Regular  
   ii. Irregular  
   iii. Extrathyroidal extension  
h. Calcifications  
   i. Micro vs. Macro-calcifications  
   ii. The status of surrounding thyroid parenchyma  
      i. Heterogeneous  
      ii. Nodular  
      iii. Normal – homogeneous

ii. Practice Based Learning  
1. Understand the importance of clinical history and other significant conditions in the accurate interpretation of the thyroid nodules  
2. Understand the importance of clinical history as related to the risk of malignancy in thyroid nodules  
   a. Family history of thyroid cancer  
   b. History of head and neck irradiation  
   c. Regional lymphadenopathy  
3. Understand how abnormalities in thyroid function can alter cell morphology, colloid and smear background  
   a. Follicular cell nuclear atypia in hypo and hyperthyroidism  
   b. Increase amount of oncocytic follicular cells in chronic lymphocytic thyroiditis i.e. hypothyroidism  
   c. Lymphocytes and lymphoid follicles in chronic lymphocytic thyroiditis i.e. hypothyroidism  
   d. Lack of watery colloid in chronic lymphocytic thyroiditis  
4. Understand the key differences between manual vs. ultrasound guided FNA  
   a. Selection of suspicious nodule for fine-needle aspiration in multinodular goiter  
   b. Sample adequacy  
   c. Targeting solid component in cystic nodule
d. Sampling deep seated thyroid nodules
5. Understand the key ultrasound features of thyroid nodules
6. Recognize the suspicious ultrasound features of thyroid nodules
   a. Hypoechoogenicity
   b. Vascularity
   c. Microcalcification
   d. Irregular margins
   e. Presence of halo

2. Thyroid Fine Needle Aspiration (FNA)
   a. Aspiration apparatus
      i. Medical Knowledge
         1. Understand that 25-27 gauge needles are preferred for initial biopsies
         2. Recognize the various types of syringe holders used for suction
      ii. Practice Based Learning
         1. Understand that additional devices for suction are usually not necessary when using smaller diameter needles
   b. Technique
      i. Medical Knowledge
         1. Understand that ultrasound guidance is preferred for nonpalpable nodules
         2. Understand that when visualized with ultrasound, different areas of large masses should be sampled, while avoiding cystic areas
         3. Understand the general principles of how cellular material is obtained and retained in the needle core
         4. Understand aspiration technique
         5. Understand that 2-5 passes per nodule is considered reasonable to ensure an adequate sample
         6. Understand proper smearing technique
      ii. Practice Based Learning
         1. Understand the clinical indications for a fine needle aspiration biopsy of a thyroid lesion
         2. Understand the possible complications of a fine needle aspiration biopsy
         3. Understand that the principal reason for a false negative result is inadequate sampling
         4. Understand that to maximize cellular yield and reduce bloody artifact, a dwell time of 2-5 seconds within a nodule and 3 forward and back oscillations per second is ideal
         5. Understand the possible histologic alterations associated with a fine needle aspiration biopsy

3. Thyroid Fine Needle Aspiration Specimen
   a. Preparations
      i. Medical Knowledge
1. Understand that tissue or cyst fluid may be directly smeared for air-dried and alcohol fixed preparations
2. Understand that air-dried preparations are stained with Romanowsky (Diff-Quik, Wright-Giemsa, Wright) stains
3. Understand that alcohol fixed preparations are stained with Papanicolaou stain
4. Understand that liquid-based processing can be utilized alone or in addition to direct smears
5. Understand that for liquid-based processing, the needle should be flushed with a small amount of liquid (0.5 cc) of Cytolyt, balanced saline, or Hank’s solution
6. Understand that for liquid-based processing, fixative may be necessary for remote transport

ii. Practice Based Learning
1. Understand that the cell-rich fluid of a liquid-based preparation can be used for a cell block

b. Staining
i. Medical Knowledge
   1. Understand that there are two types of stains used in thyroid fine needle aspiration biopsy specimens
      a. Romanowsky (Diff-Quik, Wright-Giemsa, Wright) stain
      b. Papanicolaou stain
   2. Understand the basic procedure and dye components for both the Romanowski-type and Papanicolaou stains

ii. Practice Based Learning
1. Understand the advantages and limitations for both the Romanowski-type and Papanicolaou stains

c. On-site adequacy evaluation
i. Medical Knowledge
   1. Understand that a direct smear is necessary for immediate assessment
   2. Understand that adequacy defines the quality and quantity of the sample
   3. Understand the criteria for adequacy of the Bethesda System for reporting thyroid cytopathology and the exceptions to these criteria

ii. Practice Based Learning
1. Understand that immediate assessment may decrease complications, improve triage of tissue, and increase adequacy

