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Preface: The Breadth and Depth of Imaging of the Endocrine System

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Mark E. Lockhart

Diagnosis and Evaluation of Thyroid Nodules-the Clinician's Perspective

1009

Rajasree Nambron, Richard Rosenthal, and Deepti Bahl

Thyroid nodules are a common clinical problem encountered in an endocrine practice. More and more thyroid nodules are now being detected on unrelated imaging studies, leading to an increased diagnosis of low-risk thyroid cancers. There is therefore a greater emphasis on risk assessment based on clinical and sonographic features to avoid morbidity secondary to unnecessary therapy. Molecular diagnostics are also being widely used to further characterize indeterminate nodules. The American Thyroid Association and American College of Radiology-Thyroid Imaging Reporting and Data System guidelines are the most commonly used in clinical practice for risk assessment.

Thyroid Incidentalomas: Practice Considerations for Radiologists in the Age of Incidental Findings

1019

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Radiologists very frequently encounter incidental findings related to the thyroid gland. Given increases in imaging use over the past several decades, thyroid incidentalomas are increasingly encountered in clinical practice, and it is important for radiologists to be aware of recent developments with respect to workup and diagnosis of incidental thyroid abnormalities. Recent reporting and management guidelines, such as those from the American College of Radiology and American Thyroid Association, are reviewed along with applicable evidence in the literature. Trending topics, such as artificial intelligence approaches to guide thyroid incidentaloma workup, are also discussed.

Ultrasound of the Normal Thyroid with Technical Pearls and Pitfalls

1033

Danielle M. Richman and Mary C. Frates

Ultrasound is the best imaging modality for comprehensive evaluation of the thyroid. The thyroid is best imaged using a high-frequency linear probe with the patient in a supine position with the neck hyperextended. Normal thyroid is homogeneous in appearance without defining anatomic landmarks within the gland. A few anatomic variants can occur, and it is important for the sonographer and radiologist to be aware of these variants, to avoid misidentifying them as a pathology. This article provides a comprehensive review of ultrasound of the normal thyroid gland, including technique, normal anatomy, anatomic variants, imaging appearance, and technical pearls and pitfalls.

Thyroid Ultrasound: Diffuse and Nodular Disease

1041

Lauren F. Alexander, Neema J. Patel, Melanie P. Caserta, and Michelle L. Robbin

Thyroid ultrasound with gray-scale and color Doppler is the most helpful imaging modality to differentiate normal thyroid parenchyma from diffuse or nodular thyroid

disease by evaluating glandular size, echogenicity, echotexture, margins, and vascularity. The various causes of diffuse thyroid disease often have overlapping sonographic imaging features. Thyroid nodules may be hyperplastic or neoplastic, with most due to benign hyperplastic changes in architecture and benign follicular adenomas; only a small percentage are malignant. A systematic approach to nodule morphology that includes evaluation of composition, echogenicity, margin, shape, and any echogenic foci can guide decision to biopsy or follow nodules.

Computed Tomography and MR Imaging of Thyroid Disease 1059

Katie Suzanne Traylor

Over the past several years, there has been an increase in the discovery of thyroid cancers, likely because of the marked increased utilization of computed tomography (CT) and MR imaging. Despite the increase in number of thyroid cancers, the overall mortality remains unchanged because most of these cancers are the differentiated type and have a more indolent behavior. CT and MR imaging are important in the preoperative evaluation of thyroid goiters and thyroid cancer. This article discusses the imaging characteristics of benign and malignant thyroid diseases, and the important information that needs to be relayed to the surgeon.

Parathyroid Imaging 1071

Malak Itani and William D. Middleton

Primary hyperparathyroidism (PHPT) is a common endocrine abnormality, caused in most cases by a single parathyroid adenoma. Surgery remains the first-line curative therapy in PHPT. Imaging plays a vital role in presurgical localization of parathyroid adenomas. Ultrasound provides a safe and quick imaging modality free of ionizing radiation, but is operator dependent. Sestamibi scan offers comparable sensitivity to ultrasound, improved with concurrent tomographic imaging. 4DCT remains a problem-solving technique in challenging cases and after failed neck exploration. We present an overview of various parathyroid imaging modalities, including protocols and findings, in addition to relevant pearls and pitfalls.

Neck Procedures: Thyroid and Parathyroid 1085

Nirvikar Dahiya, Maitray D. Patel, and Scott W. Young

Fine-needle aspiration (FNA) and core biopsy of masses in the neck predominantly include samples from thyroid nodules, parathyroids and lymph nodes. The diagnostic rate of a thyroid nodule FNA improves up to 6 passes and then does not significantly change. Thyroid FNA can be performed on patients who are anticoagulated. Appropriate transducer selection is essential for visualization of the needle. Lymph node biopsies can be additionally sampled for thyroglobulin assay to improve sensitivity for detection of recurrent carcinoma. Parathyroid FNA usually involves additional estimation of parathyroid hormone concentration in needle washouts. Biopsies of the neck are simple procedures with minimal complications.

Imaging of Adrenal-Related Endocrine Disorders 1099

Ceren Yalniz, Ajaykumar C. Morani, Steven G. Waguespack, and Khaled M. Elsayes

Endocrine disorders associated with adrenal pathologies can be caused by insufficient adrenal gland function or excess hormone secretion. Excess hormone

secretion may result from adrenal hyperplasia or hormone-secreting (ie, functioning) adrenal masses. Based on the hormone type, functioning adrenal masses can be classified as cortisol-producing tumors, aldosterone producing tumors, and androgen-producing tumors, which originate in the adrenal cortex, as well as catecholamine-producing pheochromocytomas, which originate in the medulla. Nonfunctioning lesions can cause adrenal gland enlargement without causing hormonal imbalance. Evaluation of adrenal-related endocrine disorders requires clinical and biochemical workup associated with imaging evaluation to reach a diagnosis and guide management.

Neuroimaging of the Pituitary Gland: Practical Anatomy and Pathology

1115

Philip R. Chapman, Aparna Singhal, Siddhartha Gaddamanugu, and Veeranjaneyulu Prattipati

The pituitary gland is a small endocrine organ located within the sella turcica. Various pathologic conditions affect the pituitary gland and produce endocrinologic and neurologic abnormalities. The most common lesion of the pituitary gland is the adenoma, a benign neoplasm. Dedicated MR imaging of the pituitary is radiologic study of choice for evaluating pituitary gland and central skull region. Computed tomography is complimentary and allows for identification of calcification and adjacent abnormalities of the osseous skull base. This review emphasizes basic anatomy, current imaging techniques, and highlights the spectrum of pathologic conditions that affect the pituitary gland and sellar region.

Molecular Imaging in the Head and Neck: Diagnosis and Therapy

1135

Brandon A. Howard

This article is a summary of the most up-to-date applications of radiopharmaceuticals to the diagnosis and therapy of benign and malignant diseases involving endocrine or neuroendocrine organs of the head and neck, focusing on radiotracers approved by the US Food and Drug Administration, such as I-123- and I-131-sodium iodide, F-18-fluorodeoxyglucose, Tc99m-sestamibi, as well as the more recently approved tracers Ga-68 DOTATATE and Lu-177 DOTATATE.

Multimodality Imaging of Neuroendocrine Tumors

1147

Samuel J. Galgano, Kedar Sharbidre, and Desiree E. Morgan

Neuroendocrine tumors are rare solid tumors with an estimated 12,000 people in the United States diagnosed each year. Neuroendocrine tumors can occur in any part of the body. There is a wide spectrum of disease, ranging from slow-growing and indolent tumors found incidentally to highly aggressive malignancies with a poor prognosis. Knowledge of neuroendocrine tumor pathology is essential in the diagnostic workup of these patients. This article focuses on the evaluation, detection, and staging of common neuroendocrine tumors with multiple imaging modalities; the information gained with a multimodality approach is often complementary and leads to image-guided treatment decision making.

Neuroendocrine Tumors: Imaging of Treatment and Follow-up

1161

Agata E. Migut, Harmeet Kaur, and Rony Avritscher

Neuroendocrine neoplasms are a heterogeneous group of tumors arising from cells distributed throughout the body. Local and regional disease is managed with surgical resection; however, treatment of higher-grade neuroendocrine

tumors (NETs), unresectable or metastatic disease is complex involving a combination of systemic targeted agents, transarterial embolization, and peptide receptor targeted therapies and is discussed in detail. The most important concept in modern NET workup is that an optimal diagnostic strategy requires combination of both anatomic and functional imaging modalities. NETs often present with unknown primary site of disease, and ^{68}Ga -DOTATATE PET can now diagnose these lesions with great sensitivity.