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## Diagnostic Imaging

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Emilio Quaia  
Editor

# Radiological Imaging of the Kidney

Second Edition

Foreword by A. L. Baert

 Springer

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*To my parents, Ada and Giancarlo, with deep gratitude*



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## Foreword to the First Edition

It is my great pleasure and privilege to introduce another volume, published in our book series “Medical Radiology – Diagnostic Imaging,” which is devoted to radiological imaging of the kidney. It is edited by E. Quaia, widely known for his numerous original contributions to urogenital radiology, especially in the areas of ultrasound, computed tomography, and the role of ultrasound contrast media in the diagnostic management of diseases of the urogenital organs.

It covers in depth the complete spectrum of superb imaging modalities which are actually available to study the normal anatomy and the pathology of the kidney and upper urinary tract, including the latest technical advances in equipment design.

The clear and informative text, the numerous well-chosen illustrations of superb technical quality, as well as the traditional Springer excellent standards of design and layout make this outstanding work a reference handbook for all certified general and urogenital radiologists. Also, radiologists in training will find it very useful for improving their knowledge and skills. Referring physicians such as urologists and nephrologists will benefit from it to improve the clinical management of their patients.

I am greatly indebted to the editor E. Quaia for his efficient and brilliant editorial work as well as for the judicious choice of the contributing authors, all well-known and internationally recognized experts in the field, who wrote the 36 excellent individual chapters of this outstanding volume.

Leuven

Albert L. Baert





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## Preface to the First Edition

The aim of this book is to provide a comprehensive analysis of the embryology, normal anatomy, and of the pathology of the kidney and the upper urinary tract (renal pelvis and upper ureter) according to the modern diagnostic imaging techniques. The opportunity provided to me by Professor Albert Baert represents a wonderful occasion to present an up-to-date resume of what is possible to obtain nowadays by imaging in the evaluation of the normal and pathologic kidney.

Significant technical improvements have allowed the use of radiological techniques to play a growing role in the imaging of renal diseases. Several new imaging techniques and new technical improvements of the preexisting imaging techniques have been introduced in the recent years. Contrast-enhanced ultrasound is now considered a well-established imaging technique in the analysis of renal perfusion and tumors. Multidetector computed tomography (CT) is able to provide high-spatial-resolution images of the kidneys and renal arterial vessels (CT angiography) and the urinary tract (CT urography). Magnetic resonance imaging (MRI) is now able to provide high signal-to-noise ratios and higher spatial and/or temporal resolutions and to display both morphological information on renal parenchyma and vessels and functional data, such as perfusion, filtration, diffusion, and oxygenation. Molecular imaging techniques have recently been applied in the assessment of renal tumors and parenchymal perfusion. All these imaging modalities have now reached an extremely high level of accuracy in detecting renal abnormalities. This book also provides a complete insight into all these diagnostic fields with the aid of high-quality images obtained with state-of-the-art equipments, as well as by figures showing macroscopic and microscopic specimens to obtain an effective radiologic-pathologic correlation with diagnostic images.

Each chapter has been written by well-recognized experts in the field, and the principal effort of the editor was to provide excellent iconography and literature revision, besides text quality. This book is principally intended for the radiology community, from the resident to the expert radiologists, even though clinicians and academic persons could also find it useful for their daily clinical practice.

The imaging archive of the radiology department of Trieste, presenting a complete iconography of all renal pathologies collected through several years of intense clinical activity and research in this field, served as a gold mine for the preparation of the book.

My sincere gratitude to Professor Baert and to Miss Ursula Davis and Daniela Brandt from Springer for their continuous support and belief in this work. A note of thanks also to other staff of Springer for the editorial work.

Trieste, Italy

Emilio Quaia



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# Contents

## Part I Embryology and Anatomy

<b>Embryology of the Kidney</b> .....	3
Marina Zweyer	
<b>Normal Radiological Anatomy and Anatomical Variants of the Kidney</b> .....	17
Emilio Quaia, Paola Martingano, Marco Cavallaro, Michael Premm, and Roberta Angileri	
<b>Normal Radiological Anatomy of the Retroperitoneum</b> .....	75
Emilio Quaia and Antonio Giulio Gennari	

## Part II Imaging and Interventional Modalities

<b>Ultrasound of the Kidney</b> .....	83
Emilio Quaia	
<b>Computed Tomography</b> .....	123
Alexia Rossi, Antonio Giulio Gennari, Roberta Angileri, Paola Martingano, Marco Cavallaro, Roberto Pozzi-Mucelli, Giulia Zamboni, Livia Bernardin, Alberto Contro, and Emilio Quaia	
<b>Magnetic Resonance Imaging of the Kidney</b> .....	167
Maria Assunta Cova, Alexia Rossi, Antonio Giulio Gennari, Marco Cavallaro, Paola Martingano, and Maja Ukmar	
<b>Renal Angiography and Vascular Interventional Radiology</b> .....	189
Fabio Pozzi-Mucelli, Andrea Pellegrin, and Roberta Pozzi-Mucelli	
<b>Nuclear Medicine</b> .....	223
Egesta Lopci and Stefano Fanti	
<b>The Role of Kidney Biopsy in the Diagnosis of Renal Disease and Renal Masses</b> .....	247
Michele Carraro and Fulvio Stacul	
<b>Nonvascular Interventional Radiology</b> .....	261
Raul N. Uppot and Arash Anvari	

## Part III Non-Tumoral Pathology

<b>Congenital and Development Disorders of the Kidney</b> .....	283
Veronica Donoghue	
<b>Renal Cystic Disease</b> .....	305
Kyongtae T. Bae, Alessandro Furlan, and Achille Mileto	