4. Thyroid Fine Needle Aspiration Specimen Diagnosis
   a. Classification scheme
      i. Medical Knowledge
         1. Understand the recommended diagnostic categories of the Bethesda System for reporting thyroid cytopathology
            a. Nondiagnostic or Unsatisfactory
               i. Cyst fluid only
ii. Virtually acellular specimen
iii. Other (obscuring blood, clotting artifact, etc)

b. Benign
   i. Consistent with a benign follicular nodule (includes adenomatoid nodule, colloid nodule, etc.)
   ii. Consistent with lymphocytic (Hashimoto) thyroiditis in the proper clinical context
   iii. Consistent with granulomatous (subacute) thyroiditis
   iv. Other

c. Atypia of Undetermined Significance or Follicular Lesion of Undetermined Significance

d. Follicular Neoplasm or Suspicious for a Follicular Neoplasm
   i. Specify if Hurthle cell (oncocytic) type

e. Suspicious for Malignancy
   i. Suspicious for papillary carcinoma
   ii. Suspicious for medullary carcinoma
   iii. Suspicious for metastatic carcinoma
   iv. Suspicious for lymphoma
   v. Other

f. Malignant
   i. Papillary thyroid carcinoma
   ii. Poorly differentiated carcinoma
   iii. Medullary thyroid carcinoma
   iv. Undifferentiated (anaplastic) carcinoma
   v. Squamous cell carcinoma
   vi. Carcinoma with mixed features (specify)
   vii. Metastatic carcinoma
   viii. Non-Hodgkin lymphoma
   ix. Other

ii. Practice Based Learning
   1. Understand the implied risk of malignancy for each diagnostic category of the Bethesda System for reporting thyroid cytopathology
      a. Nondiagnostic or Unsatisfactory
         i. 1-4%
      b. Benign
         i. 0-3%
      c. Atypia of Undetermined Significance or Follicular Lesion of Undetermined Significance
         i. ~5-15%
      d. Follicular Neoplasm or Suspicious for a Follicular Neoplasm
         i. 15-30%
      e. Suspicious for Malignancy
         i. 60-75%
      f. Malignant
2. Understand the recommended clinical management for each diagnostic category of the Bethesda System for reporting thyroid cytopathology
   a. Nondiagnostic or Unsatisfactory
      i. Repeat FNA with ultrasound guidance
   b. Benign
      i. Clinical follow-up
   c. Atypia of Undetermined Significance or Follicular Lesion of Undetermined Significance
      i. Repeat FNA
   d. Follicular Neoplasm or Suspicious for a Follicular Neoplasm
      i. Surgical lobectomy
   e. Suspicious for Malignancy
      i. Near-total thyroidectomy or surgical lobectomy
   f. Malignant
   g. Near-total thyroidectomy

5. Benign Thyroid Lesions
   a. Nodular Goiter
      i. Medical Knowledge
         1. Recognize the various etiologies of nodular goiter
            a. Inadequate iodine intake
            b. Drugs and chemicals
            c. Hereditary enzyme deficiencies
            d. Idiopathic
         2. Recognize the cytologic criteria and arrangement patterns of follicular cells in smears of nodular goiter
         3. Recognize background elements classically associated to nodular goiter
            a. Abundant colloid
            b. Macrophages
         4. Recognize symptoms associated to nodular goiter
            a. Aesthetic
            b. Compressive
            c. Endocrine
      ii. Practice Based Learning
         1. Apply the criteria that allow for distinction between nodular goiter, hyperplastic/adenomatoid and follicular neoplasm
            a. Number of nodules in gland
            b. Size of follicles
            c. Size and distribution of follicular cells
            d. Encapsulation of nodule
            e. Background elements
         2. Recognize the role of elevated TSH in the pathophysiology of nodular goiter.
b. **Hyperplastic/Adenomatoid Nodule**
   
   *i. Medical Knowledge*
   
   1. Recognize the cytologic criteria and arrangement patterns of follicular cells in smears of hyperplastic/adenomatoid nodules
   2. Recognize normal range and variability of hyperplastic/adenomatoid nodules in relation to cellularity and colloid content

