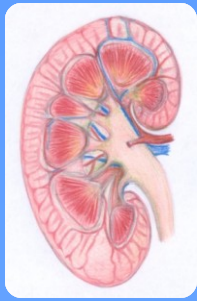




Acute Kidney Injury Students 211



Acute Kidney Injury

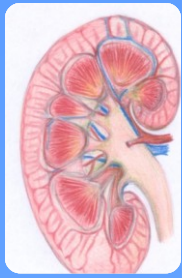
Hala Kfoury Kassouf MD, KSUF, FRCPA, EBP

Assistant Professor of pathology

Consultant Pathologist

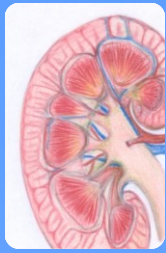
King Saud University

King Khaled University Hospital



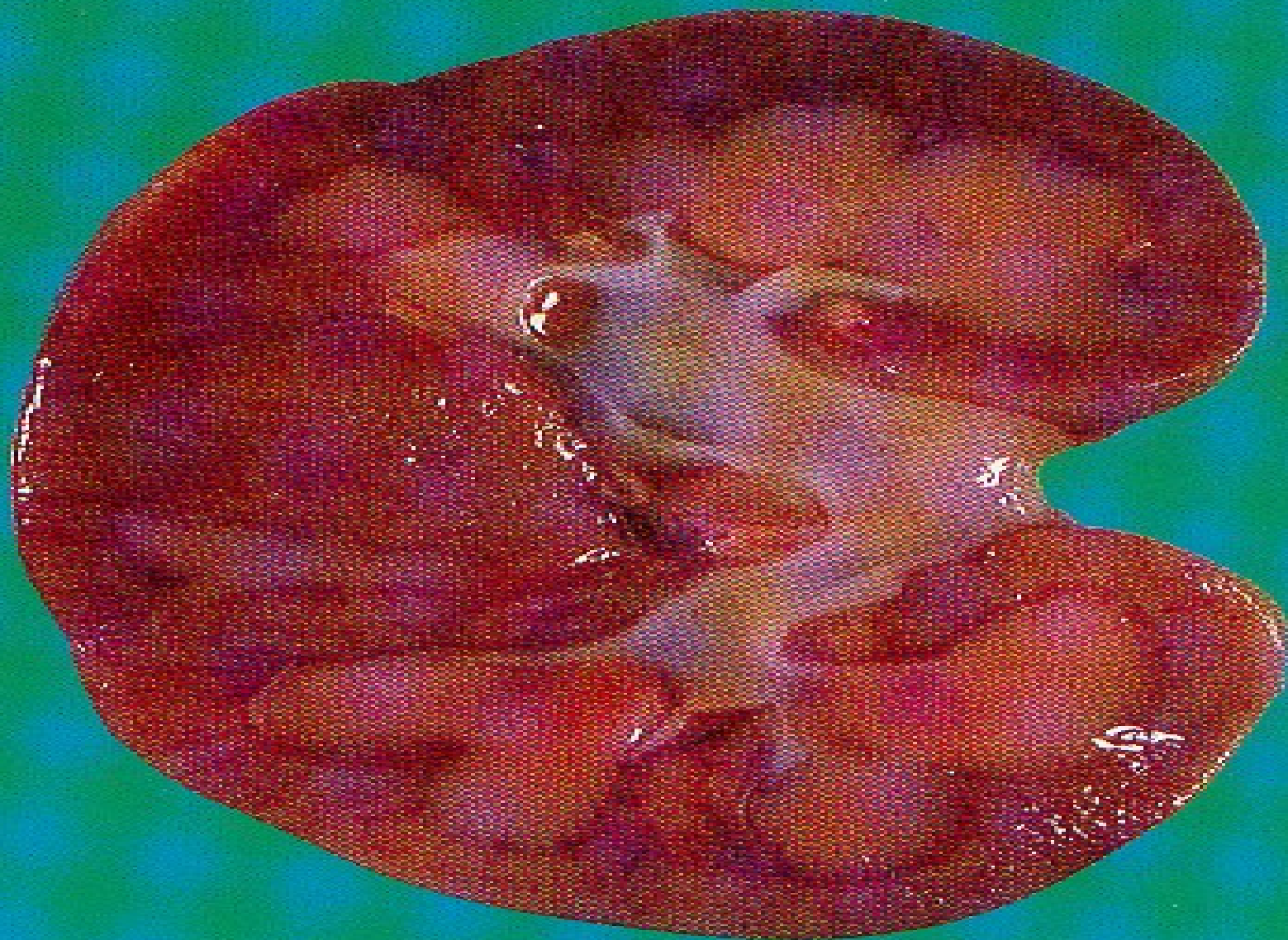
Objectives

- 1- Introduction to the renal pathology
- 2- Acute Kidney Injury
- 3- Definitions, Types, Clinical Overview, Causes
- 4- Pathological findings
- 5- Differential Diagnosis
- 6- Conclusion



