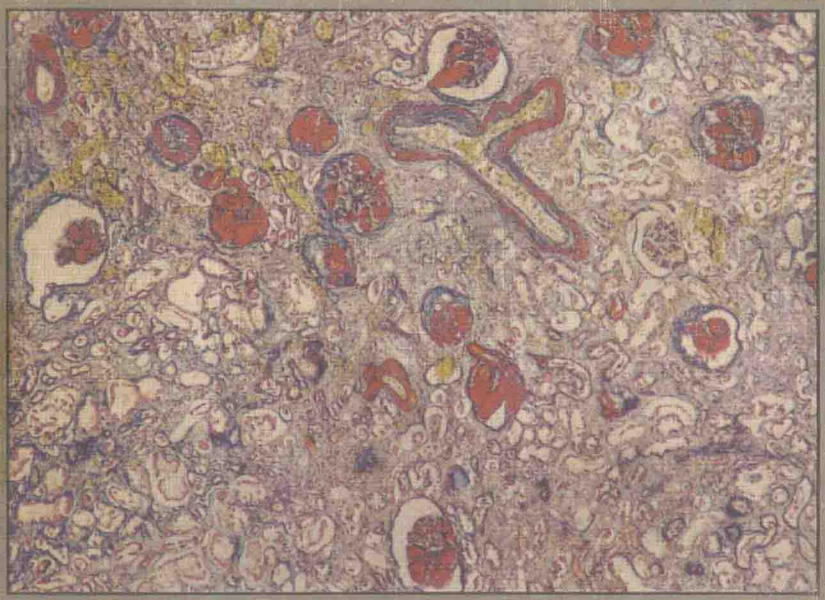
YEAR BOOK *Color Atlas Series*

COLOR ATLAS OF Renal Diseases

GEORGE WILLIAMS



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GEORGE WILLIAMS
M.D., Ph.D., F.R.C.Path.
Reader in Pathology, University of Manchester
Hon. Consultant Pathologist, Manchester Royal Infirmary

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GEORGE WILLIAMS

To Mary, Paula, Gordon and "Gipsy"

Introduction

A HEALTHY KIDNEY has a complex structure and performs many functions. Both may be significantly changed by disease which may originate in the kidney itself or involve it as complications of diseases arising in other body tissues or systems. In either case a wide variety of abnormal clinical signs and symptoms may result.

This atlas is produced from the viewpoint of a pathologist; it is therefore mainly concerned with the structural aspects of renal diseases as studied in gross specimens and microscopical preparations. To aid interpretation, appearances at both these levels have been frequently correlated. This production is directed mainly at undergraduates, who, for good reasons, often find renal diseases confusing and hard to understand—an opinion shared by not a few post-graduates as well.

Studies of structural change alone cannot provide the answers to all the problems of disease, but they are fundamental to a better understanding of them and play an important part in establishing clinical diagnosis and influencing treatment. Some of the rarer renal diseases have intentionally been omitted from this atlas, but it is hoped that the range of abnormalities illustrated is sufficiently wide to help both students and graduates understand the more common and important ones they are likely to meet.

Presentation of Specimens

MOST ILLUSTRATIONS of gross specimens presented in this atlas incorporate a measuring scale—hence magnifications are not stated in the descriptions. Magnifications for light and electron micrographs are, however, indicated.

Many staining techniques were used in preparing the sections for histology. The three most often used in the illustrations are:

(1) a combination of haematoxylin and eosin (H and E).
(2) the periodic acid-Schiff (PAS) technique which stains basement membranes and other glyco-proteins a rose-red/magenta colour, combined with haematoxylin as a nuclear stain.
(3) the martius (yellow)-scarlet-blue (MSB) technique with which collagenous connective tissue appears blue, fibrin and muscle—red, and red blood cells—yellow.

Other useful preparations were obtained using a silver methenamine—light green (MeS) combination which gives black basement membranes against a green background, and the elastic-van Gieson (EVG) stain which colours elastic tissue blue/black, collagen red, and muscle, yellow.

Preparations in which particular components are demonstrated (e.g. amyloid with Congo Red) are individually indicated.

Aspects of normal kidney structure

Kidney lobes

EACH ADULT kidney weighs about 150 gm. and is formed of upwards of 12 lobes fused into a single organ within a fibrous capsule. Each lobe consists of

Cortex, columns of Bertin and medulla

an outer cortex with an underlying medulla shaped as a pyramid with its apex pointing inwards towards the pelvis; inward extensions of the cortex between the pyramids are called the columns of Bertin. Both cortex and medulla are composed of the kidney's functional units or nephrons (at least 1 million per kidney) along with their supporting connective tissues, arteries, veins, nerves and lymph vessels. Each

The nephron

nephron is made up of a renal corpuscle and a tubule about 5 cm. long. The corpuscle consists of a

Renal corpuscle

vascular capillary tuft or glomerulus enclosed within an epithelial-lined capsule (of Bowman). The latter represents the blind end of the tubular component, which, on account of its changing outline, is described as having a proximal convolution or coil

Renal tubule

followed by a loop (of Henle) with descending and ascending limbs, and a distal convolution which contacts its corpuscle of origin at a point called the

Macula densa

macula densa. The distal convolution, which marks the extremity of the nephron, then joins a collecting tubule, the latter representing the common urinary drainage pathway of several nephrons. Such groups of nephrons together form smaller units of kidney

Renal lobules

structure called lobules which have no recognisable

Collecting tubules and ducts

anatomical boundaries. Fusion of collecting tubules near the medullary apex produces larger collecting ducts which deliver the final urinary product into the

Pelvic calyx
Renal papilla

pelvic calyces through small openings in the medullary papillae.

Most of the kidney cortex is made up of the renal corpuscles surrounded by the proximal and distal convoluted portions of the tubules. The medulla consists mainly of the tubular loops of Henle, collecting tubules and ducts and their vessels of blood supply. Where these two zones meet, along the base of each pyramid, a series of "streaks" or

Medullary rays

medullary rays run out for a short distance into the cortex and represent short parallel lengths of collecting tubules.

Kidney blood supply

This is delivered by the renal artery entering the renal sinus; thereafter, by progressive division it gives rise to smaller lobar, arcuate, then interlobular branches which penetrate between the cortical renal lobules.

Afferent and efferent arterioles

From each interlobular artery arise several afferent arterioles, each of which supplies a glomerulus. The post-glomerular or efferent arterioles then divide into a meshwork of capillaries to supply the renal tubules between which they run. Those related to juxtamedullary glomeruli follow the course of kidney tubular loops for varying distances into the medulla as the vasa recta, forming the main blood supply to the renal papillae before looping back to join the venous drainage system at the cortico-medullary junction. Progressively larger venous tributaries carry the blood back to the renal vein which leaves the kidney through the renal sinus, usually just in front of the renal artery.

Vasa recta

The glomerulus

Each glomerulus consists of thin walled capillary loops which project into the space outlined by Bowman's capsule. They are arranged in groups as lobules with a supporting connective tissue core or mesangium. The wall of each capillary consists of a basement membrane lined by endothelial cells and covered externally by epithelial cells which contact the outer surface through delicate foot processes or pedicels. Within the supporting mesangium lie the mesangial or axial cells surrounded by matrix. The urinary filtrate passing from the blood plasma in the capillary lumen across the capillary wall enters the space of Bowman's capsule and thence into a renal tubule.

Mesangium
Endothelial and epithelial cells
Foot processes

Mesangial or axial cells

Fig. 1. Bisected normal kidney. Yellow—pelvi-calyceal system; blue—vein; red—artery

Fig. 2. Diagram presentation of Fig. 1