AAES COMPREHENSIVE ENDOCRINE SURGERY FELLOWSHIP CURRICULUM

The American Association of Endocrine Surgeons (AAES) is dedicated to the maintenance of high standards in the practice of endocrine surgery. In 2004 the Executive Council of the AAES mandated the development of a Fellowship Curriculum with specific objectives to provide a more formalized structure to the existing Endocrine Surgical Fellowships. The Education & Research Committee of the AAES put together a list of objectives and guidelines for Fellowship training in Endocrine Surgery. These were circulated to the membership for their input and comments. A final draft was reviewed and ratified by the Council in October 2005. These objectives provided a structure and a framework for Fellows to enhance their postgraduate training. They were first revised in 2010 by the Education & Research Committee. In the past decade there have been many advancements in the management of endocrine surgical disease. Members of the Education and Fellowship Committees updated and revised the objectives to develop the AAES Comprehensive Endocrine Surgery Fellowship Curriculum in July 2020. The Fellow, the program director and the faculty members of a training unit should utilize this Curriculum and strive to meet these objectives. Individual programs will require flexibility in the design of the fellow's rotations and experience. Information regarding Fellowship training in Comprehensive Endocrine Surgery can be obtained from our web site www.endocrinesurgery.org

Goal: By the end of the fellowship, our trainees will have demonstrated proficiency in the assessment, surgical treatment, and surveillance of benign and malignant thyroid, parathyroid, adrenal, and GEP-NET conditions.

I. THYROID GLAND

A. Thyroid Knowledge Learning Objectives:

1. Describe the histologic appearance of normal thyroid tissue and the components of a thyroid follicle and discuss its relevance to thyroid surgery
2. Discuss the secretion and homeostasis of thyroid hormones in both the normal and pathological disease states
3. Describe the relationship of critical adjacent structures to the thyroid such as the recurrent and superior laryngeal nerves, as well as the relationship with the superior and inferior parathyroid glands
4. Explain when a non-recurrent laryngeal nerve may occur
5. Compare the pathophysiology, risk factors, and clinical presentation for the following thyroid diseases:
    a. Solitary thyroid nodule
    b. Multinodular thyroid gland
    c. Hyperthyroidism/Thyrotoxicosis including toxic adenoma, Graves' disease, and Hashimoto's disease
    d. Well-differentiated thyroid cancer (WDTC)
    e. Rare thyroid malignancies - including medullary thyroid cancer, lymphoma and anaplastic thyroid cancer
    f. Familial/syndromic thyroid cancers
6. For each of the thyroid diseases above, formulate a thorough diagnostic plan including:
    a. **History and Physical Exam:**
        i. Differentiate and list relevant findings in the patient's history, family history, and environmental exposures, especially ionizing radiation
        ii. Perform a complete physical examination of the thyroid and the neck
        iii. Recognize the typical presentation of benign or malignant thyroid tumors and signs and symptoms that might suggest a more aggressive behavior
        iv. Discuss indications for assessment of the patient's voice, vocal cords and laryngoscopy
    b. **Diagnostic interventions:**
        i. **Lab Tests:**
            1. Select appropriate lab tests in different thyroid pathologies:
            2. Describe indications for TFTs, thyroid antibodies, calcitonin, CEA, and genetic testing
        ii. **Imaging Modalities:**

1. Discuss indications for thyroid ultrasound, elastography, axial imaging, and nuclear medicine imaging
2. Describe the TIRADS versus ATA classification system in relation to different types of thyroid nodules
3. Describe appearance of parathyroid incidentalomas and abnormal cervical lymph nodes on ultrasound
4. Explain limitations of ultrasound and recognize when to consider additional work up such as CT, MRI and/or PET CT
5. Analyze radiologic studies to appropriately distinguish between surgically resectable from unresectable thyroid lesions

iii. **Biopsy:**
1. List indications for fine needle aspiration (FNA) biopsy of different thyroid nodules and neck masses
2. Describe the Bethesda classification for the cytologic interpretations of thyroid lesions
3. Recommend molecular testing of thyroid FNA specimens when indicated
4. Discuss findings of molecular testing and their implications
5. Recommend appropriate course of action based on molecular findings