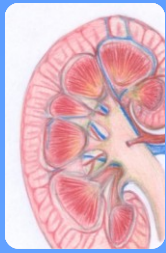
Outline

- Terminology
- Etiology
- Pathophysiology
- Pathological Evaluation



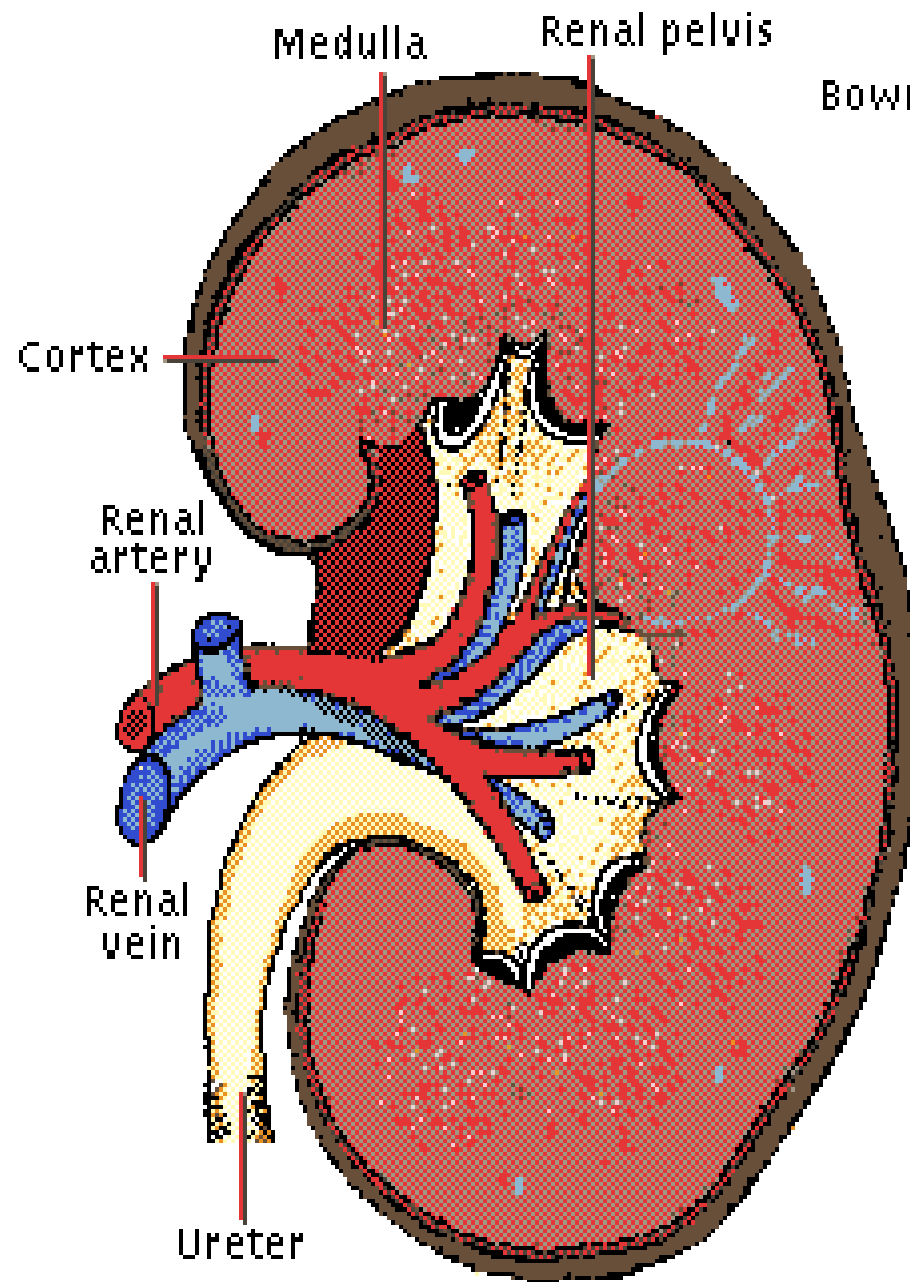
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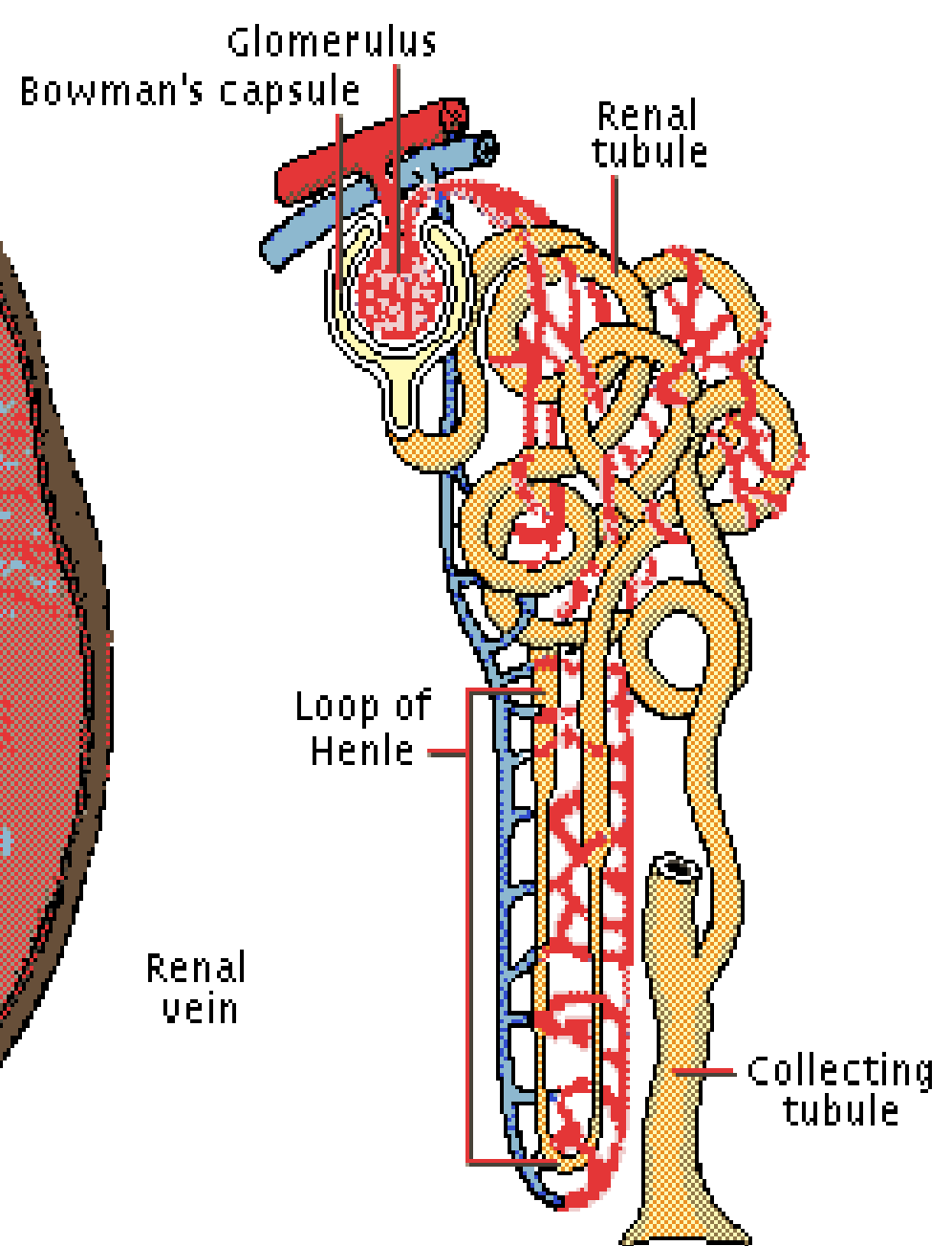


