The topic of normal vascular and glomerular anatomy is introduced here to serve as a reference point for later illustrations of disease-specific alterations in morphology.
1.2 Glomerulonephritis and Vasculitis

**FIGURE 1-1**

A. The major renal circulation. The renal artery divides into the interlobar arteries (usually 4 or 5 divisions) that then branch into arcuate arteries encompassing the corticomedullary junction of each renal pyramid. The interlobular arteries (multiple) originate from the arcuate arteries.  

B. The renal microcirculation. The afferent arterioles branch from the interlobular arteries and form the glomerular capillaries (hemi-arterioles). Efferent arterioles then reform and collect to form the post-glomerular circulation (peritubular capillaries, venules and renal veins [not shown]). The efferent arterioles at the corticomedullary junction dip deep into the medulla to form the vasa recta, which embrace the collecting tubules and form hairpin loops. (Courtesy of Arthur Cohen, M.D.)
Normal Vascular and Glomerular Anatomy

**FIGURE 1-2** (see Color Plate)
Microscopic view of the normal vascular and glomerular anatomy. The largest intrarenal arteries (interlobar) enter the kidneys between adjacent lobes and extend toward the cortex on the side of a pyramid. These arteries branch dichotomously at the corticomedullary junction, forming arcuate arteries that course between the cortex and medulla. The arcuate arteries branch into a series of interlobular arteries that course at roughly right angles through the cortex toward the capsule. Blood reaches glomeruli through afferent arterioles, most of which are branches of interlobular arteries, although some arise from arcuate arteries. ILA—interlobular artery; aa—afferent arteriole.

**FIGURE 1-3**
Microscopic view of the juxtaglomerular apparatus. The juxtaglomerular apparatus (arrow) located immediately adjacent to the glomerular hilus, is a complex structure with vascular and tubular components. The vascular component includes the afferent and efferent arterioles, and the region between them is known as the lacis. The tubular component consists of the macula densa (arrowhead). The juxtaglomerular apparatus is an integral component of the renin-angiotensin system.

**FIGURE 1-4**
Electron micrograph of the arterioles. Modified smooth muscle cells of the arterioles of the juxtaglomerular apparatus produce and secrete renin. Renin is packaged in characteristic amorphous mature granules (arrow) derived from smaller rhomboid-shaped immature proteogranules (arrowhead).
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1.4 Glomerulonephritis and Vasculitis

FIGURE 1-5 (see Color Plate)
Microscopic view of the glomeruli. Glomeruli are spherical “bags” of capillaries emanating from afferent arterioles and confined within the urinary space, which is continuous with the proximal tubule. The capillaries are partially attached to the mesangium, a continuation of the arteriolar wall consisting of mesangial cells (A, arrow) and the matrix (B, arrow). The free wall of glomerular capillaries, across which filtration takes place, consists of a basement membrane (arrowheads) covered by visceral epithelial cells with individual foot processes (FP) and lined by endothelial cells.

FIGURE 1-6
Schematic illustration of a glomerulus and adjacent hilar structure. Note the relationship of mesangial cells to the juxtaglomerular apparatus and distal tubule (macula densa). Red—mesangial cells; blue—mesangial matrix; black—basement membrane; green—visceral and parietal epithelial cells; yellow—endothelial cells. (From Churg and coworkers [1]; with permission.)

FIGURE 1-7
Electron photomicrograph illustrating a portion of the ultrastructure of the glomerular capillary wall. The normal width of the lamina rara externa (LRE) plus the lamina densa (LD) plus the lamina rara interna (LRI) equals about 250 to 300 nm. The spaces between the foot processes (FP), having diameters of 20 to 60 nm, are called filtration slit pores. It is believed they are the path by which filtered fluid reaches the urinary space (U). The endothelial cells on the luminal aspect of the basement membrane (BM) are fenestrated, having diameters from 70 to 100 nm (see Fig. 1-9). The BM (LRE plus LD plus LRI) is composed of Type IV collagen and negativity charged proteoglycans (heparan sulfate). L—lumen. (From Churg and coworkers [1]; with permission.)
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FIGURE 1-8
Scanning electron microscopy of the glomerulus. The surface anatomy of the interdigitating foot processes of normal visceral epithelial cells (podocytes) is demonstrated. These cells and their processes cover the capillary, and ultrafiltration occurs between the fine branches of the cells. (From Churg and coworkers [1]; with permission.)

FIGURE 1-9
Scanning electron microscopy of the glomerulus. The surface anatomy of endothelial cells of a normal glomerulus is demonstrated. Note the fenestrated appearance. (From Churg and coworkers [1]; with permission.)

Reference