iv. **Staging:**
1. Stage different thyroid malignancies accurately based on AJCC classification system

c. **Treatments:**
i. Formulate a treatment plan based on the characteristics of the disease and specific needs of the patient and also includes pre-operative care including antibiotics, steroids, surgical preparation for Grave'/hyperthyroidism, vitamin D/calcium, and VTE prophlaxis.
ii. Discuss and select the appropriate treatment options: Curative versus palliative, surgical, versus nonsurgical
iii. In surgical patients, plan appropriately to consult additional services to assist with management, if necessary
iv. Develop a plan for pregnant patients with thyroid diseases that require surgical interventions
v. Outline a treatment algorithm for adult and pediatric patients with MEN 2a or 2b without evidence of a thyroid lesion
vi. List the indications for prophylactic neck dissection in N0 thyroid malignancies and how this might differ based on primary disease pathology
vii. Evaluate and manage patients with possible nodal disease
viii. Discuss the risks of primary versus revision surgery for thyroid malignancies
ix. Discuss the benefits and limitations of recurrent laryngeal nerve monitoring
x. Discuss the different approaches to identify and preserve the recurrent and superior laryngeal nerve during thyroid surgery
xi. Recognize (preoperatively or intraoperatively) when to consider resection of an involved recurrent laryngeal nerve
xii. Outline an approach to rehabilitation of a patient needing recurrent nerve resection or suffering from a nerve injury including:
1. Primary repair
2. Cable graft
3. Ansa to distal nerve repair
4. Secondary approaches to vocal fold paresis and paralysis
xiii. Describe extended thyroid surgery indications and situations that require tracheal resection, laryngectomy, or other extended operations

xiv. Analyze a pathology report and recognize the classic histopathologic findings for papillary thyroid cancer, follicular thyroid cancer, medullary thyroid cancer, anaplastic thyroid cancer, and thyroid lymphoma
xv. Explain indications for adjuvant therapy following surgery for thyroid cancer based on staging, pathologic characteristics, operative findings, and post-surgical imaging (radioactive iodine scan) and recommend adjuvant treatments when appropriate, including these options:
    1. RAI Treatment
    2. External beam radiation therapy
    3. Targeted therapy (BRAF inhibitors and TKI)
xvi. Discuss and recommend options for recurrent and metastatic disease including:
    1. Additional surgery
    2. Additional RAI or external beam
    3. Systemic treatment
xvii. Recognize common complications of thyroid and lateral neck surgery. Formulate a plan to treat post-operative complications including:
    1. Postoperative hemorrhage and surgical bed hematoma
    2. Hypocalcemia
    3. Recurrent nerve injury
    4. Chyle leak
    5. Surgical site infections

d. **Surveillance:**
    i. Formulate an evidence based surveillance program for thyroid cancer survivors based on established guidelines (such as NCCN)
    ii. Appropriately use these tests in surveillance:
        1. TSH, Tg, anti-Tg antibodies
        2. Neck ultrasound
        3. Select other imaging such as chest imaging and/or PET/CT in appropriate cases.
    iii. Recognize the common signs and symptoms of recurrent disease and plan an appropriate work up plan

B. Thyroid Skill Learning Objectives:

1. Global Skills:

a. Perform a thorough oncologic physical exam of the thyroid gland including the central and lateral neck, and oral cavity
b. Perform or demonstrate ability to conduct a diagnostic thyroid ultrasound
    i. Use or describe optimal ultrasound machine settings for thyroid evaluation
    ii. Be able to record accurate measurements including three-dimensional sizing of thyroid nodules and document any findings
    iii. Evaluate the central and lateral neck lymph nodes for malignancy
    iv. Understand the use of ultrasound to evaluate vocal cord motion
    v. Compare ultrasound findings with previous studies to determine interval change
    vi. Perform or demonstrate understanding on how to obtain informed consent and perform an ultrasound guided fine need aspiration (FNA)
c. Perform or describe a flexible fiberoptic laryngoscopy
    i. Operation and trouble-shooting of the camera and video equipment
    ii. Administer appropriate pre-procedure analgesics
    iii. Interpret laryngoscopy findings
d. Coordinate a multi-disciplinary care approach, including endocrinology, pathology, nuclear medicine, and oncology
e. Compile appropriate billing codes for office performed procedures
f. Explain post-operative incision care and pain management to a patient requiring thyroid surgery