The Kidney Biopsy

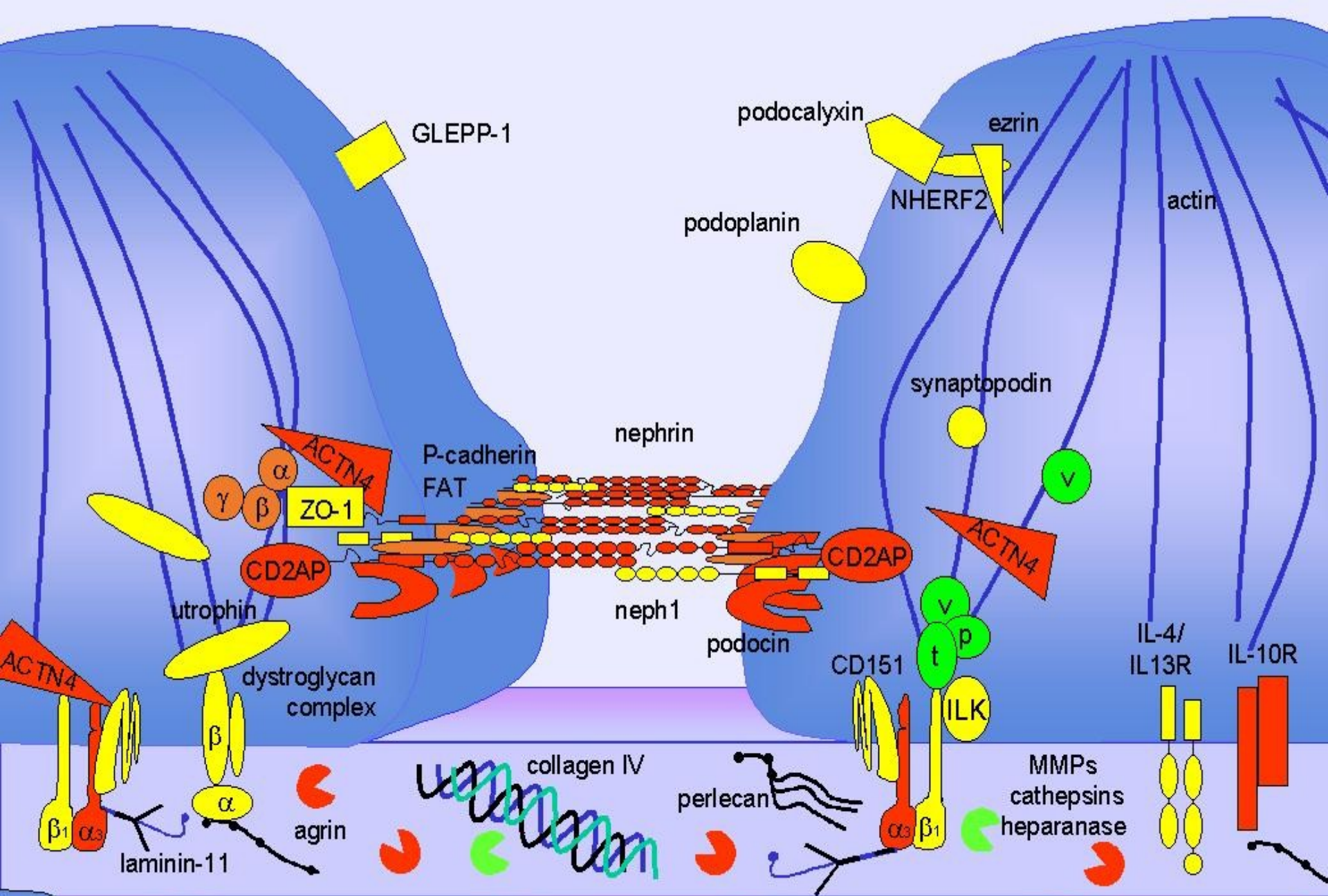
- General architecture
- Vasculature
- The Glomerulus



