AMERICAN ASSOCIATION OF ENDOCRINE SURGEONS ENDOCRINE SURGERY CURRICULUM FOR GENERAL SURGERY RESIDENTS

INTRODUCTION

The following is a curriculum developed by the American Association of Endocrine Surgeons Education Committee outlining the knowledge and skill objectives that should be taught, learned, and demonstrated by the completion of general surgery residency. Although the field of endocrine surgery encompasses many uncommon diseases and syndromes, the curriculum is based on common endocrine diseases where the practicing general surgeon is often involved in the care. Other, uncommon syndromes outlined are appropriate for review because of their underlying pathophysiology and presence on standardized examinations. A resident successfully demonstrating all of these objectives will have the appropriate background to perform common endocrine surgical procedures commensurate with his/her skill and expertise.

THYROID DISEASE

Goals:
Outline the knowledge and skill objectives in thyroid disease that should be taught, learned, demonstrated, and evaluated by the completion of general surgery residency.

PGY1

Knowledge Objectives
By the completion of the first year, the general surgery resident should be able to:

1. Demonstrate normal thyroid anatomy in a cadaver or in the operating room, including the thyroid gland, its vascular supply and venous drainage, the parathyroid glands, recurrent laryngeal nerves, strap muscles, and platysma.

2. Describe normal variants in recurrent laryngeal nerve anatomy including frequency.

3. Describe normal thyroid embryogenesis and descent.

4. Outline the normal thyroid hormone synthetic pathway including iodine metabolism and feedback mechanisms.

5. Describe the impact of specific medications on the thyroid hormone synthetic pathway and thyroid function.

6. Describe the impact of aging on the thyroid hormone synthetic pathway and thyroid function.

7. Outline appropriate thyroid function testing for the following clinical scenarios, including interpretation of predicted test results:
   - Thyroid nodule
   - Goiter
   - Hyperthyroidism
   - Hypothyroidism

8. Develop an algorithm that includes pertinent history, examination findings, and diagnostic evaluation of:
   - A palpable thyroid nodule
   - A nonpalpable nodule discovered on ultrasound performed for nonthyroid pathology

9. Describe the recognition, evaluation, and management of the following early postoperative complications:
   - Hematoma
   - Hypocalcemia

10. Describe the outpatient management of the following postoperative conditions
    - Thyroid hormone replacement, postoperative
    - Postoperative hypocalcemia
    - Postoperative voice changes

Skill objectives

By the completion of the first year, the general surgery resident should be able to:

1. Obtain a focused history, perform an examination, and institute the diagnostic evaluation of a patient with the following conditions:
   - Thyroid nodule
   - Goiter
   - Hyperthyroidism

2. Palpate and describe a thyroid nodule

3. Palpate and describe a goiter

4. Identify exophthalmos

PGY 2&3

Knowledge Objectives

In addition to the previous objectives, by the completion of the third clinical year, the general surgery resident should be able to:

1. Outline algorithms for the evaluation and treatment of:
   - Well-differentiated thyroid cancer
   - Medullary thyroid cancer
   - Thyroid lymphoma
   - Anaplastic thyroid cancer

2. Describe risk factors for well-differentiated thyroid cancer, medullary thyroid cancer, and anaplastic thyroid cancer.

3. Outline algorithms for the evaluation and treatment of hyperthyroidism due to Graves' disease, toxic nodule, medications, pregnancy.

4. Describe the clinical presentation of thyroid storm and outline the treatment of thyroid storm.

5. Outline an algorithm for the evaluation and management of nontoxic multinodular goiter, including substernal goiter with and without airway involvement.

6. Outline the pathophysiology of:
   - Multinodular goiter
   - Grave's disease
   - Thyroid cancer

7. Describe operative approaches to thyroid pathology

8. Outline the staging and prognosis in thyroid cancer

9. Recognition and treatment of common postoperative complications
   - Hematoma
   - Hypocalcemia
   - Thyroid storm
   - Voice changes

Skill objectives

In addition to the previous objectives, by the completion of the third clinical year, the general surgery resident should be able to:

1. Demonstrate normal anatomy in the operating room

2. Palpate and describe a thyroid nodule

3. Perform a fine needle aspiration biopsy of a palpable thyroid nodule

4. Perform the initial steps in thyroid surgery, including
    - Patient positioning and marking
    - Skin incision and raising subplatysmal flaps
    - Opening strap muscles
    - Close strap muscles, platysma, and skin

PGY 4&5

Knowledge objectives

In addition to the previous objectives, by the completion of the final clinical year, the general surgery resident should be able to:

1. Outline the complete evaluation and management of patients with thyroid cancer (papillary, follicular, medullary, anaplastic) including:
    - Preoperative evaluation including radiographic studies
    - Operative approaches including discussion of lobectomy vs. total thyroidectomy
    - Indications for and extent of neck dissection
    - Incidental finding of cancer in resected specimen
    - Metastatic thyroid cancer
    - Large remnant in patient with thyroid cancer
    - Tracheal invasion
    - Esophageal invasion
    - Postoperative treatment, surveillance, and monitoring

2. Outline the complete evaluation and management of nontoxic multinodular goiter and substernal goiter

3. Describe approaches for reoperative thyroid surgery

4. Describe the management of intraoperative recurrent nerve injury

Skill Objectives

In addition to the previous objectives, by the completion of the final clinical year, the general surgery resident should be able to:

1. Interpret thyroid ultrasound images.

2. Perform and interpret head and neck ultrasonography
    - Identify which ultrasound equipment/probes are best used for head and neck ultrasonography.
    - Identify normal structures visualized during ultrasound of the head and neck (Thyroid, parathyroid, lymph nodes, trachea, carotid artery, internal jugular vein, inferior and superior thyroid vessels, parotids, submandibular glands)
    - Describe the echogenicity of a visualized structure as hypoechoic, isoechoic, anechoic or hyperechoic relative to the normal thyroid gland
    - Use ultrasound to identify thyroid nodules, parathyroid adenomas and adenopathy
    - Describe which features of a thyroid nodule on ultrasound are more worrisome for malignancy

3. If possible perform an ultrasound guided fine needle aspiration biopsy of a thyroid nodule

4. Assess vocal cord function either by flexible transnasal endoscopy or indirect laryngoscopy.

PARATHYROID DISEASE

Goals:

Outline the knowledge and skill objectives in parathyroid disease that should be taught, learned, demonstrated, and evaluated by the completion of general surgery residency.

PGY1

Knowledge Objectives

By the completion of the first year, the general surgery resident should be able to:

1. Demonstrate normal parathyroid anatomy in a cadaver or in the operating room, including typical gland locations, blood supply, and relationship to the recurrent laryngeal nerves and other adjacent structures.

2. Describe normal parathyroid embryogenesis and descent. Describe how this affects ectopic gland location

3. Outline the normal calcium metabolic pathway including vitamin D metabolism, parathyroid hormone production and regulation, and calcitonin production and regulation.

4. Describe the impact of specific medications and medical conditions on serum calcium and calcium metabolism.

5. Describe the impact of aging on calcium metabolism.

6. Outline the evaluation and treatment of life-threatening hypercalcemia.

7. Outline the appropriate evaluation for the following clinical scenarios, including interpretation of expected test results:
   - Primary hyperparathyroidism
   - Secondary hyperparathyroidism
   - Tertiary hyperparathyroidism
   - Hypercalcemia associated with malignancy
   - Hypercalcemia associated with medications

8. Develop an algorithm that includes pertinent history, examination findings, and initial diagnostic evaluation of:
   - Asymptomatic primary hyperparathyroidism
   - Symptomatic primary hyperparathyroidism

9. Describe the recognition, evaluation, and management of the following postoperative complications:
    - Hematoma
    - Hypocalcemia
    - Voice changes

Skill objectives
By the completion of the first year, the general surgery resident should be able to:

1. Obtain a focused history, perform an examination, and institute the diagnostic evaluation of a patient with hypercalcemia

PGY 2&3

Knowledge Objectives
In addition to the previous objectives, by the completion of the third clinical year, the general surgery resident should be able to:

1. Demonstrate in a cadaver or the operating room typical locations for ectopic parathyroid glands.

2. Be familiar with current Consensus guidelines for surgical treatment of asymptomatic patients. Discuss the initial evaluation of patients with asymptomatic hyperparathyroidism being considered for observation. This should include an outline of the appropriate follow up of these patients including diagnostic evaluation, frequency of testing, and anticipated outcomes. Describe which patients are appropriate candidates for nonoperative management of hyperparathyroidism.

3. Outline indications for and interpretation of results of bone density testing.

4. Outline outpatient follow up after parathyroidectomy.

5. Outline an algorithm for the preoperative localization of parathyroid adenoma in patients with primary hyperparathyroidism. Discuss the rationale and accuracy of the various localizing strategies and tests.

6. Outline an algorithm for intraoperative confirmation of successful parathyroidectomy during full neck exploration and minimally invasive parathyroidectomy.