2. Operating Room Skills:

a. Demonstrate appropriate patient positioning for thyroid surgery
b. Safely identify and ligate the superior pole vessels
c. Demonstrate safe use of an energy device or alternative for hemostatic ligation
d. Formulate a plan for high superior poles or inadequate exposure of these vessels
e. Recognize relationship of the superior vessels with the superior laryngeal nerve
f. Operate or demonstrate use of a nerve monitoring system
g. Demonstrate appropriate lead placement and knowledge of equipment
h. Trouble-shoot common malfunctions
i. Analyze the information obtained from the nerve monitoring apparatus
j. Accurately identify and dissect the recurrent laryngeal nerve including:
k. Recognize relationship with the parathyroid glands
l. Recognize when to consider recurrent laryngeal nerve resection
m. Be familiar with approaches to repair nerve injury
n. Recognize and preserve parathyroid tissue during thyroidectomy including:
    a. Recognize parathyroid devascularization
    b. Perform parathyroid auto-transplantation
o. Evaluate for presence of pyramidal lobe to ensure removal of all thyroid tissue
p. Obtain and evaluate for adequate hemostasis
q. Perform central lymph node dissection including nodes posterior to the recurrent nerve
r. Perform or assist in a modified radical neck dissection

C. Thyroid Attitudinal Learning Objectives:

1. Thyroid nodule:

a. Explain the natural history of thyroid nodules to patients. Answer questions regarding incidence of cancer in thyroid nodules from patients and referring physicians and alleviate the anxiety of a new growth on imaging
b. Educate patients and physicians about the prudence of observation for benign appearing nodules
c. Prepare patients for the possibility of indeterminate or non diagnostic FNA results. The endocrine surgeon should also be able to lead the patient through the decision making process if such a result is obtained and be able to discuss the risks and benefits of surgery vs observation

2. Multinodular goiter:

a. Discuss indications for surgery and be able to re-assure patients and referring physicians that goiters can be observed if they do not meet an indication for surgery
b. Discuss the probabilities that certain symptoms may or may not improve following surgery

3. Well differentiated thyroid cancer:

a. Reassure patients papillary thyroid cancer generally has an excellent prognosis in younger patients. Also discuss the real life socioeconomic implications of being diagnosed with a cancer, even if that cancer has a good prognosis
b. Discuss in detail the appropriate risks and benefits of observation for small papillary thyroid cancers
c. Explain the risks and benefits of thyroid lobectomy and total thyroidectomy. Be able to aid the patient in deciding on the option that is best for the patient
d. Discuss the risks of surgery including recurrent laryngeal nerve injury and hypoparathyroidism and what those injuries would mean of the patients health and lifestyle if they occur
e. Present a patient's story in a multi-disciplinary tumor board. Be able to proficiently communicate with other members of the treatment team before and after surgery and clearly delineate the follow up plan
f. Prepare the patient for potential adjuvant therapies such as radioactive iodine and TSH suppression
g. Discuss the implications of post thyroidectomy hypothyroidism

4. Medullary thyroid cancer:

a. Discuss the long term treatment for medullary thyroid cancer which may include recurrence and additional surgeries
b. Explain to a patient the potential implications regarding the potential to be diagnosed with other cancers. Also be able to discuss the implications of a familial syndrome on other members of the family and potentially in young children
c. Guide the patient through the follow up period including explaining the significance of doubling times

5. Anaplastic thyroid cancer:

a. Conduct frank conversations with the patient and the family about end of life care and decision making

