Preface

The study of kidney development and maintenance is critical in understanding the progression of human disease. Disruption of renal development can give rise to congenital pathologies including cystic diseases and pediatric kidney cancer. Maintenance of the kidney is critical to prevent renal damage later in life, which may lead to fibrosis and chronic kidney disease (CKD). Current research aimed at understanding kidney development and homeostasis is enabling the field to progress toward regenerative and stem cell therapies to repair damaged nephrons. Our improved imaging capabilities as well as our growing understanding of the molecular mechanisms behind nephrogenesis are leading to novel strategies to generate nephrons de novo as potential treatment for CKD and other renal pathologies.

Research in animal models has made substantial contributions to our fundamental understanding of nephrogenesis. Models including the fly, fish, and frog have simplified nephron organization and structure, enabling their use to assess the formation and function of the kidney. Although their kidneys are structurally less complex, they perform similar functions as those of mammals, such as maintaining physiological water and electrolyte balance and removing waste and toxins. Additionally, the molecular processes involved in nephrogenesis are highly conserved among these models, allowing researchers to uncover the fundamental molecular events required for nephron formation and function through their study. These models are also being used in studies of human kidney diseases. The first section of this volume focuses on the use of animal models to study kidney development, function, disease, and repair.

During kidney formation, molecular signaling leads to coordination of cell renewal and differentiation, leading to the development of specific cell fates. The intricate signaling networks among different cell types within the kidney give rise to the development of functional nephrons. Researchers have invested significant effort in understanding the molecular signaling involved in kidney development within the nephrogenic zone, collecting duct system, and stromal compartment. By understanding the processes involved in the formation of renal tissues, some of the mechanisms underlying renal disease are becoming apparent. The second section of

this volume examines the developmental and disease processes that occur within the nephrogenic zone, collecting duct system, and the stromal components of the kidney.

In order for the developing kidney to function properly, its epithelial tissue must undergo morphogenesis to generate functioning nephric tubes. Recent imaging advances have accelerated our study of morphogenetic processes within the kidney. Additionally, significant advances have been made in understanding developmental anomalies leading to morphogenetic defects within the urinary tract. The most prevalent among these abnormalities are cystic kidney diseases. Maintenance of the kidney is also important in order to prevent the establishment of renal diseases, including fibrosis. The final section of this volume describes morphogenesis and maintenance of the kidney and the diseases resulting from the disruption of these processes.

Our current understanding of developmental and disease processes in the kidney continues to expand with the establishment of novel techniques and approaches along with imaging technologies to study nephrogenesis. Additionally, the classical approaches to explore nephron development and maintenance have provided a strong foundation for our understanding of the molecular processes involved. Current studies in kidney development and disease are taking advantage of our molecular understanding along with novel strategies to generate nephrons de novo for potential therapeutic use in the long run.

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