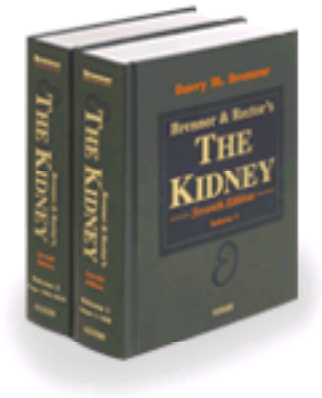


---

**Benner & Rector's the Kidney 7th edition (November 14, 2003) by Barry M. Brenner (Editor), FL**



By OkDoKeY

---

– **Frontmatter**

■ **Title Page**

■ **Copyright Page**

■ **Dedication**

■ **Contributors**

■ **Preface**

■ **Foreword**

+ **Section I - Elements of Normal Renal Structure and Function**

+ **Section II - Disturbances in Control of Body Fluid Volume**

+ **Section III - Pathogenesis of Renal Disease**

+ **Section IV - Pathophysiology of Renal Disease**

+ **Section V - Management of the Patient with Renal Failure**

---

## **– Section I - Elements of Normal Renal Structure and Function**

- + 1 - Anatomy of the Kidney**
- + 2 - Developmental Biology of the Kidney**
- + 3 - Biology of Renal Cells in Culture**
- + 4 - Cell-Cell and Cell-Matrix Interactions in the Kidney**
- + 5 - The Metabolic Basis of Solute Transport**
- + 6 - The Molecular Basis of Solute Transport**
- + 7 - The Renal Circulations**
- + 8 - Glomerular Ultrafiltration**
- + 9 - Renal Transport of Glucose, Amino Acids, Sodium, Chloride, and Water**
- + 10 - Control of Renal Potassium Excretion**
- + 11 - Renal Acidification Mechanisms**
- + 12 - Renal Transport of Calcium, Magnesium, and Phosphate**
- + 13 - The Cell Biology of Vasopressin Action**
- + 14 - Urine Concentration and Dilution**
- + 15 - Renal Handling of Organic Anions and Cations: Excretion of Uric Acid**
- + 16 - Vasoactive Peptides and the Kidney**
- + 17 - Arachidonic Acid Metabolites and the Kidney**

---

– **Section II - Disturbances in Control of Body Fluid Volume**

+ 18 - Control of Extracellular Fluid Volume and the Pathophysiology of Edema Formation

+ 19 - Pathophysiology of Water Metabolism

+ 20 - Acid-Base Disorders

+ 21 - Disorders of Potassium Balance

+ 22 - Clinical Disturbances of Calcium, Magnesium, and Phosphate Metabolism

---

### **– Section III - Pathogenesis of Renal Disease**

- + [23 - Approach to the Patient with Kidney Disease](#)
- + [24 - Laboratory Assessment of Kidney Disease: Clearance, Urinalysis, and Kidney Biopsy](#)
- + [25 - Interpretation of Urine Electrolyte and Acid-Base Parameters](#)
- + [26 - Radiologic Assessment of the Kidney](#)
- + [27 - Acute Renal Failure](#)
- + [28 - Primary Glomerular Disease](#)
- + [29 - Secondary Glomerular Disease](#)
- + [30 - Tubulointerstitial Diseases](#)
- + [31 - Urinary Tract Infection, Pyelonephritis, and Reflux Nephropathy](#)
- + [32 - Disorders of the Renal Arteries and Veins](#)
- + [33 - Microvascular Diseases of the Kidney](#)
- + [34 - Toxic Nephropathy](#)
- + [35 - The Kidney and Hypertension in Pregnancy](#)
- + [36 - Inherited Disorders of the Renal Tubule](#)
- + [37 - Cystic Diseases of the Kidney](#)
- + [38 - Diabetic Nephropathy](#)
- + [39 - Nephrolithiasis](#)
- + [40 - Urinary Tract Obstruction](#)
- + [41 - Renal Neoplasia](#)

---

– **Section IV - Pathophysiology of Renal Disease**

- + 42 - Renal and Systemic Manifestations of Glomerular Disease
- + 43 - Adaptation to Nephron Loss
- + 44 - Biology of the Vascular Wall in Hypertension
- + 45 - Essential Hypertension
- + 46 - Renovascular Hypertension and Ischemic Nephropathy
- + 47 - Hypertension and Renal Disease
- + 48 - Pathophysiology of Uremia
- + 49 - Hematologic Consequences of Renal Failure
- + 50 - Cardiovascular Aspects of Chronic Kidney Disease
- + 51 - Neurologic Complications of Renal Insufficiency
- + 52 - Renal Osteodystrophy
- + 53 - Effect of Aging on Renal Function and Disease