    - Describe differences between a bilateral 4-gland exploration, a unilateral exploration and a focused exploration

7. Outline the prevention, recognition, and management of hungry bone syndrome after parathyroidectomy.

8. Outline a diagnostic and treatment pathway for patients with non-MEN familial hyperparathyroidism

9. Describe the technique of cryopreservation and its role in the treatment of patients with multigland disease or during reoperative parathyroid surgery

10. Outline the interpretation of intraoperative PTH monitoring results and their correlation with postoperative eucalcemia

Skill objectives
In addition to the previous objectives, by the completion of the third clinical year, the general surgery resident should be able to:

1. Demonstrate normal parathyroid anatomy in the operating room at the time of parathyroidectomy or thyroidectomy.

2. Interpret a sestamibi scan.

3. Perform the following steps of parathyroidectomy (Be able to describe difference in performing a full neck exploration, minimally invasive approach, unilateral or focused)
   - Patient positioning and marking
   - Skin incision and raising subplatysmal flaps
   - Opening strap muscles
   - Close strap muscles, platysma, and skin

PGY 4&5

Knowledge objectives
In addition to the previous objectives, by the completion of the final clinical year, the general surgery resident should be able to:

1. Outline the complete evaluation and management of patients with parathyroid cancer including:
   - Preoperative evaluation including radiographic studies
   - Operative approaches
   - Extent of resection
   - Postoperative treatment, surveillance, and monitoring

2. Describe in detail the different techniques of focused parathyroidectomy including:
   - Mini incision open
   - Radioguided
   - Video-assisted and endoscopic approaches

3. Outline the complete evaluation and management of recurrent or persistent hyperparathyroidism, including imaging studies and selective venous sampling.

4. Describe regional anesthesia for minimally invasive parathyroidectomy

5. Describe the treatment pathway for MEN 1 and 2A patients, including the order in which the different manifestations should be treated

Skill Objectives
In addition to the previous objectives, by the completion of the final clinical year, the general surgery resident should be able to:

1. Perform a parathyroidectomy (preferably both full neck exploration and minimally invasive), including
   - Intraoperative identification and resection of adenoma
   - Intraoperative identification of normal parathyroid glands
   - Intraoperative identification of hyperplasia

2. Reimplant a parathyroid gland

3. Participate in or perform re-exploration for persistent or recurrent hyperparathyroidism.

4. Assess vocal cord function either by flexible transnasal endoscopy or indirect laryngoscopy.

5. Interpret a neck ultrasound, demonstrating the thyroid gland, adjacent structures and a parathyroid adenoma or hyperplasia.
   - Identify which ultrasound equipment/probes are best used for head and neck ultrasonography
   - Identify typical locations where an abnormal parathyroid may be visualized during ultrasound of the head and neck
   - Use ultrasound to identify parathyroid adenomas, hyperplastic parathyroids and learn about the ultrasound features that help differentiate them from thyroid nodules and adenopathy.
   - Participate in or learn the protocol and value of performing a fine needle aspiration of a parathyroid with measurement of PTH levels on the needle washout.

ADRENAL DISEASE

Goals:
Outline the knowledge and skill objectives in adrenal disease that should be taught, learned, demonstrated, and evaluated by the completion of the general surgery residency.

PGY 1

Knowledge Objectives
By the completion of the first year, the general surgery resident should be able to:

1. Describe the embryology, histology, and physiology of the adrenal gland, distinguishing differences in the cortex and medulla.

2. Describe the anatomy of the adrenal gland, including the arterial supply, venous drainage and relationship to adjacent structures.

3. Outline the biosynthesis and physiologic effects of glucocorticoids, mineralocorticoids, and adrenal sex steroids.

4. Outline the catecholamine synthetic pathway.

5. Identify the etiologies, common signs and symptoms, and clinical presentations of Cushing's syndrome.

6. Outline the diagnostic evaluation of hypercortisolism.

7. Describe the protocol for perioperative steroid use in a patient taking exogenous steroids.

8. Outline the etiologies, clinical presentation, evaluation and management of adrenal insufficiency.

9. Identify complications of adrenalectomy, including adrenal insufficiency and the diagnosis, treatment, and causes.

10. Describe the signs, symptoms, and evaluation of primary hyperaldosteronism.

11. Differentiate between primary and secondary hyperaldosteronism.

12. Describe the general attributes of adrenocortical carcinoma.

13. Describe the physiology, clinical presentation, treatment, and preoperative preparation of pheochromocytoma.

14. Perform a thorough physical examination and be familiar with signs of hormone excess. (hirsuitism, striae, acne, facial changes, clitoral hypertrophy, etc)

Skill objectives
By the completion of the first year, the general surgery resident should be able to:

1. Identify both adrenal glands in a cadaver or in the operating room.

2. Locate the adrenal glands on a CT scan

PGY 2 & 3

Knowledge Objectives
In addition to the previous objectives, by the completion of the third clinical year, the general surgery resident should be able to:

1. Outline the diagnostic pathway of ACTH dependent vs. ACTH independent Cushing's syndrome, including the role of the low and high dose dexamethasone suppression test. Understand normal ranges and those expected for suppression of cortisol and be familiar with the utility and role of salivary, venous and urinary cortisol assessments.