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II. PARATHYROID GLANDS

A. Parathyroid Knowledge Learning Objectives:

1. Describe parathyroid embryology and how this can be applied to both eutopic and ectopic parathyroid localization
2. Describe the anatomic relationship of the parathyroid glands to the recurrent laryngeal nerve
3. Compare the histology of normal parathyroid glands to that of parathyroid adenomas and parathyroid hyperplasia. Explain the histologic criteria for the diagnosis of parathyroid carcinoma
4. Describe calcium, phosphate, and vitamin D homeostasis and how this influences Parathyroid hormone (PTH) secretion
5. Describe the effects of PTH on the skeletal, kidney and intestinal systems and its half-life.
6. Create differential diagnoses for hypercalcemia and describe how to differentiate among possible diagnoses
7. Compare the pathophysiology, clinical presentation, natural history , and indications for surgery in patients with primary, secondary and tertiary hyperparathyroidism as well as patients with parathyroid carcinoma
8. Explain and compare normocalcemic primary hyperparathyroidism and normohormonal primary hyperparathyroidism to classical primary hyperparathyroidism. Describe clinical manifestations and role of surgery for both of these variants
9. Describe the familial syndromes associated with primary hyperparathyroidism. Formulate a plan for the identification and management of such patients, including indications to perform genetic testing
10. Compare the scope, indications, limitations, and sensitivity, for the following imaging modalities: ultrasound (surgeon vs. radiologist-performed), sestamibi +/- SPECT, MRI, 4D-CT
11. Describe and justify the indications for surgery and surgical options for patients with primary hyperparathyroidism, secondary hyperparathyroidism and tertiary hyperparathyroidism
12. Describe the surgical approach for a patient with suspected parathyroid cancer including en-bloc resection
13. Describe the indications, techniques, and pitfalls of intraoperative adjuncts that are available for parathyroidectomy (Intraoperative PTH, radio-guided surgery, auto-fluorescence)
14. Describe and compare non-surgical management options for patients with primary, secondary, and tertiary hyperparathyroidism including close surveillance, bisphosphonates, calcimimetics, and ethanol ablation
15. Describe and compare the limitations and appropriate utilization of both intra-operative frozen section and PTH aspiration of the parathyroid gland
16. Define long-term cure of parathyroid disease and monitoring for recurrence.

B. Parathyroid Skills Learning Objectives:

1. Evaluate a patient with hyperparathyroidism with a complete history and physical exam (specifically eliciting signs/symptoms, family history, medication history, prior neck/cardiac surgery)
2. Explain the diagnostic work up for patients with primary hyperparathyroidism: Pre-operative PTH, calcium, creatinine, vitamin d, 24h urine calcium + creatinine, DEXA, renal ultrasound/KUB
3. Evaluate a patient with persistent/recurrent primary hyperparathyroidism
(including review operative reports/pathology, select appropriate imaging modalities, describe and interpret results of invasive techniques for localization and intra-operative adjuncts)
4. Describe/demonstrate the key components of a comprehensive parathyroid ultrasound
5. Describe/demonstrate the key components of direct and indirect laryngoscopy for assessment of voice function
6. Compare and justify the patients who are candidates for a minimally invasive approach vs a four-gland parathyroid exploration
7. Describe the operative management of patients with a familial syndrome causing primary hyperparathyroidism
8. Describe the technique for parathyroid auto-transplantation (preservation and preparation of the explanted parathyroid gland, location for auto-transplantation and technical components of the procedure)

9. Describe the peri-operative management of patient with secondary hyperparathyroidism (laboratory evaluation, dialysis, calcium/vit D supplementation, identification and management of hypocalcemia)
10. Describe the peri-operative management of hypercalcemic crisis, hungry bone syndrome, and vitamin D deficiency
11. Demonstrate use of intra-operative PTH and explain the criteria used to determine a successful drop
12. Use the knowledge of anatomy and embryology to find superior, inferior, and ectopic parathyroid glands
13. Demonstrate use or knowledge of how to apply ultrasound or technetium 99 to perform guided parathyroidectomy
14. Compare indications and benefits of a lateral versus central approach for a re-operative parathyroidectomy
15. Recognize clinical signs suspicious for a diagnosis of parathyroid carcinoma and formulate an appropriate surgical plan
16. Describe surgical management of parathyroid carcinoma
17. Describe alternate access approaches to parathyroidectomy