---

**- Section V - Management of the Patient with Renal Failure**

- + 54 - Diuretics**
- + 55 - Antihypertensive Drugs**
- + 56 - Specific Pharmacologic Approaches to Clinical Renoprotection**
- + 57 - Nutritional Therapy in Renal Disease**
- + 58 - Erythropoietin Therapy in Renal Disease and Renal Failure**
- + 59 - Hemodialysis**
- + 60 - Peritoneal Dialysis**
- + 61 - Intensive Care Nephrology**
- + 62 - Extracorporeal Treatment of Poisoning**
- + 63 - Transplantation Immunobiology**
- + 64 - Donor and Recipient Issues in Renal Transplantation**
- + 65 - Clinical Aspects of Renal Transplantation**
- + 66 - Prescribing Drugs in Renal Disease**

---

---

---

I

II

III

# **BRENNER & RECT** **The Kidney**

**Seventh Edition**

**Barry M. Brenner M.D., A.M. (Hon.), D.Sc. (Hon.), D.M.Sc. (Hon.), M.D. (Hon.), Dipl. (Hon.), F.R.**

Samuel A. Levine Professor of Medicine  
Harvard Medical School  
Director Emeritus,  
Renal Division,  
and Senior Physician,  
Department of Medicine  
Brigham and Women's Hospital  
Boston, Massachusetts

---

**SAUNDERS**  
*An Imprint of Elsevier*

---

---

IV



---

**SAUNDERS**

An Imprint of Elsevier

The Curtis Center  
Independence Square West  
Philadelphia, Pennsylvania 19106

Volume 1: Part no. 9997637097

Volume 2: Part no. 9997637100

Two-volume set ISBN 0-7216-0164-2

**BRENNER & RECTOR'S THE KIDNEY**

© 2004, 2000, 1996, 1991, 1986, 1981, 1976, Elsevier Inc. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, and information storage and retrieval system, without permission in writing from the publisher.

Permissions may be sought directly from Elsevier's Health Sciences Rights Department in Philadelphia, PA, USA. Email: [healthpermissions@elsevier.com](mailto:healthpermissions@elsevier.com). You may also complete your request on-line via the Elsevier ScienceDirect website. Please visit the "Obtaining Permissions" link on the Elsevier ScienceDirect website. For more information, please contact the Elsevier ScienceDirect Customer Support and then "Obtaining Permissions."

**NOTICE**

Nephrology is an ever-changing field. Standard safety precautions must be followed, but as new research and treatment and drug therapy may become necessary or appropriate. Readers are advised to check the product information of each drug to be administered to verify the recommended dose, the method and duration of administration, and the treating physician, relying on experience and knowledge of the patient, to determine dosages and administration. The editor and publisher assume no liability for any injury and/or damage to persons or property arising from the use of the information contained in this publication.

The Publisher

**Library of Congress Cataloging-in-Publication Data**

Brenner & Rector's the kidney / editor, Barry M. Brenner—7th ed.

p. cm.

Includes bibliographical references and index.

ISBN 0-7216-0164-2

1. Kidneys—Diseases. 2. Kidneys. I. Title: Kidney. II. Brenner, Barry M. III. Rector, Floyd C.

RC902.K53 2004

616.6'1—dc21

2003042846

Acquisitions Editor: Susan Diehl

*Jane and I  
dedicate this edition  
to our mothers  
Beatrice and Sally  
our children  
Rob, Jen, and Ron  
and our wonderful grandson Sam*

---

## Contributors

### **Zaid A. Abassi Ph.D.**

Senior Lecturer,  
Faculty of Medicine,  
Technion,  
Israeli Institute of Technology;  
Principal Investigator,  
Laboratory of Vascular Biology and Renal Physiology,  
Rambam Medical Center,  
Haifa, Israel  
*Control of Extracellular Fluid Volume and the Pathophysiology of Edema Formation*

### **Sharon Anderson M.D.**

Professor of Medicine,  
Oregon Health Sciences University School of Medicine,  
Portland, Oregon  
*Renal and Systemic Manifestations of Glomerular Disease*