Kidney



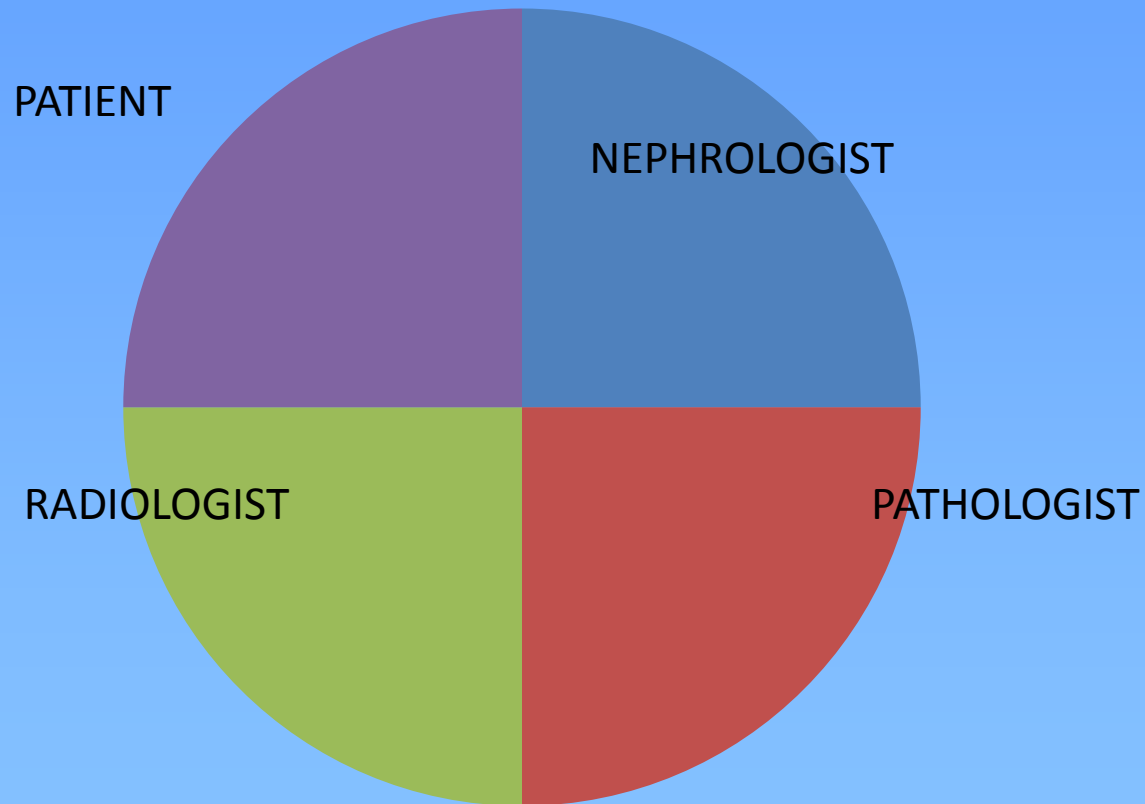
Nephron



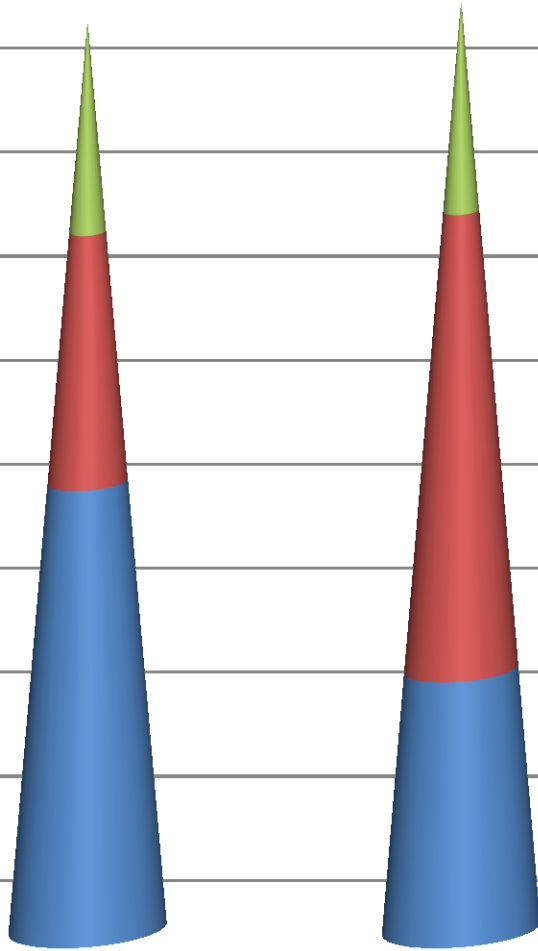


The Kidney Biopsy

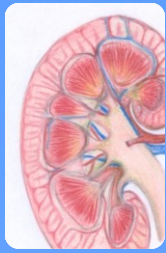
PEOPLE INVOLVED



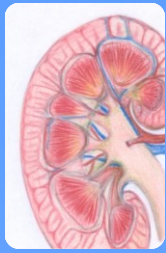
The Kidney Biopsy



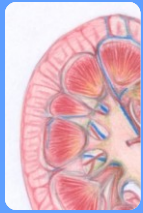
TECHNOLOGIST PATHOLOGIST



Acute renal failure is a syndrome defined by a sudden loss of renal function over several hours to several days.



RPGN (Rapidly Progressive Glomerulonephritis) is a syndrome defined by the rapid loss of renal function over days to weeks due to acute glomerulonephritis.



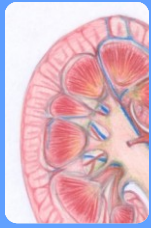
What constitutes the syndrome of ARF?