2. Describe the localization studies available for adrenal tumors, including CT scanning, MIBG, PET scanning, and MRI.

3. Distinguish bilateral hyperplasia vs. unilateral disease in Cushing's syndrome and primary hyperaldosteronism.

4. Describe the diagnostic algorithm for primary hyperaldosteronism.

5. Describe the treatment and outcome for primary hyperaldosteronism in patients treated with adenoma vs. bilateral adrenal hyperplasia.

6. Outline the diagnostic evaluation and treatment of adrenocortical carcinoma.

7. Outline the diagnostic pathway for pheochromocytoma and review of the treatment modalities and recommendations.

8. Describe the evaluation and treatment of an adrenal incidentaloma.

9. Explain the etiology, diagnosis, and treatment of adrenal cystic disease.

10. Explain the role of fine needle aspiration biopsy in the evaluation of adrenal tumors.

11. Describe operative approaches for adrenal surgery, including the laparoscopic trans- and extraperitoneal approaches and anterior, lateral and posterior open approaches.

12. Understand functioning imaging modalities for pheochromocytoma and adrenal hyperplasia (i.e., MIBG or NP 59 scanning)

13. Understand technique involved with adrenal vein sampling; role of ACTH stimulation and cortisol assessment to document accuracy of catheter location.

14. Understand algorithm and dosing of preoperative preparation/blockade for pheochromocytoma

15. Be familiar with medications that can alter interpretation of catecholamines (i.e. antidepressants, Tylenol, etc)

Skill objectives

In addition to the previous objectives, by the completion of the third clinical year, the general surgery resident should be able to:

1. Identify adrenal anatomy, blood supply, and surrounding structures at the time of adrenalectomy or other operation.

2. Demonstrate operative exposure (open or laparoscopic; human, cadaver, or animal) of either adrenal gland.

PGY 4 & 5

Knowledge Objectives

In addition to the previous objectives, by the completion of the final clinical year, the general surgery resident should be able to:

1. Describe congenital adrenal hyperplasia.

2. Describe the surgical approaches to pheochromocytoma.

3. Review all the surgical options/approaches for adrenalectomy and the indications for each.

4. Describe the intraoperative management of patients with pheochromocytoma during surgery regarding anesthetic management, surgical technique, and pre and postoperative care.

5. Identify the distinguishing characteristics of extraadrenal pheochromocytomas.

6. Describe the evaluation and treatment of multiple endocrine neoplasia type 2 syndrome in a patient with adrenal lesions.

7. Describe the treatment options for a patient with malignant pheochromocytoma.

8. Identify the steps for a safe and successful right and left laparoscopic transabdominal adrenalectomy. Be familiar with operative technique (positioning, steps of the operation)

9. Describe the diagnosis and treatment of paragangliomas.

10. Be familiar with common complications following adrenalectomy and ways to avoid them.

11. Be comfortable with maintenance or physiologic dosing of steroids and florinef following bilateral adrenalectomy. Be comfortable with conversion of steroid supplementation. (ex: Dexamethasone, Solumedrol, hydrocortisone)

12. Understand indications and technique of subtotal adrenalectomy

13. Have an understanding of intraoperative medical management of adrenergic crisis.

Skill Objectives

In addition to the previous objectives, by the completion of the final clinical year, the general surgery resident should be able to:

Perform an adrenalectomy (open or laparoscopic), including patient positioning, dissection, resection, and postoperative care.

GASTROINTESTINAL NEUROENDOCRINE TUMORS

Gastrointestinal neuroendocrine tumors are rare entities. Therefore, the focus of this section is on gastrointestinal hormone pathophysiology and recognition of syndromes associated with tumors producing these hormones. Because of the rarity of these tumors and syndromes, only knowledge objectives are incorporated in this section of the curriculum.

Goals:

Outline the knowledge objectives in neuroendocrine tumors that should be taught, learned, demonstrated, and evaluated by the completion of general surgery residency.