### **Gerald B. Appel M.D.**

Professor of Clinical Medicine,  
Columbia University College of Physicians and Surgeons;  
Director of Clinical Nephrology,  
Presbyterian Hospital Division of the New York-Presbyterian Hospital,  
New York, New York  
*Secondary Glomerular Disease*

### **Raymond Ardaillou M.D.**

Emeritus Professor of Physiology,  
Faculty of Medicine,  
University of Paris 6—Saint-Antoine,  
Paris, France  
*Biology of Renal Cells in Culture*

---

Professor and Chair,  
Department of Medicine,  
American University of Beirut;  
Attending Physician,  
American University of Beirut Medical Center,  
Beirut, Lebanon  
*Microvascular Diseases of the Kidney*

**James L. Bailey M.D.**

Professor of Medicine,  
Emory University School of Medicine;  
Attending Physician,  
Grady Memorial Hospital and Emory University Hospital,  
Atlanta, Georgia  
*Pathophysiology of Uremia*

**Matthew A. Bailey Ph.D.**

Postdoctoral Fellow,  
Department of Cellular and Molecular Physiology,  
Yale University School of Medicine,  
New Haven, Connecticut  
*Control of Renal Potassium Excretion*

**Laurent Baud M.D., Ph.D.**

Professor of Physiology,  
Faculty of Medicine,  
University of Paris 6—Saint-Antoine;  
Director,  
Department of Physiology,  
Hôpital Tenon,  
Paris, France  
*Biology of Renal Cells in Culture*

**Michel Baum M.D.**

Professor of Pediatrics and Internal Medicine,  
Department of Pediatrics,  
University of Texas Southwestern Medical Center at Dallas,  
Dallas, Texas  
*Renal Transport of Glucose, Amino Acids, Sodium, Chloride, and Water*

**Bradford C. Berk M.D., Ph.D.**

Faculty,  
GEBS Cell Regulation and Molecular Pharmacology,  
University of Rochester School of Medicine and Dentistry;  
Physician-in-Chief,  
Strong Memorial Hospital,  
University of Rochester Medical Center,  
Rochester, New York  
*Biology of the Vascular Wall in Hypertension*

---

New York, New York  
*Essential Hypertension*

**Alain Bonnardeaux M.D., Ph.D.**

Associate Professor of Medicine,  
Université de Montréal;  
Scientific Director,  
Centre de Recherche Guy-Bernier,  
Hôpital Maisonneuve-Rosemont,  
Montréal, Québec, Canada  
*Inherited Disorders of the Renal Tubule*

**Hugh Redmond Brady M.D., Ph.D.**

Professor of Medicine and Therapeutics,  
Conway Institute of Biomolecular and Biomedical Research,  
University College Dublin;  
Attending Physician,  
Mater Misericordiae University Hospital,  
Dublin, Ireland  
*Cell-Cell and Cell-Matrix Interactions;  
Acute Renal Failure*

**Barry M. Brenner M.D.**

Samuel A. Levine Professor of Medicine,  
Harvard Medical School;  
Director Emeritus, Renal Division, and Senior Physician,  
Department of Medicine,  
Brigham and Women's Hospital,  
Boston, Massachusetts  
*The Renal Circulations;  
Glomerular Ultrafiltration;  
Renal and Systemic Manifestations of Glomerular Disease;  
Adaptation to Nephron Loss*

**Matthew D. Breyer M.D.**

Division of Nephrology and Hypertension,  
Vanderbilt University School of Medicine,  
Nashville, Tennessee  
*Arachidonic Acid Metabolites and the Kidney*

**Michael E. Brier M.D.**

Professor of Medicine,  
University of Louisville School of Medicine;  
Kidney Disease Program,  
Division of Nephrology,  
Department of Veterans Affairs,  
Louisville, Kentucky  
*Prescribing Drugs in Renal Disease*

**Dennis Brown Ph.D.**

---

Los Angeles, California  
*Hypertension and Renal Disease*

**Riccardo Candido M.D.**

Physician,  
Department of Medicine and Neurology,  
University of Trieste,  
Trieste, Italy  
*Vasoactive Peptides and the Kidney*

**Charles B. Carpenter M.D.**

Professor of Medicine,  
Harvard Medical School;  
Senior Physician,  
Laboratory of Immunogenetics and Transplantation,  
Brigham and Women's Hospital,  
Boston, Massachusetts  
*Transplantation Immunobiology*