- Accumulation of nitrogenous waste products.
- Increased Scr.
- Derangement of extracellular fluid balance.
- Acid-base disturbance.
- Electrolyte and mineral disorders.

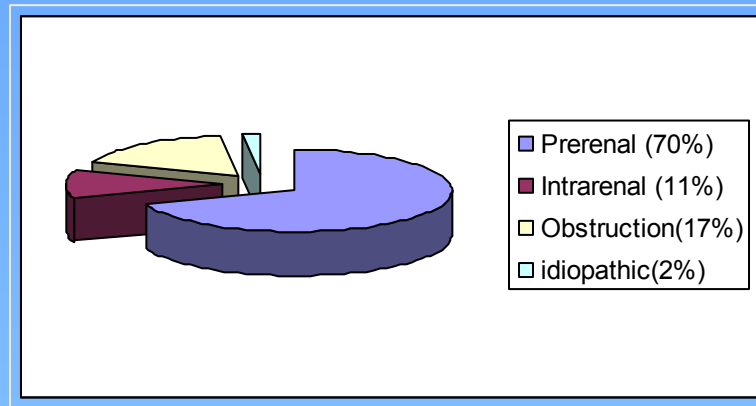


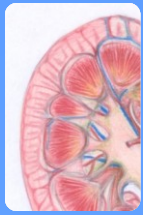
Epidemiology

- Inpatient
 - 1% all admissions
 - 2-5% all hospitalizations
 - 4-15% post cardiopulmonary bypass
 - $\leq 20\%$ all ICU patients
- Outpatients
 - cases/million/year
 - 140-209 general population
 - 17 adults < 50 yr
 - 949 adults 80-89 yr