   *ii. Practice Based Learning*
   
   1. Apply the criteria that allow for distinction between nodular goiter, hyperplastic/adenomatoid and follicular neoplasm
      a. Number of nodules in gland
      b. Size of follicles
      c. Size and distribution of follicular cells
      d. Encapsulation of nodule
      e. Background elements
   2. Understand the significance of clinical history and radiology in the differential diagnosis of hyperplastic/adenomatoid nodules and follicular neoplasms
   3. Recognize the limitations of cytology in the diagnosis of hyperplastic/adenomatoid nodules and follicular neoplasms in cases with overlapping features

c. **Chronic lymphocytic thyroiditis**
   
   *i. Medical Knowledge*
   
   1. Understand the epidemiology of chronic lymphocytic thyroiditis
   2. Recognize the main endocrine manifestations of chronic lymphocytic thyroiditis
   3. Understand the pathophysiology of chronic lymphocytic thyroiditis as a classic autoimmune process
   4. Recognize the antibodies characteristically associated to chronic lymphocytic thyroiditis
      a. Antithyroglobulin antibodies
      b. Antimicrosomal antibodies
   5. Recognize the characteristic cytologic appearance of chronic lymphocytic thyroiditis
      a. Frequently hypercellular specimen
      b. Variable number of follicular cells and/or Hurthle cells with occasional mild nuclear atypia
      c. Polymorphic lymphoid population with occasional plasma cells in background forming characteristic "lymphoid tangles"

   *ii. Practice Based Learning*
   
   1. Recognize that Hashimoto's thyroiditis is a clinico-pathologic diagnosis, not to be used in the reporting of thyroid FNAs
2. Recognize the cytokine effect on follicular cells present in chronic lymphocytic thyroiditis as a potential mimic of papillary thyroid carcinoma
3. Be aware of the increased incidence of lymphoma in chronic lymphocytic thyroiditis
4. Differentiate chronic lymphocytic thyroiditis with prominent Hurthle cell changes from oncocytic follicular neoplasms

**d. Other Inflammatory Conditions of the Thyroid**

*Medical Knowledge*

1. Understand the epidemiology, pathophysiology and main clinical and cytologic characteristics of classic inflammatory processes of the thyroid
   a. Acute thyroiditis
   b. Granulomatous (subacute, de Quervain's) thyroiditis
   c. Riedel's thyroiditis
   d. Grave's Disease
      i. Role of thyroid stimulating immunoglobulin
      ii. Characteristic "flame cell"

*Practice Based Learning*

1. Recognize the significance of these diagnosis or treatment and follow-up of the patient
2. Differentiate Riedel's thyroiditis from the fibrotic stage of chronic lymphocytic thyroiditis
3. Recognize architectural and cytologic features of Grave's disease as potential mimics of neoplastic/malignant follicular processes
4. Recognize the extrathyroidal manifestations of Grave's disease

**6. Thyroid Neoplasms**

*Follicular Neoplasms*

*Medical Knowledge*

1. Recognize clinical and radiologic features suggestive of a follicular neoplasm
2. Understand the histologic criteria utilized to diagnose follicular adenomas and minimally invasive follicular carcinomas in surgical pathology material and their implication in cytologic evaluation of thyroid FNAs
   a. Usually single
   b. Encapsulation
   c. Presence or absence of capsular and/or vascular invasion
3. Understand the histologic criteria utilized to diagnose widely invasive follicular carcinoma
4. Recognize the architectural and cytologic criteria for diagnosing follicular neoplasms
   a. Hypercellular specimen
b. Altered architectural pattern
   i. Microfollicle formation - most common
   ii. Macrofollicle formation
   iii. Solid pattern
   iv. Significant cell crowding
   v. Decreased amount of colloid in background

   c. Classic cytologic characteristics
      i. Minimal to mild nuclear atypia
      ii. Nuclear hyperchromasia
      iii. Inconspicuous nucleoli

5. Recognize that large follicular neoplasms may undergo cystic degeneration

ii. Practice Based Learning

1. Understand the clinical and surgical implication of diagnosing follicular neoplasm in a thyroid FNA specimen
2. Understand that differentiation of a follicular adenoma from a follicular carcinoma cannot be made in thyroid FNA specimens
3. Recognize that cases exhibiting nuclear features of papillary thyroid carcinoma are excluded from this category
4. Recognize widely invasive follicular carcinoma as an aggressive neoplasm with a clinical presentation that differs from that in follicular adenoma and minimally invasive follicular carcinoma
5. Differentiate follicular neoplasms with cystic degeneration from nodular goiter
6. Recognize cases in which repeat FNA might help clarify the nature of the lesion
   a. Hypocellular lesion with microfollicular pattern - "Atypia of Undetermined Significance"