**Anil Chandraker M.D.**

Instructor of Medicine,  
Harvard Medical School;  
Director,  
Renal Transplant Clinics,  
Brigham and Women's Hospital,  
Boston, Massachusetts  
*Transplantation Immunobiology*

**Ingrid J. Chang M.D.**

Fellow,  
Division of Nephrology,  
Vanderbilt University Medical Center,  
Nashville, Tennessee  
*Extracorporeal Treatment of Poisoning*

**Devasmita Choudhury M.D.**

Associate Professor of Internal Medicine,  
University of Texas Southwestern Medical Center at Dallas;  
Director of Dialysis,  
Dallas Veterans Affairs Medical Center,  
Dallas, Texas  
*Effect of Aging on Renal Function and Disease*

**Michael R. Clarkson M.B.**

Fellow in Nephrology,  
Renal Division,  
Brigham and Women's Hospital,  
Boston, Massachusetts  
*Acute Renal Failure*

---

*Urinary Tract Infection, Pyelonephritis, and Reflux Nephropathy*

**John K. Crean Ph.D.**

Lecturer,  
University College Dublin,  
Dublin, Ireland  
*Cell-Cell and Cell-Matrix Interactions*

**Pirouz Daeihagh M.D.**

Assistant Professor,  
Department of Internal Medicine and Nephrology,  
Wake Forest University School of Medicine,  
Winston-Salem, North Carolina  
*Peritoneal Dialysis*

**Vivette D. D'Agati M.D.**

Professor of Pathology and Director,  
Renal Pathology Laboratory,  
Columbia University College of Physicians and Surgeons;  
Attending Physician in Pathology,  
Columbia Presbyterian Medical Center,  
New York, New York  
*Secondary Glomerular Disease*

**Mogamat Razeen Davids M.D.**

Associate Professor,  
University of Stellenbosch,  
Cape Town;  
Senior Specialist,  
Tygerberg Hospital,  
Tygerberg, South Africa  
*Interpretation of Urine Electrolyte and Acid-Base Parameters*

**Paul E. de Jong M.D., Ph.D.**

Professor of Nephrology,  
University of Groningen;  
Head,  
Division of Nephrology,  
University Hospital Groningen,  
Groningen, The Netherlands  
*Specific Pharmacologic Approaches to Clinical Renoprotection*

**Dick de Zeeuw M.D., Ph.D.**

Professor and Head,  
Department of Clinical Pharmacology,  
University Hospital Groningen,  
Groningen, The Netherlands  
*Specific Pharmacologic Approaches to Clinical Renoprotection*

**Matthew Dollins M.D.**

---

**Murray J. Favus M.D.**

Professor of Medicine,  
University of Chicago Pritzker School of Medicine;  
Director,  
Bone Program,  
University of Chicago Hospital,  
Chicago, Illinois  
*Nephrolithiasis*

**Bernard V. Fishbach M.D.**

Clinical Fellow,  
Division of Nephrology,  
Vanderbilt University Medical Center,  
Nashville, Tennessee  
*Extracorporeal Treatment of Poisoning*

**Steven Fishbane M.D.**

Associate Professor of Medicine,  
State University of New York at Stony Brook School of Medicine,  
Stony Brook;  
Vice Chairman,  
Department of Medicine,  
Winthrop-University Hospital,  
Mineola, New York  
*Erythropoietin Therapy in Renal Disease and Renal Failure*

**Gerard Friedlander M.D., Ph.D.**

Professor of Physiology,  
Faculty of Medicine of Xavier Bichat,  
University of Paris 7;  
Director,  
Inserm Unit 426,  
Paris, France  
*Biology of Renal Cells in Culture*

**Gerardo Gamba M.D., Ph.D.**

Professor,  
Biomedical Research Institute,  
Faculty of Medicine,  
National University of Mexico;  
Department of Nephrology,  
Instituto Nacional de Ciencias Mèdicas y Nutricion Salvador Zubiràn,  
Instituto de Investigaciones Biomèdicas,  
Mexico City, Mexico  
*Urine Concentration and Dilution*

**Daniel J. George M.D.**

Associate Professor of Medicine,  
Harvard Medical School;  
Dana Farber Cancer Institute,



---

University of Toronto Faculty of Medicine;  
Staff Nephrologist,  
St. Michael's Hospital,  
Toronto, Ontario, Canada  
*Interpretation of Urine Electrolyte and Acid-Base Parameters*