C. Parathyroid Attitudinal Learning Objectives:

1. Explain how to counsel patients regarding the possibility of surgical failure or need for reoperation in the future
2. Describe the informed consent discussion for a patient with suspected familial primary hyperparathyroidism as compared to a patient with sporadic primary hyperparathyroidism.
3. Explain how to counsel patients with secondary hyperparathyroidism regarding hungry bone syndrome
4. Describe the multimodal management of parathyroid disease and establish working relationships with primary care providers, endocrinologist, and nephrologists
5. Explain how to counsel patients regarding parathyroid cancer

Further Parathyroid Resources:

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III. ADRENAL GLANDS

A. Adrenal Knowledge Learning Objectives:

1. Define normal adrenal anatomy bilaterally, focusing on vascular supply. Describe common anatomic variants.
2. Describe the histology of the adrenal gland, including each of the layers of the cortex as well as the medulla
3. Explain the normal physiology of the adrenal glands, including secretion and feedback loops associated with each layer of the gland (i.e., aldosterone, cortisol, catecholamines, and androgens/estrogen)
4. Compare the scope, indications, limitations, and sensitivity for the following imaging modalities available for the adrenal gland (CT,MRI, PET, MIBG, Octreotide scan, Dotatate)
5. Describe the work up and management of an incidental adrenal mass
6. Describe the clinical presentation, requirements for biochemical diagnosis, perioperative testing, surgical treatment, and perioperative management for the following adrenal diseases:
    a. Primary hyperaldosteronism
    b. Adrenal Cushing's syndrome
    c. Pheochromocytoma
    d. Virilizing adrenal tumor
7. List the key steps in performing a left and right adrenalectomy, using both open and minimally-invasive approaches
8. Describe the surgical approach for a patient with suspected or biopsy-proven adrenocortical cancer, including en-bloc resection of other organs, lymphadenectomy, and justification of operative approach
9. Describe the potential complications associated with open and laparoscopic adrenalectomy
10. Describe non-surgical management options for patients with an adrenal nodule that does not meet criteria for resection, including repeat hormonal evaluation and surveillance imaging
11. Discuss the inherited endocrinopathies that can be associated with adrenal pathology, and formulate a plan for the identification and management of such patients, including indications to perform genetic testing.
12. Formulate a plan for post-operative management of functional adrenal tumors and malignancies, including medication regimens, biochemical surveillance, and repeat imaging

B. Adrenal Skills Learning Objectives:

1. Evaluate a patient with an adrenal nodule, including a complete history and physical exam (specifically eliciting signs/symptoms, family history, surgical history, medication use)
2. Interpret diagnostic testing performed as part of an adrenal nodule workup, including plasma aldosterone concentration, aldosterone-renin ratio, urine cortisol, salivary cortisol, low-dose dexamethasone suppression test, ACTH, plasma metanephrines, urine metanephrines, DHEA-S
3. Determine when patients should be referred for advanced diagnostic testing for functional adrenal disorders, including salt-loading test, high-dose dexamethasone suppression testing
4. Determine which patients should undergo adrenal vein sampling and interpret the results
5. Select and justify the optimal operative approach for adrenalectomy for each individual patient, accounting for factors such as patient history, physical characteristics, tumor characteristics, and underlying pathology
6. Demonstrate safe surgical technique for removal of the left or right adrenal gland via a minimally-invasive approach: 1) laparoscopic transabdominal, 2) laparoscopic retroperitoneal approach, or 3) robotic approach
7. Demonstrate safe surgical technique for removal of the left or right adrenal gland via an open anterior approach
8. Determine when advanced techniques in adrenalectomy should be employed, including bilateral adrenalectomy or cortical-sparing approaches