7. Recognize mimics of follicular neoplasms
   a. Accidental aspiration of parathyroid gland

b. Oncocytic Follicular Neoplasm
   i. Medical Knowledge

1. Understand the histologic criteria utilized to diagnose Hurthle cell adenomas and Hurthle cell carcinomas in surgical pathology material and their implication in cytologic evaluation of thyroid FNAs
   a. Exclusively (or almost exclusively) composed of Hurthle cells
   b. Usually single
   c. Encapsulation
   d. Presence or absence of capsular and/or vascular invasion

2. Recognize the altered architectural pattern characteristic of oncocytic follicular neoplasms
   a. Predominantly single cells
   b. Syncytial-like sheets
c. Decreased colloid

3. Recognize the cytologic characteristics of Hurthle cells
   a. Finely granular cytoplasm
   b. Large and round central nuclei
   c. Prominent nucleoli

4. Recognize the absence of lymphocytic or plasma cell infiltrate in the specimen

ii. Practice Based Learning

1. Recognize the significance of differentiating oncocytic follicular neoplasms from follicular neoplasms NOS
   a. Significantly different histology
   b. Potentially different molecular alterations

2. Understand the clinical and surgical implication of diagnosing oncocytic follicular neoplasm in a thyroid FNA specimen

3. Understand that differentiation of an oncocytic follicular adenoma from a Hurthle cell carcinoma cannot be made in thyroid FNA specimens

4. Recognize that cases exhibiting nuclear features of papillary thyroid carcinoma are excluded from this category

5. Recognize prominent Hurthle cell metaplasia in nodular goiter and chronic lymphocytic thyroiditis as a potential mimic of oncocytic follicular neoplasm

6. Recognize cases in which repeat FNA might help clarify the nature of the lesion
   a. Hypocellular lesion with exclusively oncocytic follicular cells - "Atypia of Undetermined Significance"

7. Recognize mimics of oncocytic follicular neoplasms
   a. Accidental aspiration of parathyroid gland with oncocytic change
   b. Medullary thyroid carcinoma with abundant granular cytoplasm

c. Other

i. Medical Knowledge

1. Recognize architectural and cytologic criteria of distinct but less common follicular neoplasms
   a. Hyalinizing trabecular adenoma
   b. Clear cell adenoma

ii. Practice Based Learning

1. Recognize characteristic cytologic features of hyalinizing trabecular adenoma as a major mimic of papillary thyroid carcinoma and medullary thyroid carcinoma

2. Understand that clear cell change can be present in all major variants of thyroid neoplasms and is not unique to follicular neoplasms

3. Understand that thyroid lesions with clear cell change can represent metastatic disease from other primary organs
7. Malignant Thyroid Lesions
   a. Follicular Cell Derived - Papillary Thyroid Carcinoma
      i. Medical Knowledge
         1. Understand the epidemiology of papillary thyroid carcinoma and the risk factors associated to its development
         2. Recognize the classic nuclear features of papillary thyroid carcinoma
            a. Nuclear enlargement
            b. Nuclear clearing
            c. Peripherally placed micronucleoli
            d. Nuclear membrane irregularities including nuclear grooves
            e. Nuclear pseudoinclusions
         3. Recognize the variants of papillary thyroid carcinoma according to architectural and cytologic characteristics
            a. Classic variant
            b. Follicular variant
            c. Macrofollicular variant
            d. Cystic variant
            e. Tall-cell variant
            f. Columnar-cell variant
            g. Diffuse Sclerosing variant
            h. Oncocytic cell variant
            i. Solid variant
            j. Warthin-like variant
            k. Cribriform morular variant
         4. Recognize features commonly associated with the presence of papillary thyroid carcinoma
            a. Psammoma bodies
            b. Multinucleated giant cells
            c. Dense "bubble-gum" colloid
      ii. Practice Based Learning
         1. Understand the clinical and surgical implication of diagnosing papillary thyroid carcinoma in a thyroid FNA specimen
         2. Recognize cases with features considered suspicious but insufficient for a diagnosis of papillary thyroid carcinoma and understand the utility of repeat FNA or molecular testing in these instances
            a. Atypia of undetermined significance "AUS"
         3. Understand that certain variants of papillary thyroid carcinoma act more aggressively
            a. Diffuse Sclerosing variant
            b. Tall-cell variant
            c. Columnar-cell variant
            d. Oncocytic cell variant
4. Recognize cystic degeneration of papillary thyroid carcinoma as a common occurrence yielding hypocellular specimens

