

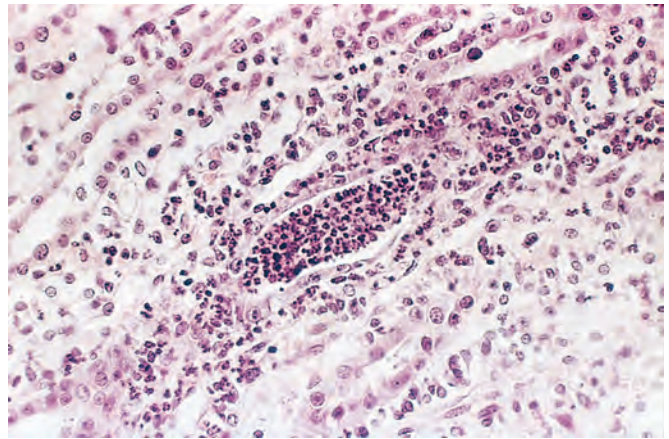


**Figure 20-27** Acute pyelonephritis. Cortical surface shows grayish white areas of inflammation and abscess formation.

In the early stages, the neutrophilic infiltration is limited to the tubules. The tubular lumens are a conduit for the extension of the infection, and soon, the infection extends to the interstitium and produces abscesses that destroy the involved tubules (Fig. 20-28). Characteristically, glomeruli are relatively resistant to the infection. Extensive disease, however, eventually also destroys the glomeruli, and fungal pyelonephritis (e.g., *Candida*) often affects glomeruli and results in granulomatous interstitial inflammation.

Three complications of acute pyelonephritis can be encountered.

- **Papillary necrosis** is seen mainly in diabetics, sickle cell disease, and in those with urinary tract obstruction. Papillary necrosis is usually bilateral but may be unilateral. One or all of the pyramids of the affected kidney may be involved. On cut section, the tips or distal two thirds of the pyramids have areas of gray-white to yellow necrosis (Fig. 20-29). On microscopic examination the necrotic tissue shows characteristic

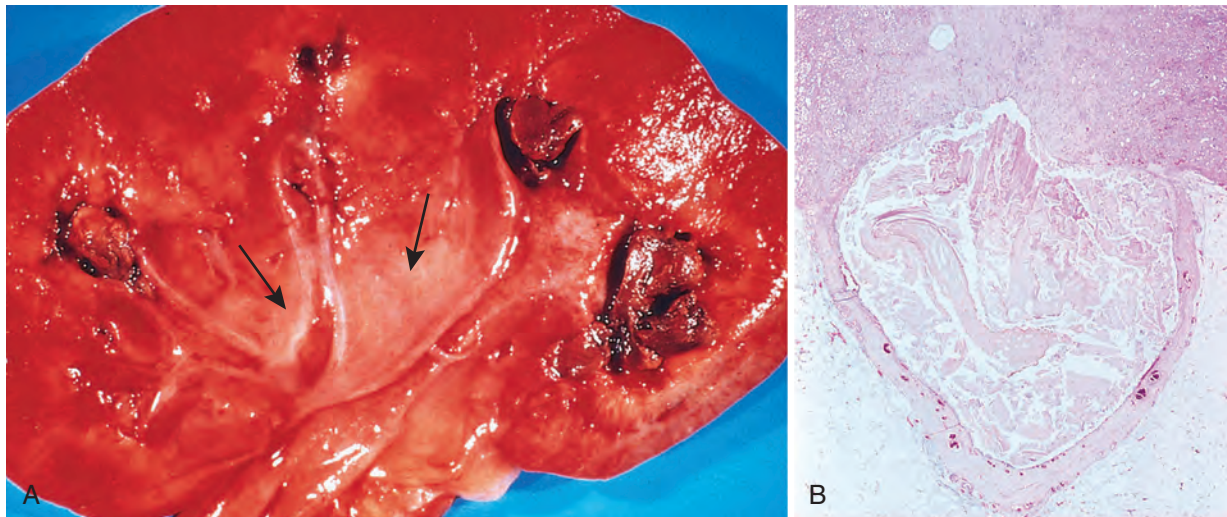


**Figure 20-28** Acute pyelonephritis marked by an acute neutrophilic exudate within tubules and interstitial inflammation.

ischemic coagulative necrosis, with preservation of outlines of tubules. The leukocytic response is limited to the junctions between preserved and destroyed tissue.

- **Pyonephrosis** is seen when there is total or almost complete obstruction, particularly when it is high in the urinary tract. The suppurative exudate is unable to drain and thus fills the renal pelvis, calyces, and ureter with pus.
- **Perinephric abscess** is an extension of suppurative inflammation through the renal capsule into the perinephric tissue.

After the acute phase of pyelonephritis, healing occurs. The neutrophilic infiltrate is replaced by one that is predominantly composed of macrophages, plasma cells, and lymphocytes. The inflammatory foci are eventually replaced by irregular scars that can be seen on the cortical surface as fibrous depressions. Such scars are characterized microscopically by tubular atrophy, interstitial fibrosis, and a lymphocytic infiltrate in a characteristic patchy, jigsaw pattern with intervening preserved parenchyma. **The pyelonephritic scar is almost always associated with inflammation, fibrosis, and deformation of the underlying calyx and pelvis**, reflecting the role of ascending infection and vesicoureteral reflux in the pathogenesis of the disease.



**Figure 20-29** Papillary necrosis. Areas of pale-gray necrosis involve the papillae (arrows).