Recent topics in kidney research: morphology and molecular cell biology

Tatsuo Sakai¹

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It is my great pleasure to present in the current volume of *Anatomical Science International* a special issue concerning recent topics on the morphology and cell biology of the kidney, including contributions from among the most active researchers in this field. The kidney is a vital organ in the human body and is one of the most complicated organs in terms of both structure and function. Kidney tissue is highly organized, with two cortical subdivisions and three medullary zones, and it contains many specific cell types, including three in the glomerulus and fifteen along the renal tubule. Aside from the brain, the structural and functional complexity of the kidney far exceeds those of the other vital organs (the heart, lung, liver, and small intestine).

The vital role of the kidney was first recognized in the early nineteenth century by an English physician, Richard Bright, who discovered differences in the postmortem kidneys of patients with scarlet fever and systemic edema as compared to other postmortem kidneys (Bright 1827). Such kidney diseases were then called “Bright’s disease.” Since then, many investigations have contributed to improving our understanding of the structure and function of the kidney, in particular: the discovery of Bowman’s capsule (Bowman 1842) and the loop of Henle (Henle 1862), the proposal that renal function involves two steps (Ludwig 1852–1856), the discovery of podocytes and mesangial cells (Zimmermann 1915, 1929), and physiological studies of the renal tubule performed by Smith,

which culminated in his famous textbooks on renal physiology (Smith 1951).

The current special issue consists of six review articles. The first two deal with the glomerulus, the next two with the renal tubule, and the last two with pathological and evolutionary aspects of the kidney.

The renal glomeruli are highly interesting to nephrologists since they play a pivotal role in urine formation and are very susceptible to pathological and mechanical burdens. The first article focuses on the evolutionary morphology of glomeruli and podocytes, elucidating the morphological similarities between different kinds of slit diaphragms (Ichimura and Sakai 2017). The second article provides an overview of the experimental pathology after mesangial cell damage in order to elucidate the mechanical function of these cells in sustaining the structure of the glomerulus against high intraglomerular blood pressure (Kurihara and Sakai 2017).

The reabsorption and excretion of fluids and solutes by the renal tubules and their modulation are crucial influences on the final composition of urine. The third article overviews the current state of knowledge on the water channel aquaporin family in the kidney to provide a better understanding of water homeostasis in the living body (Matsuzaki et al. 2017). The fourth article considers the interesting question of how organic anions are secreted in the renal proximal tubules in order to provide a possible explanation for the molecular mechanism of action and the side effects of diuretics (Anzai et al. 2017).

The fifth article reports recent progress in the molecular pathology of renal cystic diseases caused by genetic changes in cystoproteins localized in the cilia and/or centrioles (Yokoyama 2017). The sixth and last article concerns the phylogenetic development of the renin–angiotensin system (RAS), focusing on the molecular

✉ Tatsuo Sakai
tatsuo@juntendo.ac.jp

¹ Department of Anatomy and Life Structure, Juntendo University School of Medicine, 2-1-1 Hongo, Bunkyo-ku, Tokyo 113-8421, Japan

evolution of the RAS cascade properties of angiotensin II receptors and the function of the RAS in nonmammalian vertebrates (Nishimura 2017).

I hope that the present special issue will intellectually stimulate a wide range of investigators of anatomy, physiology, and nephrology to encourage further research into kidney structure, function, and pathogenesis.

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