---

\*Deceased

---

x

**L. Lee Hamm M.D.**

Professor of Medicine and Chief,  
Section of Nephrology and Hypertension,  
Tulane University School of Medicine;  
Vice Chairman,  
Department of Medicine,  
Tulane University Health Sciences Center,  
New Orleans, Louisiana  
*Renal Acidification Mechanisms*

**Donna S. Hanes M.D.**

Assistant Professor,  
Division of Nephrology,  
University of Maryland School of Medicine;  
Attending Physician,  
University of Maryland Hospital,  
Baltimore, Maryland  
*Antihypertensive Drugs*

**Raymond C. Harris M.D.**

Professor of Medicine and Director,  
Division of Nephrology and Hypertension,  
Vanderbilt University School of Medicine,  
Nashville, Tennessee  
*Arachidonic Acid Metabolites and the Kidney*

**Matthias A. Hediger Ph.D.**

Associate Professor,  
Harvard Medical School;  
Director,  
Membrane Biology Program,  
Renal Division,  
Brigham and Women's Hospital,  
Boston, Massachusetts  
*The Molecular Basis of Solute Transport*

**William L. Henrich M.D.**

Professor of Medicine,  
University of Maryland School of Medicine;  
Chairman,

---

Physician,  
Alfred Hospital,  
Melbourne, Australia  
*Vasoactive Peptides and the Kidney*

**J. Charles Jennette M.D.**

Professor and Chair,  
Department of Pathology and Laboratory Medicine,  
University of North Carolina at Chapel Hill School of Medicine,  
Chapel Hill, North Carolina  
*Primary Glomerular Disease*

**Eric Jonasch M.D.**

Assistant Professor of Medicine,  
University of Texas—Houston Medical School;  
Attending Physician,  
M. D. Anderson Cancer Center,  
Houston, Texas  
*Renal Neoplasia*

**Kamel S. Kamel M.D.**

Assistant Professor of Medicine,  
University of Toronto Faculty of Medicine;  
Staff Nephrologist,  
St. Michael's Hospital,  
Toronto, Ontario, Canada  
*Interpretation of Urine Electrolyte and Acid-Base Parameters*

**Hussein H. Karnib M.D.**

Senior Fellow,  
Division of Nephrology,  
Department of Internal Medicine,  
American University of Beirut Medical Center,  
Beirut, Lebanon  
*Microvascular Diseases of the Kidney*

**Bertram L. Kasiske M.D.**

Professor,  
University of Minnesota Medical School—Minneapolis;  
Director,  
Division of Nephrology,  
Hennepin County Medical Center,  
Minneapolis, Minnesota  
*Laboratory Assessment of Kidney Disease: Clearance, Urinalysis, and Kidney Biopsy*

**Carolyn J. Kelly M.D.**

Professor of Medicine,  
University of California,  
San Diego,  
School of Medicine,

---

Research Assistant Professor,  
Division of Nephrology and Hypertension,  
Oregon Health Sciences University School of Medicine,  
Portland, Oregon;  
Deputy Head,  
Diabetes Center,  
Institute of Clinical and Experimental Medicine,  
Prague, Czech Republic  
*Renal and Systemic Manifestations of Glomerular Disease*

**Bruce C. Kone M.D.**

Vice Chairman,  
Department of Medicine,  
and Director,  
Division of Renal Diseases and Hypertension,  
University of Texas—Houston Medical School;  
Chief of Nephrology,  
Memorial Hermann Hospital,  
Houston, Texas  
*The Metabolic Basis of Solute Transport*

**Michael A. Kraus M.D.**

Associate Professor of Clinical Medicine,  
Division of Nephrology,  
Indiana University School of Medicine University Hospital,  
Indianapolis, Indiana  
*Intensive Care Nephrology*

---

XI

**John H. Laragh M.D.**

Professor of Medicine,  
Weill Medical College of Cornell University;  
Attending Physician in Medicine,  
New York-Presbyterian Hospital,  
New York, New York  
*Essential Hypertension*

**Moshe Levi M.D.**

Professor of Medicine, Physiology, and Biophysics and Head,  
Division of Renal Diseases and Hypertension,  
University of Colorado Health Sciences Center,  
Denver, Colorado  
*Effect of Aging on Renal Function and Disease*

**Wilfred Lieberthal M.D.**

Professor,  
Department of Medicine,  
Division of Nephrology

---

Instructor in Medicine,  
Harvard Medical School;  
Attending Physician,  
Renal Division,  
Brigham and Women's Hospital,  
Boston, Massachusetts  
*Clinical Aspects of Renal Transplantation*