<b>Renal Parenchymal and Inflammatory Diseases</b> . . . . .	335
Emilio Quaia	
<b>Obstructive Uropathy, Pyonephrosis, and Reflux Nephropathy in Adults</b> . . . . .	353
Emilio Quaia, Luca De Paoli, Paola Martingano, and Marco Cavallaro	
<b>Nephrocalcinosis and Nephrolithiasis</b> . . . . .	391
Siân Phillips and Gareth R. Tudor	
<b>Acute Renal Infections</b> . . . . .	411
Alfredo Blandino, Silvio Mazzotti, F. Minutoli, G. Ascenti, and M. Gaeta	
<b>Chronic Renal Infections and Renal Fungal Infections</b> . . . . .	437
Emilio Quaia, Paola Martingano, Marco Cavallaro, Roberta Angileri, and Fulvio Stacul	
<b>Renal Vascular Abnormalities</b> . . . . .	469
Therese M. Weber and Mark E. Lockhart	
<b>Imaging of Renal Trauma</b> . . . . .	483
Stuart E. Mirvis	
<b>Part IV Tumoral Pathology</b>	
<b>Benign Solid Renal Tumors</b> . . . . .	501
Emilio Quaia	
<b>Imaging in Renal Cell Carcinoma</b> . . . . .	537
Daichi Hayashi, Ali Guermazi, and Nagaraj Setty-Holalkere	
<b>Rare and Secondary Tumors of the Kidney and Renal Pseudotumors</b> . . . . .	571
Annelies Rappaport and Raymond H. Oyen	
<b>Radio-frequency Ablation and Cryoablation for Renal Cell Carcinoma</b> . . . . .	593
Andrew Hines-Peralta, S. Nahum Goldberg, Emilio Quaia, and Fulvio Stacul	
<b>Upper Urinary Tract Tumors</b> . . . . .	603
Emilio Quaia and Paola Martingano	
<b>Renal Lymphoma and Renal Sarcoma</b> . . . . .	631
Annelies Rappaport and Raymond H. Oyen	
<b>Cystic Renal Masses</b> . . . . .	645
Olivier H�el�enon, J.M. Correas, S. Merran, and A. Vieillefond	
<b>Part V Special Topics</b>	
<b>The Pediatric Kidney</b> . . . . .	675
Michael Riccabona	
<b>The Kidney in the Elderly</b> . . . . .	709
Emilio Quaia	
<b>Renal Failure</b> . . . . .	739
Emilio Quaia	
<b>Renal Transplantation</b> . . . . .	757
Nicolas Grenier	
<b>Imaging of Dialysis</b> . . . . .	787
Emilio Quaia, Salvatore Sammartano, and Ferruccio Degrassi	

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<b>Imaging of the Postoperative Kidney</b> . . . . .	807
Emilio Quaia	
<b>Contrast Media-Induced Nephropathy and Nephrogenic Systemic Fibrosis</b> . . . . .	825
Fulvio Stacul	
<b>Functional Imaging of the Kidney</b> . . . . .	839
Nicolas Grenier	
<b>Molecular Imaging and Tumoral Antigen Targeting</b> . . . . .	863
Cristina Nanni and Stefano Fanti	
<b>Research Perspectives and Future Trends in Renal Imaging</b> . . . . .	871
Nicolas Grenier	
<b>Index</b> . . . . .	889



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## List of Acronyms

ACEi	Angiotensin-converting enzyme inhibitor
ADC	Apparent Diffusion Coefficient
AIP	Average Intensity Projection
AVF	Arteriovenous fistula
AVM	Arteriovenous malformation
CDC	Collecting duct carcinoma
CEUS	Contrast-enhanced ultrasound
CPR	Curved Planar Reformat
CPS	Cadence Contrast Pulse Sequencing
CTU	CT urography
DECT	Dual-energy CT
DRC	Direct radionuclide cystography
DRF	Differential renal function
DSA	Digital subtraction angiography
DWI	Diffusion – weighted imaging
EDTA	Ethylenediaminetetraacetic acid
ERPF	Effective renal plasma
ES	Ewing sarcoma
EVAR	Endovascular aneurysm repair
GBM	Glomerular basal membrane
GCKD	Glomerulocystic kidney disease
GIST	Gastrointestinal stromal tumor
IRC	Indirect radionuclide cystography
IVC	Inferior Vena Cava
LAO	left anterior oblique
MCDK	Multicystic dysplastic kidney
MCN	Multilocular cystic nephroma
MEST	Mixed epithelial and stromal tumors
MIP	Maximum intensity projection
MPO	Myeloperoxidase
MRI	Magnetic Resonance Imaging
NCBA	N-butyl-cyanoacrylate
NPHP	juvenile nephronophthisis
NSS	Nephron-sparing surgery
PAN	Polyarteritis Nodosa
PBG	Prosthetic bridge graft
PC	Phase Contrast
PNET	Primitive neuroectodermal tumor
PSV	Peak Systolic Velocity
PTFE	Polytetrafluoroethylene
PTRA (PTA)	Percutaneous transluminal renal angioplasty
PVA	Polyvinyl alcohol

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REST	Renal epithelial and stromal tumors
RFA	Radiofrequency ablation
RNC	Radionuclide cystography
RVH	Renovascular hypertension
RVT	Renal vein thrombosis
SA-MRI	Small animal Magnetic Resonance Imaging
SCT	Sickle cell trait
SENSE	Sensitivity encoding
SLE	Systemic lupus erythematosus
SMA	Superior Mesenteric Artery
SNR	Signal-to-noise ratio
SWL	Shock wave lithotripsy
TAE	Transarterial embolization
THI	Tissue harmonic imaging
TOF	Time of Flight
USCA	Ultrasonography contrast agents
VCUG	Voiding cystourethrography
VR	Volume Rendering
VUS	Voiding urosonography
WBC	White Blood Cells



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