C. Adrenal Attitudinal Learning Objectives:

1. Working as part of a multi-disciplinary team, formulate a plan for management of patients with complex adrenal disorders, including hyperaldosteronism, hypercortisolism, pheochromocytoma, adrenal cortical carcinoma, adrenal metastasis, or genetic syndromes with adrenal nodules
2. Counsel patients on the risks, benefits, indications, and alternatives to adrenalectomy for surgical indications to include: hyperaldosteronism, hypercortisolism, pheochromocytoma, large non-functional nodule, adrenocortical carcinoma, adrenal metastasis
3. Counsel patients on the implications and prognosis of their underlying adrenal disorder
4. Explain pathology results to patients in plain language
5. Formulate a plan for long-term post-operative follow-up of patients with adrenal disorders, based on their underlying pathology
6. Counsel patients on any intra-operative complications and their potential longer-term implications

Further Adrenal Resources:

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IV: GASTROENTEROPANCREATIC NEUROENDOCRINE TUMORS (GEP-NETs)

A. GEP-NET Knowledge Learning Objectives:

1. Diagnosis of GEP-NETs

a. Develop a differential diagnosis for the following biochemical states:
   i. Hyperinsulinemia
   ii. Hypoglycemia
   iii. Hypergastrinemia

b. For each of the following GEP-NET, describe the symptoms, clinical manifestations, hormones, and effects of each GEP-NETs associated hypersecretory state:
   i. Pancreatic NET
   ii. Insulinoma
   iii. Gastrinoma
   iv. Glucagonoma
   v. Somatostatinoma
   vi. Vasoactive Intestinal Peptide (VIP)-oma
   vii. Pancreatic Polypeptide (PP)-oma
   viii. GI-NET
   ix. Gastric carcinoid - differentiate between the three sub-types based on etiology, including plasma gastrin levels and gastric pH
      1. SBNETs
      2. Appendiceal NETs
      3. Colorectal NETs
      4. Carcinoid syndrome
      5. Non-functional GEP-NETs

c. Describe the cell-of-origin for each GEP-NET tumor, basic histopathologic features, and cell surface receptor expression.

d. Identify the anatomic distribution of PNETs including gastrinoma

e. Classify GEP-NETs per the WHO classification, highlighting its schematic based on differentiation, grade, and Ki-67 index
   i. Well-differentiated NETs (G1, G2, G3)
   ii. Poorly-differentiated NECs (G3)
   iii. Mixed

f. Estimate each GEP-NETs propensity for metastasis (%)

g. Discuss known genomic drivers of sporadic and hereditary GEP-NETs.

h. Distinguish between well-differentiated (e.g. DAXX/ATRX) and poorly differentiated (e.g. RB1, P53) tumor genomics

i. Review common drivers of NET-associated hereditary endocrinopathies
   i. MEN1, VHL, NF1, Tuberous sclerosis

j. Describe pertinent biochemical tests & tumor markers, highlighting the rationale and interpretation based on GEP-NET functionality:
   i. Pancreatic NET
      1. Insulinoma
         a. Interpret results of glucose, insulin, C-peptide, proinsulin, beta-hydroxybutyrate, sulfonylurea, and insulin autoantibody levels
         b. Indications and approach for 72-hour fast
      2. Gastrinoma
         a. Define indications for secretin-stim test
         b. Interpret gastrin and gastric acid levels
      3. Glucagonoma
      4. VIPoma
      5. Somatostatinoma
      6. PPoma

7. Non-Functioning NET of the pancreas

ii. GI-NET: SBNET and colorectal NET

1. Describe potential for hereditary endocrinopathy & associated concomitant tumors (i.e. MEN1, VHL, NF1, Tuberous sclerosis)
    a. List additional biochemical work-up considerations
2. Define germline mutation testing
3. Determine localization studies and relative accuracy for GEP-NETs
4. Describe utility of cross-sectional imaging studies (e.g. CT, MRI) as well as NET imaging characteristics
5. Define indications for invasive diagnostic procedures
    a. EGD
    b. Colonoscopy
    c. EUS +/- FNA
6. Discuss utility of arterial stimulation with venous sampling.
7. Differentiate the molecular targets and accuracy of functional imaging tests (eg. indium-111 pentetreotide versus 68-Ga DOTATATE PET-CT imaging)
8. List tumors with less SSTR2 affinity, which may be less likely to be detected
9. Explain indication for 18 FDG PET/CT
10. Outline localization approach for GEP-NETs of unknown primary

2. **<u>Treatment of GEP-NETs:</u>**

a. Review peri-operative considerations for GEP-NETs:

i. Elaborate on the following preoperative considerations:

ii. If considering splenectomy:

1. Pneumococcal/HIB/meningococcal vaccine

iii. Octreotide perioperatively if concern for carcinoid crisis

iv. Concurrent cholecystectomy if consider octreotide as part of adjuvant therapy

v. Liver-directed therapies:

1. Hepatic chemoembolization
2. Hepatic radioembolization
3. Hepatic arterial embolization
4. Ablative therapy

vi. Discuss indications for observation vs. surgery, considering relevant factors such as tumor size and MEN1

vii. Describe initial medical management of functional tumors, including pharmacologics

viii. Describe medical management of carcinoid syndrome and evaluation for carcinoid heart disease

ix. Identify medical agent for refractory carcinoid syndrome

x. List pharmacological agents for carcinoid crisis

xi. In hereditary endocrinopathies with concomitant tumors, describe order of surgical resection

b. Develop surgical plan (discussed in Skills section):

i. Include operative approach for non-localized tumors on pre-op imaging (e.g. gastrinomas)

ii. Differentiate surgical approaches based on tumor location, functional subtype (e.g. insulinoma vs. gastrinoma), and degree of local invasion or metastatic burden.

iii. Recognize specific consideration for midgut NET: laparoscopic versus open; prophylactic cholecystectomy; extent of lymph node dissection; management of poorly-differentiated/high-grade tumors

iv. Discuss management options for NET liver mets (NETLM) with unknown primary

v. Name options for liver parenchymal sparing procedures

vi. List options for treatment of non-liver metastatic sites:

1. Peritoneal metastasis

2. Bone metastasis

3. **Post-operative Management/Surveillance:**
    a. Develop post-operative surveillance strategy based on serial exams, biochemical tests, and imaging studies.
    b. GI-NET: state duration and frequency of biochemical and imaging surveillance, including which studies to perform
    c. Offer appropriate multidisciplinary treatments for recurrent or metastatic disease after weighing the following treatments risks/benefits:
        i. Medical management (e.g. SSA)
        ii. Surgical options/debulking. State the percent debulking threshold desired.
        iii. Traditional chemotherapeutic options (e.g. platinum-based / etoposide / FOLFIRINOX for NEC)
        iv. Radiation therapy
        v. Ablative therapies (e.g. RFA)
        vi. Intra-arterial therapy (e.g. TACE)
        vii. Targeted therapy
        viii. Somatostatin analogs
        ix. mTOR / VEGF inhibitors
        x. Peptide receptor radionuclide therapy (i.e. lutetium Lu 177 Dotatate)
        xi. Liver transplantation

B. GEP-NETs Skills Learning Objectives:

1. Pertinent operations:
    a. Elaborate on how to conduct each of the following key steps for exploration of a non-localized PNET – either minimally invasive or open
        i. Kocher maneuver to mobilize second portion of duodenum and pancreas head
        ii. Dividing gastrocolic ligament to approach lesser sac and pancreas body/tail
        iii. Intraoperative ultrasound to assess for lesions and for proximity to duct
    b. Elaborate on how to conduct each of the following key steps for pancreatoduodenectomy – either minimally invasive or open
        i. Mobilizing the duodenum and pancreatic head
        ii. Isolating the SMV
        iii. Mobilizing the stomach and duodenum to assess proximal extent of resection
        iv. Skeletonizing the porta hepatis
        v. Cholecystectomy and transecting the CHD
        vi. Mobilizing and transect the proximal jejunum
        vii. Transecting the pancreatic neck and divide the remaining structures to the specimen
        viii. Reconstructing pancreaticojejunostomy, hepaticojejunostomy, and gastrojejunostomy
        ix. Drain placement
    c. Elaborate on how to conduct each of the following key steps for distal pancreatectomy - either minimally invasive or open
        i. Extent of resection
        ii. Dividing the gastrocolic ligament to approach lesser sac
        iii. Ligating and dividing the gastrosplenic ligament including the short gastrics (if spleen preserving, then preserve at least 50% of the short gastrics in case need to take splenic vein)
        iv. Mobilizing the inferior and superior borders of the pancreas. The splenic artery will be along the superior border
        v. Dissecting the splenic vein free posteriorly
        vi. Identifying the lesion in the pancreas and ensure adequate margin
        vii. Ligating the splenic artery/vein independently (unless spleen preserving)

viii. Mobilizing the retroperitoneal and lateral attachments to the spleen (unless spleen preserving)
ix. Transecting the pancreas and typically will reinforce the staple line
x. Drain placement

d. Describe how you would proceed intraoperatively for each of the following GI NETs:
    i. Gastric Type 3
        1. Endoscopic resection, wedge resection, or gastrectomy with lymphadenectomy
    ii. Small Bowel NET
        1. Segmental bowel resection with regional lymphadenectomy
        2. Intraoperative assessment of remainder of small bowel for synchronous disease
    iii. Duodenal NET
        1. Transduodenal resection if localized
        2. Pancreatoduodenectomy otherwise (see below)
    iv. Appendiceal NET
        1. Appendectomy adequate if ≤2 cm
        2. Right hemicolectomy if >2 cm, or lymphovascular/mesoappendiceal invasion, or atypical histologic features
    v. Rectal
        1. Transanal resection if ≤2 cm, T1
        2. Low anterior resection if >2 cm with lymphadenectomy, or rarely APR
e. Describe how you would proceed intraoperatively for each of the following PNETs:
    i. Non-functional PNET
        1. Hereditary: resect if >2 cm and avoid resection of small stable tumors if out of range of planned extent of resection (e.g. parenchyma-sparing)
        2. Non-hereditary:
            a. Enucleation, distal pancreatectomy or pancreatoduodenectomy if localized
            b. If >2 cm, resection with lymphadenectomy
    ii. Gastrinoma
        1. Non-localized – usually in pancreas head - duodenotomy, IOUS, enucleation, periduodenal node dissection (see below)
        2. Localized - enucleation with periduodenal lymphadenectomy, pancreatoduodenectomy, or distal pancreatectomy/splenectomy/lymphadenectomy (see below)
    iii. Insulinoma
        1. Enucleation if localized
        2. Surgical ptions if not localized
        3. Discuss why octreotide should be avoided pre-operatively
    iv. Glucagonoma and VIPoma
        1. If in tail of pancreas
        2. If not in tail of pancreas

C. GEP-NETs Attitudinal Learning Objectives:

1. Discuss and interpret test results (laboratory and imaging) related to the work up of the following hypersecretory syndromes in lay terms:
    a. Insulinoma
    b. Gastrinoma
    c. Glucagonoma
    d. Somatostatinoma
    e. VIP-oma
    f. PP-oma
    g. Gastric carcinoid
    h. Small bowel NET

i. Appendiceal NET
j. Colorectal NET
k. Carcinoid syndrome

2. Counsel patients on the malignant potential and risk of the above syndromes
3. Determine which patients with GEP-NETs harbor hereditary endocrinopathy risk and appropriately determine consultation with genetics team
4. Collaborate with a multidisciplinary team for patients with recurrent or metastatic GEP-NET
5. Evaluate when and for which patients to consult with other surgical specialists (surgical oncology, hepatobiliary, etc.) for optimal surgical care

Further GEP-NETs Resources:

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