**Gerhard Malnic M.D.**

Professor,  
Department of Physiology and Biophysics,  
Instituto de Ciências Biomédicas,  
Universidade de São Paulo,  
São Paulo, Brazil  
*Control of Renal Potassium Excretion*

**Kevin J. Martin M.B., B.Ch.**

Professor of Medicine,  
St. Louis University School of Medicine;  
Director,  
Division of Nephrology,  
St. Louis University Hospital,  
St. Louis, Missouri  
*Renal Osteodystrophy*

**Michael Mauer M.D.**

Department of Pediatric Nephrology,  
University of Minnesota Hospital and Clinic,  
Minneapolis, Minnesota  
*Diabetic Nephropathy*

**Dianne B. McKay M.D.**

Assistant Member,  
Scripps Research Institute;  
Director of Research,  
Division of Nephrology,  
Scripps Clinic,  
La Jolla, California  
*Donor and Recipient Issues in Renal Transplantation*

**Lawrence P. McMahon M.D.**

Senior Lecturer,  
University of Melbourne;  
Director,  
Department of Nephrology,  
Western Hospital,  
Melbourne, Australia  
*Cardiovascular Aspects of Chronic Kidney Disease*

**Maya Meux M.D.**

---

University of Texas Southwestern Medical Center at Dallas,  
Dallas, Texas  
*Renal Transport of Glucose, Amino Acids, Sodium, Chloride, and Water*

**Bruce A. Molitoris M.D.**

Professor of Medicine and Director,  
Nephrology Division,  
Indiana University School of Medicine,  
Indianapolis, Indiana  
*Intensive Care Nephrology*

**David B. Mount M.D.**

Assistant Professor of Medicine,  
Harvard Medical School;  
Attending Physician,  
Renal Division,  
Brigham and Women's Hospital,  
Boston, Massachusetts  
*The Molecular Basis of Solute Transport;  
Disorders of Potassium Balance*

**Patrick H. Nachman M.D.**

Associate Professor of Medicine,  
Division of Nephrology,  
University of North Carolina at Chapel Hill School of Medicine,  
Chapel Hill, North Carolina  
*Primary Glomerular Disease*

**Gerjan Navis M.D.**

Professor of Experimental Nephrology and Renal Pharmacology,  
University Hospital Groningen,  
Groningen, The Netherlands  
*Specific Pharmacologic Approaches to Clinical Renoprotection*

**Eric G. Neilson M.D.**

Hugh Jackson Morgan Professor of Medicine and Chair,  
Department of Medicine,  
Vanderbilt University School of Medicine;  
Physician-in-Chief,  
Vanderbilt University Hospital,  
Vanderbilt University Medical Center,  
Nashville, Tennessee  
*Tubulointerstitial Diseases*

**Soren Nielsen M.D., Ph.D.**

Professor of Cell Biology and Pathophysiology,

---

*Toxic Nephropathy*

**Patrick S. Parfrey M.D.**

University Research Professor,  
Health Sciences Center;  
Staff Nephrologist and Director,  
Patient Research Centre,  
Health Care Corporation of St. John's,  
St. John's, Newfoundland, Canada  
*Cardiovascular Aspects of Chronic Kidney Disease*

**Hans-Henrik Parving M.D.**

Steno Diabetes Center,  
Gentofte, Denmark  
*Diabetic Nephropathy*

**David L. Perkins M.D.**

Associate Professor,  
Harvard Medical School;  
Laboratory of Molecular Immunology,  
Department of Medicine,  
Brigham and Women's Hospital,  
Boston, Massachusetts  
*Transplantation Immunobiology*

**Georgi Pirtskhalaishvili M.D., Ph.D.**

Fellow and AFUD Scholar,  
Department of Urology,  
University of Pittsburgh School of Medicine,  
Pittsburgh, Pennsylvania  
*Urinary Tract Obstruction*

**Martin R. Pollak M.D.**

Assistant Professor of Medicine,  
Harvard Medical School;  
Attending Physician,  
Brigham and Women's Hospital,  
Boston, Massachusetts  
*Clinical Disturbances of Calcium, Magnesium, and Phosphate Metabolism*