b. Follicular Cell Derived - Poorly Differentiated Carcinoma
   i. Medical Knowledge
      1. Understand the epidemiologic and clinical characteristics of poorly differentiated carcinoma of the thyroid
      2. Recognize the altered architectural pattern characteristic of poorly differentiated thyroid carcinoma
         a. Insular pattern
         b. Solid pattern
         c. Trabecular pattern
      3. Recognize the cytologic characteristics of poorly differentiated thyroid carcinoma
         a. Uniform cell population with high nucleus to cytoplasm ration and occasional plasmacytoid appearance
         b. Variable nuclear atypia
         c. Mitosis
         d. Single cell apoptosis and necrosis
      4. Recognize that poorly differentiated thyroid carcinoma lacks the nuclear features characteristic of papillary thyroid carcinoma
   ii. Practice Based Learning
      1. Understand the clinical and surgical implication of diagnosing poorly differentiated thyroid carcinoma in a thyroid FNA specimen
      2. Understand that poorly differentiated thyroid carcinoma may be associated to a better differentiated component of papillary thyroid carcinoma or follicular carcinoma
      3. Recognize the limitations of thyroid FNA in diagnosing poorly differentiated thyroid carcinoma given its overlapping features with follicular neoplasms and understand the use of additional information in making this distinction
         a. Clinical history
         b. Radiology
      4. Recognize metastatic malignancy to the thyroid as a major differential diagnosis of poorly differentiated thyroid carcinoma

c. Follicular Cell Derived - Anaplastic Carcinoma
   i. Medical Knowledge
      1. Understand the epidemiology and characteristic aggressive clinical presentation of anaplastic carcinoma of the thyroid
      2. Recognize the architectural and cytologic characteristics of anaplastic thyroid carcinoma
         a. Hypercellular specimen with isolated cells
         b. Markedly atypical epithelioid and/or spindle cells
c. Nuclear membrane irregularities

d. Prominent nucleoli

e. Plasmacytoid or rhabdoid morphology with frequent multinucleation

f. Mitosis with abnormal mitotic figures

g. Necrosis

ii. Practice Based Learning

1. Understand the clinical implication of diagnosing anaplastic thyroid carcinoma in a thyroid FNA specimen

2. Understand the potentially high false negative rate of FNA in cases with extensive fibrosis or tumor necrosis

3. Understand that anaplastic thyroid carcinomas arise from well-differentiated follicular or papillary thyroid carcinomas and are often associated to foci of well-differentiated tumor

4. Recognize metastatic malignancy to the thyroid as a major differential diagnosis of anaplastic thyroid carcinoma

d. Follicular Cell Derived - Other

i. Medical Knowledge

1. Recognize the cytologic criteria of less common primary thyroid malignancies derived from the follicular cells
   a. Squamous cell carcinoma
   b. Mucoepidermoid carcinoma
   c. Adenoid cystic carcinoma
   d. Mucinous signet-ring cell carcinoma

ii. Practice Based Learning

1. Understand that these common primary thyroid malignancies are indistinguishable from metastatic disease to the thyroid and that pertinent clinical information is essential in making these diagnosis

2. Recognize the aggressive behavior of primary thyroid squamous cell carcinoma

e. C-Cell Derived - Medullary Thyroid Carcinoma

i. Medical Knowledge

1. Recognize medullary thyroid carcinoma as an neuroendocrine tumor arising from the C-cells of the thyroid

2. Understand the epidemiology and clinical characteristics of medullary thyroid carcinoma.

3. Understand that both sporadic and familiar cases of medullary thyroid carcinoma occur and recognize the main mutation associated to familiar cases