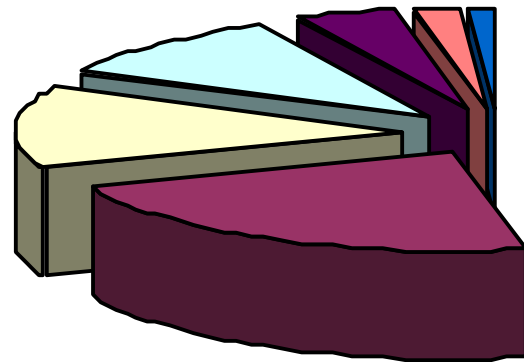


Etiology of ARF among Outpatients

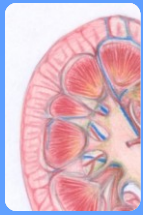




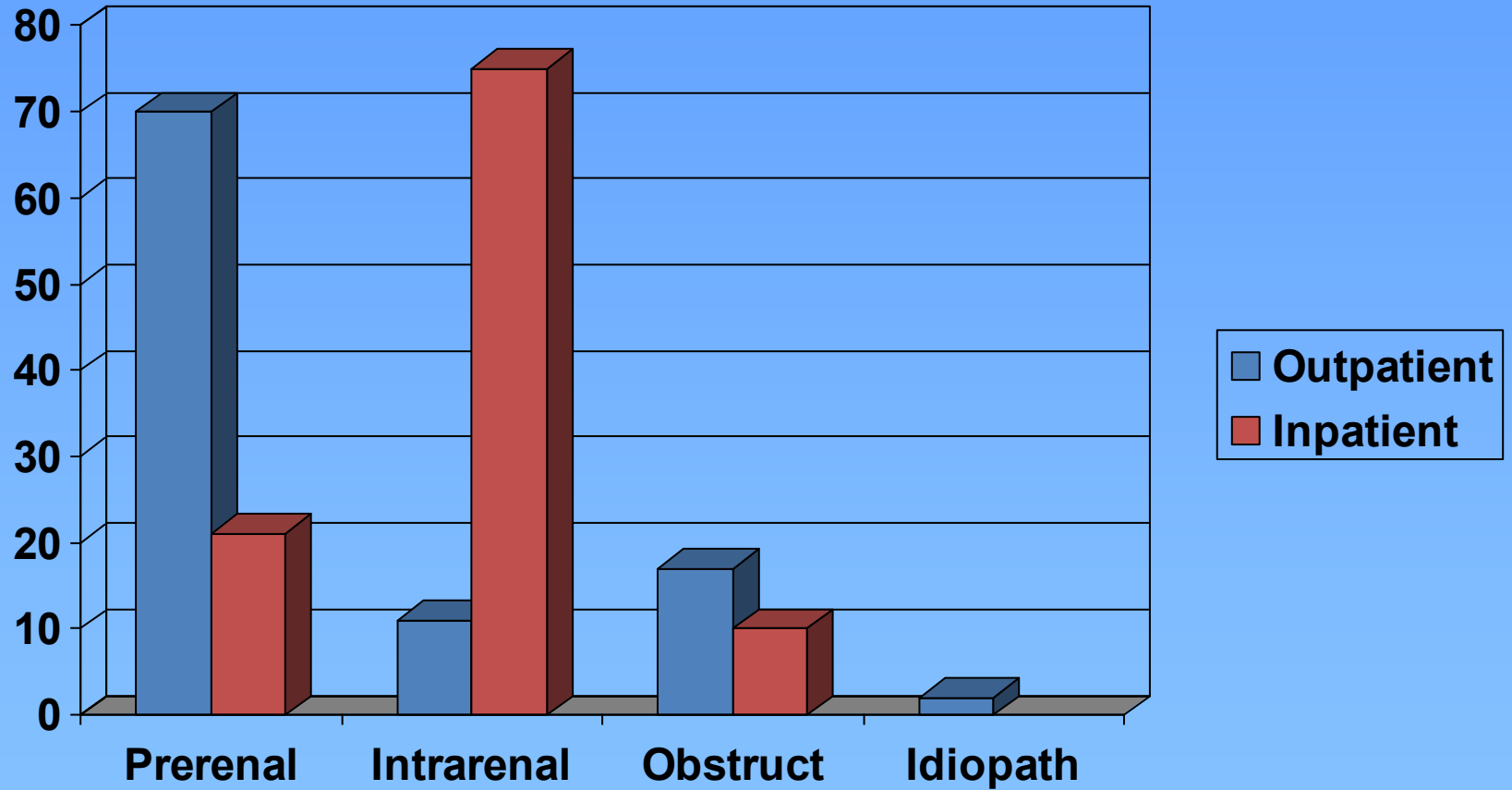
Etiology of ARF among Inpatients

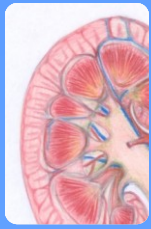


- ATN (45%)
- Prerenal (21%)
- ARF on CKD (13%)
- Obstruction (10%)
- GN/vasc (4%)
- AIN (2%)
- Atheroemboli (1%)



Etiology of ARF

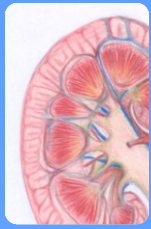




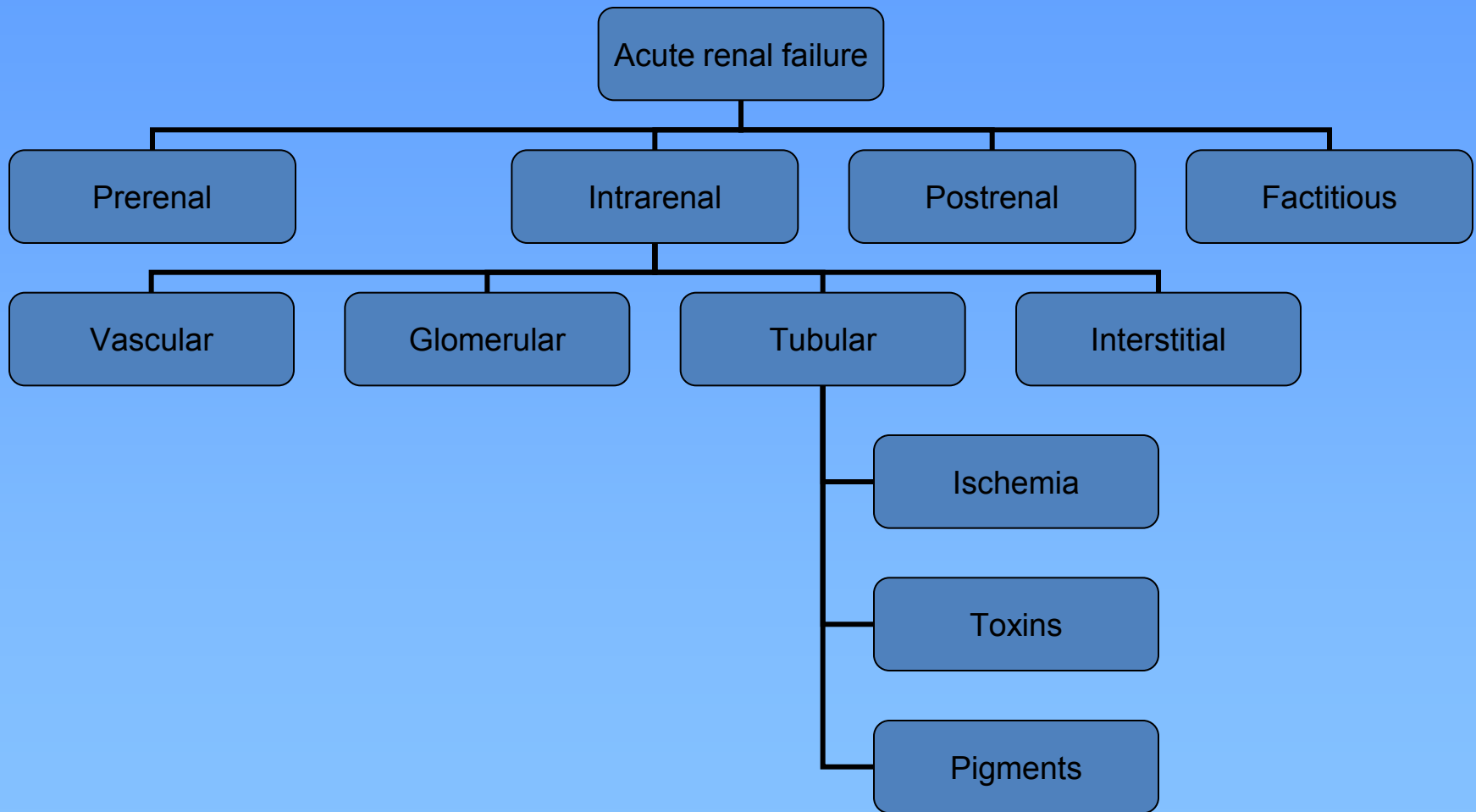
Mortality of ARF

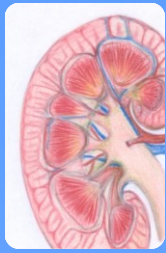
- “Despite technical progress in the management of acute renal failure over the last 50 years, mortality rates seem to have remained unchanged at around 50%.”

Am J Med (2005)118:827-832.

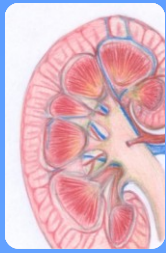


The Pathophysiology of ARF



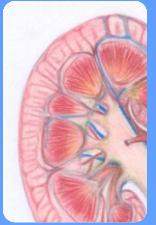


There is a continuum from pre-renal physiology to ischemic pathology.