**Hamid Rabb M.D.**

Associate Professor of Medicine,  
Johns Hopkins University School of Medicine;  
Physician Director,  
Kidney Transplant Program,  
Johns Hopkins Hospital,  
Baltimore, Maryland  
*Cell-Cell and Cell-Matrix Interactions*

**Jai Radhakrishnan M.D.**

---

Mario Negri Institute for Pharmacological Research,  
Negri Bergamo Laboratories,  
Division of Nephrology and Dialysis,  
Bergamo, Italy  
*Hematologic Consequences of Renal Failure*

**Eberhard Ritz M.D.**

Nephrology, Dialysis, and Transplantation,  
Sektion Nephrologie,  
Med. Universitätsklinik,  
Heidelberg, Germany  
*Diabetic Nephropathy*

**Michael V. Rocco M.D.**

Professor,  
Internal Medicine and Nephrology,  
Wake Forest University School of Medicine,  
Winston-Salem, North Carolina  
*Peritoneal Dialysis*

**Andreas Rolfs Ph.D.**

Department of Biochemistry and Molecular Pharmacology,  
Harvard Medical School,  
Boston;  
Harvard Institute of Proteomics,  
Cambridge, Massachusetts  
*The Molecular Basis of Solute Transport*

**Michael F. Romero Ph.D.**

Associate Professor,  
Department of Physiology and Biophysics,  
Case Western Reserve University School of Medicine,  
Cleveland, Ohio  
*The Molecular Basis of Solute Transport*

**Pierre Ronco M.D., Ph.D.**

Professor of Renal Medicine,  
Faculty of Medicine,  
University of Paris 6—Saint-Antoine;  
Director,  
Department of Nephrology and Inserm Unit 489,  
Hôpital Tenon,  
Paris, France  
*Biology of Renal Cells in Culture*

**Robert H. Rubin M.D.**

Professor of Medicine,  
Harvard Medical School;  
Associate Director,  
Division of Infectious Diseases,

---

Vanderbilt University School of Medicine;  
Director,  
End-Stage Renal Disease Program,  
Vanderbilt University Medical Center,  
Nashville, Tennessee  
*Hemodialysis*

**Domenic A. Sica M.D.**

Professor of Medicine,  
Virginia Commonwealth University School of Medicine;  
Chairman,  
Section of Clinical Pharmacology and Hypertension,  
Virginia Commonwealth University Health System,  
Richmond, Virginia  
*Renal Handling of Organic Anions and Cations: Excretion of Uric Acid*

**Saba Silé M.D.**

Fellow in Nephrology,  
Vanderbilt University School of Medicine,  
Nashville, Tennessee  
*Extracorporeal Treatment of Poisoning*

**John R. Silkensen M.D.**

Assistant Professor,  
University of Minnesota Medical School—Minneapolis;  
Staff Nephrologist,  
Division of Nephrology,  
Hennepin County Medical Center,  
Minneapolis, Minnesota  
*Laboratory Assessment of Kidney Disease: Clearance, Urinalysis, and Kidney Biopsy*

**Karl L. Skorecki M.D.**

Professor,  
Bruce Rappaport Faculty of Medicine,  
Technion,  
Israeli Institute of Technology;  
Director,  
Department of Nephrology and Molecular Medicine,  
Rambam Medical Center,  
Haifa, Israel  
*Control of Extracellular Fluid Volume and the Pathophysiology of Edema Formation*

**Eduardo Slatopolsky M.D.**

Professor of Medicine and Joseph Friedman Professor of Renal Diseases in Medicine,  
Washington University School of Medicine;  
Attending Physician,  
Barnes-Jewish Hospital,  
St. Louis, Missouri  
*Renal Osteodystrophy*

**John C. Stivelman M.D.**



---

sample content of Brenner and Rector's The Kidney

- [Home Land pdf, azw \(kindle\), epub](#)
- [download The Ice Storm](#)
- [La bÃ©tarde book](#)
- [read Fire in the Sky \(Seekers, Book\) pdf, azw \(kindle\)](#)
  
- <http://junkrobots.com/ebooks/Chrysler-s-Turbine-Car--The-Rise-and-Fall-of-Detroit-s-Coollest-Creation.pdf>
- <http://schrolf.de/books/The-Ice-Storm.pdf>
- <http://conexdx.com/library/The-Fourth-Crusade-1202-04--The-betrayal-of-Byzantium--Campaign--Volume-237-.pdf>
- <http://test.markblaustein.com/library/Fire-in-the-Sky--Seekers--Book-.pdf>