PGY1 – 3

Knowledge Objectives

By the completion of the third year, the general surgery resident should be able to:

1. Describe the site of synthesis, mechanism of action, and normal physiologic effects of the following gastrointestinal hormones
   - Gastrin
   - Insulin
   - Glucagon
   - Vasoactive Intestinal Peptide
   - Somatostatin

2. Describe the different cell types of the endocrine pancreas, their synthetic products, stimuli and inhibitors to these products, and distribution in the pancreas.

3. Describe the symptoms and syndromes associated with the hypersecretion of the following gastrointestinal hormones:
   - Gastrin
   - Insulin
   - Glucagon
   - Vasoactive Intestinal Peptide
   - Somatostatin

4. Describe the typical presentation of carcinoid tumors.

5. Describe the sites of occurrence of carcinoid tumors including their frequency and propensity for developing carcinoid syndrome.

6. Describe the pathophysiology of carcinoid syndrome.

PGY 4&5

Knowledge objectives

In addition to the previous objectives, by the completion of the final clinical year, the general surgery resident should be able to:

1. Describe the diagnostic approach including biochemical evaluation, ancillary studies, and recommended localization methods for the following tumors:
   - Gastrinoma
   - Insulinoma
   - Glucagonoma
   - VIPoma
   - Somatostatinomas
   - Nonfunctional neuroendocrine tumors

2. Describe the indications for surgery, operative approaches, and expected outcomes for the following tumors:
   - Gastrinoma
   - Insulinoma
   - Glucagonoma
   - VIPoma
   - Somatostatinomas
   - Nonfunctional neuroendocrine tumors

3. Understand how to diagnose and treat the syndrome of post gastric bypass hypoglycemia

4. Outline an algorithm for surgical management of carcinoid tumors based on site, size, and presence of carcinoid syndrome.

5. Outline the follow up of patients who have undergone resection of carcinoid tumors.

6. Outline the management of liver metastases of the neuroendocrine tumors.

FAMILIAL ENDOCRINOPATHIES

Familial endocrinopathies are rare entities; however they have important screening and treatment implications. Because of their rarity only knowledge objectives are incorporated in this section of the curriculum.

Goals:
Outline the knowledge objectives in familial endocrinopathies that should be taught, learned, demonstrated, and evaluated by the completion of general surgery residency.

Multiple Endocrine Neoplasia Syndromes

Knowledge Objectives
By the completion of the final clinical year, the general surgery resident should be able to:

1. Describe the components of each of the following multiple endocrine neoplasia (MEN) syndromes, their mode of inheritance, and the frequency of expression of each component:
   - MEN type 1
   - MEN type 2A
   - MEN type 2B

2. Outline the diagnostic approach for each of the MEN syndromes.

3. Describe the treatment, including timing of operative approach, for each component of the following syndromes:
   - MEN type 1
   - MEN type 2A
   - MEN type 2B

4. Outline recommended genetic testing for patients suspected of having one of the MEN syndromes.

5. Outline the recommended screening for kindred of patients with the different MEN syndromes.

6. Outline the recommended follow up of patients with the different MEN syndromes.

7. Describe the prognosis for each of the MEN syndromes.

Familial Medullary Thyroid Cancer

Knowledge Objectives
By the completion of the final clinical year, the general surgery resident should be able to:

1. Describe the mode of inheritance of familial medullary thyroid cancer (FMTC).

2. Outline the diagnostic evaluation, including genetic testing, of FMTC.

3. Outline the recommended treatment, including the role of prophylactic thyroidectomy, for FMTC.

4. Outline the recommended screening for kindred of patients with the different MEN syndromes.

5. Outline the recommended follow up of patients with FMTC.

6. Describe the prognosis for FMTC.

7. Compare and contrast the evaluation and management of FMTC with sporadic medullary thyroid cancer.

Familial Papillary Thyroid Cancer

Knowledge Objectives

By the completion of the final clinical year, the general surgery resident should be able to:

1. Describe the diagnostic criteria for familial papillary thyroid cancer (FPTC).

2. Describe the mode of inheritance of FPTC.

3. Outline recommended screening for FPTC.

4. Outline the recommended treatment of FPTC.

5. Outline the recommended follow up of patients with FPTC.

6. Describe the prognosis for FPTC.

7. Compare and contrast the evaluation and management of FPTC with sporadic papillary thyroid cancer.

Familial non-MEN Hyperparathyroidism

Knowledge Objectives

By the completion of the final clinical year, the general surgery resident should be able to:

1. Describe the diagnostic criteria for familial non – MEN hyperparathyroidism (FHPTH).

2. Describe the mode of inheritance of FHPTH.

3. Outline recommended screening for FHPTH.

4. Compare and contrast the evaluation and management of FHPTH with sporadic primary hyperparathyroidism.