The diseases of the tubules:

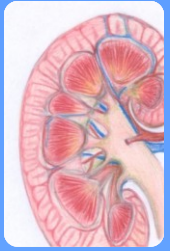
- 1. Acute tubular necrosis**
- 2. Tubulointerstitial disease**



Acute tubular necrosis (ATN)

- ***Clinicopathological entity***
- ***Destruction of tubular epithelial cell***
- ***Clin. acute suppression of renal function
(no urine or below 400 ml/24h)***
- ***Most common cause of renal failure***

Acute tubular necrosis (ATN)



Caused by:

- Vascular obstruction (PN, HT, HUS)
- Glomerular diseases (RPGN)
- Acute tubulointerstitial nephritis (drugs)
- Massive infection (pyelonephritis)
- DIC
- Urinary obstruction (stones, prostatic hypertrophy, tumors)



Tubular Toxins

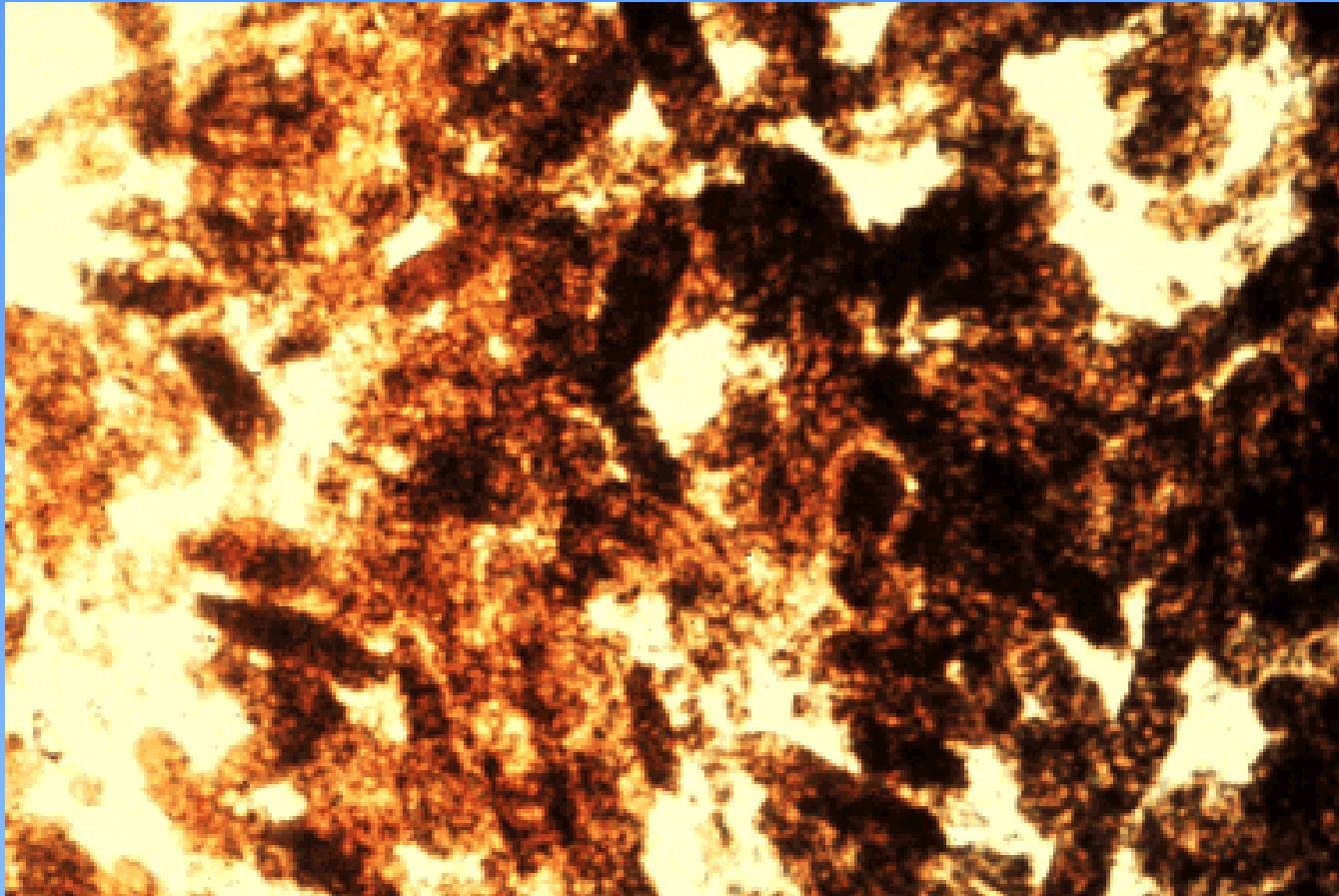
- Antimicrobials: aminoglycosides, vancomycin, foscarnet, pentamidine, amphotericin B
- Chemotherapeutics: cisplatin, mitomycin C, ifosfamide
- Immunotherapy: IVIG
- Complex Sugars: maltose, sucrose, mannitol
- Heavy metals
- Sepsis, hypoxia
- Radiocontrast agents

Diagnostic Approach to Acute Renal Failure

- History
- Record review
- Physical examination
 - Volume status assessment
- Bladder evaluation
- Urinalysis

JASN 9(4):710-718, 1998

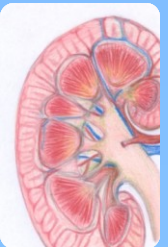


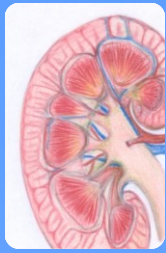


Sediment in ATN Urine sediment showing multiple, muddy brown granular casts. These findings are highly suggestive of acute tubular necrosis in a patient with acute renal failure. Courtesy of Harvard Medical School.