4. Recognize the main syndromes associated to development of medullary thyroid carcinoma
   a. MEN IIA
b. MEN IIB
5. Recognize the architectural and cytologic characteristics of medullary thyroid carcinoma
   a. Hypercellular specimen
   b. Isolated single cells and/or syncytial growth pattern
   c. Variable cell morphology - epithelioid, plasmacytoid and spindle cells
   d. Characteristic granular "salt and pepper" chromatin
   e. Inconspicuous nucleoli
   f. Occasional pseudoinclusions, multinucleation and bizarre giant cells
   g. Presence of dendritic cytoplasmic processes
6. Recognize the presence of background amyloid as an important characteristic in diagnosing medullary thyroid carcinoma

ii. Practice Based Learning
1. Understand the clinical and surgical implication of diagnosing medullary thyroid carcinoma in a thyroid FNA specimen
2. Recognize the utility of calcitonin levels in the diagnosis and follow-up of medullary thyroid carcinoma
3. Recognize potential mimics of medullary thyroid carcinoma
   a. Oncocytic follicular neoplasms
   b. Hyalinizing trabecular adenoma
   c. Plasmacytoma
   d. Metastatic malignancy to thyroid - melanoma

f. Lymphoma
   i. Medical Knowledge
      1. Recognize the existence of primary thyroid lymphomas
         a. Extranodal marginal zone B-cell lymphoma
         b. Diffuse large B-cell lymphoma
      2. Understand the increased incidence of lymphomas arising in association with chronic lymphocytic thyroiditis
      3. Recognize the main cytologic criteria necessary to consider a diagnosis of thyroid lymphoma
   ii. Practice Based Learning
      1. Be able to differentiate lymphoma arising in the thyroid gland from cases with exuberant chronic lymphocytic thyroiditis
      2. Recognize the need to identify cases suspicious for lymphoma during on-site evaluation to obtain additional material for flow cytometric analysis
      3. Understand that pertinent clinical information is crucial to differentiate primary from metastatic lymphoma in the thyroid

g. Metastatic Carcinoma
   i. Medical Knowledge
1. Recognize metastatic disease to the thyroid as a relatively common occurrence
2. Recognize malignancies known to often metastasize to the thyroid
   a. Renal cell carcinoma
   b. Malignant melanoma
   c. Breast adenocarcinoma
   d. Lung adenocarcinoma

ii. Practice Based Learning
1. Recognize metastatic disease to the thyroid as a mimic of primary thyroid malignancies
2. Recognize the value of clinical history in evaluation of malignant thyroid nodules
3. Recognize the limitations of thyroid FNA in the workup of metastatic disease to the thyroid
4. Recognize the use of obtaining additional material at time of on-site evaluation for potential additional ancillary tests
   a. Immunohistochemistry
   b. Molecular studies

8. Molecular Analysis of Thyroid Fine Needle Aspiration Specimens
   i. Medical Knowledge
      1. Recognize the main genetic mutations associated with the various thyroid neoplasms
         a. BRAF point mutations
         b. RET/PTC rearrangements and mutations
         c. RAS point mutations
         d. PAX8/PPARγ rearrangements
      2. Understand the basic molecular testing methods to evaluate for the presence of characteristic mutations
   ii. Practice Based Learning
      1. Recognize molecular analysis of thyroid FNA specimens as an ancillary tool in the work-up of few but not all cases
      2. Recognize the importance of on-site evaluation of thyroid FNA specimens as a triage for requesting additional material for performing appropriate molecular tests
         a. "Atypia of undetermined significance / follicular lesion of undetermined" – mutation panel (BRAF, RAS, RET/PTC & PAX8/PPARγ rearrangements
      3. Recognize the utility of testing for a panel of mutations to further characterize thyroid FNA samples with indeterminate cytology
      4. Understand the technical issues in molecular testing of thyroid samples
         a. Preservation of specimen
         b. Time to processing
         c. Methodology employed for molecular testing
9. **System Based Practice Monitors**

i. Develop an understanding of the organization and function of the different technical sections of the laboratory processing and diagnosing thyroid cytology specimens, and to practice cost-effective laboratory utilization and resource allocation that does not compromise quality care.

ii. Develop clear understanding of the government regulations for State, CLIA, CAP, JCAHO, HIPPA/patient data security requirements for practice management.

iii. Demonstrate a clear understanding of basic billing requirements (ICD-9 & CPT-codes) and re-imbursement policies in compliance with Medicare and Medicaid.

iv. Develop an understanding of quality assurance and quality control issues relative to thyroid pathology. This includes but not limited to:

1. Histopathologic correlation of atypical and malignant cases
2. Using validation protocols and appropriate controls for each test performed; molecular, IHC, in-situ hybridization, etc.
References: