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Preface: Contemporary Renal Imaging **xiii**

Steven C. Eberhardt and Steven S. Raman

Contrast Reaction Readiness for Your Department or Facility **841**

Carolyn L. Wang and Erik V. Soloff

Moderate and severe contrast reactions are rare but can be life threatening. Appropriate contrast reaction management is necessary for the best patient outcome. This review summarizes the types and incidences of adverse events to contrast media, treatment algorithms, and equipment needed to treat common contrast reactions, the current status of contrast reaction management training, and preventative strategies to help mitigate adverse contrast events.

Protocol Optimization for Renal Mass Detection and Characterization **851**

Jason S. Chu and Zhen J. Wang

Renal masses increasingly are found incidentally, largely due to the frequent use of medical imaging. Computed tomography (CT) and MR imaging are mainstays for renal mass characterization, presurgical planning of renal tumors, and surveillance after surgery or systemic therapy for advanced renal cell carcinomas. CT protocols should be tailored to different clinical indications, balancing diagnostic accuracy and radiation exposure. MR imaging protocols should take advantage of the improved soft tissue contrast for renal tumor diagnosis and staging. Optimized imaging protocols enable analysis of imaging features that help narrow the differential diagnoses and guide management in patients with renal masses.

Image Interpretation: Practical Triage of Benign from Malignant Renal Masses **875**

Evan Allgood and Steven S. Raman

Indeterminate renal masses remain a diagnostic challenge for lesions not initially characterized as angiomyolipoma or Bosniak I/II cysts. Differential for indeterminate renal masses include oncocytoma, fat-poor angiomyolipoma, and clear cell, papillary, and chromophobe renal cell carcinoma. Qualitative and quantitative techniques using data derived from multiphase contrast-enhanced imaging have provided methods for specific differentiation and subtyping of indeterminate renal masses, with emerging applications such as radiocytogenetics. Early and accurate characterization of indeterminate renal masses by multiphase contrast-enhanced imaging will optimize triage of these lesions into surgical, ablative, and active surveillance treatment plans.

Mimics and Pitfalls in Renal Imaging **885**

Erick M. Remer

There are several potential pitfalls that radiologists face when interpreting images of the kidneys. Some result from image acquisition and can arise from the imaging equipment or imaging technique, whereas others are patient related. Another category of pitfalls relates to image interpretation. Some difficulties stem from methods to detect enhancement after contrast administration, whereas others are benign

entities that can mimic a renal tumor. Finally, interpretation and diagnosis of fat-containing renal masses may be tricky due to the complexities discerning the pattern of fat within a mass and how that translates to an accurate diagnosis.

Approach to Renal Cystic Masses and the Role of Radiology

897

Andrew D. Smith and Asser Abou Elkassem

Most renal masses are benign cysts; a subset are malignant. Most renal masses are incidental findings. Evaluation of renal cysts has evolved with updates to the Bosniak classification system and other guidelines. The Bosniak classification provides detailed definitions and extends the system from computed tomography to MR imaging. This article provides a simple approach to the evaluation of cystic or potentially cystic renal masses. The radiologist is central to this process. Key elements include confirming that a renal lesion is cystic and not solid, determining the need for further characterization by imaging, and judicious application of the Bosniak classification system.

Imaging of Renal Infections and Inflammatory Disease

909

Maria Zulfiqar, Cristián Varela Ubilla, Refky Nicola, and Christine O. Menias

Acute pyelonephritis is a bacterial infection of the renal parenchyma and collecting system. Diagnosis is based on clinical findings of fever, flank pain, and urinary tract infection. Computed tomography findings include renal enlargement with wedge-shaped heterogeneous areas of decreased enhancement, known as a “striated nephrogram.” Imaging is primarily used to diagnose complications such as emphysematous pyelonephritis, renal abscess, and pyonephrosis. Chronic pyelonephritis can have varying appearances on imaging ranging from xanthogranulomatous pyelonephritis or, in extreme cases, renal replacement lipomatosis.

Reporting on Renal Masses, Recommendations for Terminology, and Sample Templates

925

Patricia Balthazar, Hena Joshi, and Marta E. Heilbrun

Given the incidence of small renal masses, from benign cysts to malignancy, most radiologists encounter these lesions multiple times during their career. Radiologists have an opportunity to provide critical data that will further refine the understanding of the impact of these masses on patient outcomes. This article summarizes and describes recent updates and understanding of the critical observations and descriptors of renal masses. The templates and glossary of terms presented in this review article facilitate the radiology reporting of such data elements, giving radiologists the opportunity to improve diagnostic accuracy and influence management of small renal masses.

Use of Contrast Ultrasound for Renal Mass Evaluation

935

Kevin G. King

An introduction to the expanding modality of contrast-enhanced ultrasound is provided, along with basics on contrast agents and technique. The contrast ultrasound findings of multiple renal tumors are reviewed with examples, including clear cell renal cell carcinoma, papillary renal cell carcinoma, chromophobe renal cell carcinoma, other rare renal cell carcinoma subtypes, oncocytoma, upper tract urothelial carcinoma, lymphoma, and angiomyolipoma, followed also by brief discussions of renal infections and pseudolesions.

Update on Hereditary Renal Cancer and Imaging Implications 951

Stephanie M. Walker, Rabindra Gautam, Baris Turkbey, Ashkan Malayeri, and Peter L. Choyke

Up to 8% of renal cancers are thought to have a hereditary component. Several hereditary renal cancer syndromes have been identified over the last few decades. It is important for the radiologist to be aware of findings associated with hereditary renal cancer syndromes to detect tumors early, enroll patients in appropriate surveillance programs, and improve outcomes for the patient and affected family members. This review discusses from a radiologist's perspective well-known hereditary renal cancer syndromes and emerging genetic mutations associated with renal cancer that are less well characterized, focusing on imaging features and known associations.

Review of Multimodality Imaging of Renal Trauma 965

Ling-Chen Chien, Keith D. Herr, Krystal Archer-Arroyo, Mona Vakil, and Tarek N. Hanna

Blunt trauma accounts for more than 95% of traumatic renal injury and results from shear forces from rapid acceleration or deceleration and/or collision against the spine or ribs. The use of multiphasic contrast-enhanced computed tomography (CT) has proven pivotal in the evaluation and management of traumatic kidney injury, and CT imaging features provide the basis for nonsurgical staging. This article describes the epidemiology and mechanisms of blunt and penetrating traumatic renal injury and reviews the range of findings from various imaging modalities, with a particular emphasis on contrast-enhanced CT.

Percutaneous Thermal Ablation for Treatment of T1a Renal Cell Carcinomas 981

Sepideh Shakeri and Steven S. Raman

Based on Surveillance, Epidemiology, and End Results studies, most renal cancers are low grade and slow growing. Long-term, single-center studies show excellent outcomes of percutaneous thermal ablation for T1a renal cell carcinoma (RCC), comparable to partial nephrectomy without affecting renal function and with much lower rates of complications. However, there are no multicenter randomized controlled trials of multiple ablative modalities or comparison with partial nephrectomy, and most studies are single-arm observational studies with short-term and intermediate follow-up. For treatment of stage T1a RCC, percutaneous TA is an effective alternative to surgery with preservation of renal function, low risk, and comparable overall and disease-specific survival.

Radiomics and Artificial Intelligence for Renal Mass Characterization 995

Meghan G. Lubner

Radiomics allows for high throughput extraction of quantitative data from images. This is an area of active research as groups try to capture and quantify imaging parameters and convert these into descriptive phenotypes of organs or tumors. Texture analysis is one radiomics tool that extracts information about heterogeneity within a given region of interest. This is used with or without associated machine learning classifiers or a deep learning approach is applied to similar types of data. These tools have shown utility in characterizing renal masses, renal cell carcinoma, and assessing response to targeted therapeutic agents in metastatic renal cell carcinoma.