Diagnostic Approach to Acute Renal Failure

- Consider therapeutic trials
 - Volume challenge
 - Foley placement
 - Hemodynamic support
- Consider renal biopsy
- Consider empiric therapy





ACUTE RENAL FAILURE

Acute tubular necrosis (ATN)

ACUTE RENAL FAILURE



I. Acute tubular necrosis (ATN)

- A. Clinically, rapid deterioration in renal function usually, but not always associated with oliguria.
- B. Many different kidney diseases may present with acute renal failure although ATN is the most common cause by far.
- C. Conditions associated with ATN
 - 1. Shock**
 - 2. Sepsis**
 - 3. Incompatible blood transfusions**
 - 4. Burns**
 - 5. Crush injury**
 - 6. Drugs**

D. Classification of ATN



1. Ischemic

- **Pathogenesis involves patchy necrosis of tubular epithelial cells resulting from reduced blood flow. Tubular obstruction by sloughed epithelial cells may perpetuate the lesion.**
- **Renal biopsies are characterized by flattened tubular epithelium, regenerating cells, interstitial edema, and pigmented granular and hyaline casts.**

2. Toxic

- **Associated with heavy metal poisoning, ingestion of organic solvents (methanol, ethylene glycol), and certain antibiotics (aminoglycosides).**
- **Characteristically the lesion in the renal tubules is generalized in the proximal tubule.**

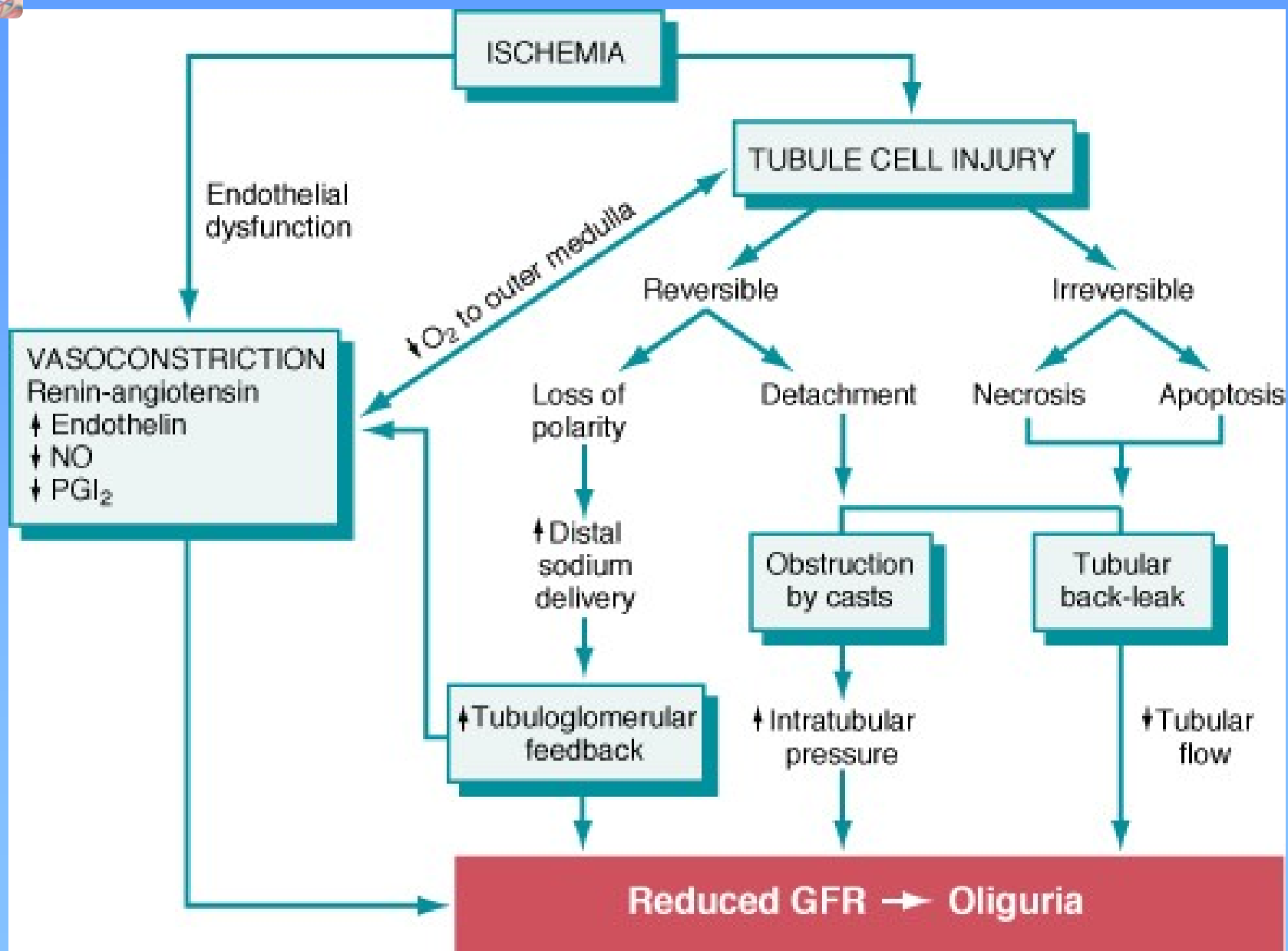
ACUTE RENAL FAILURE

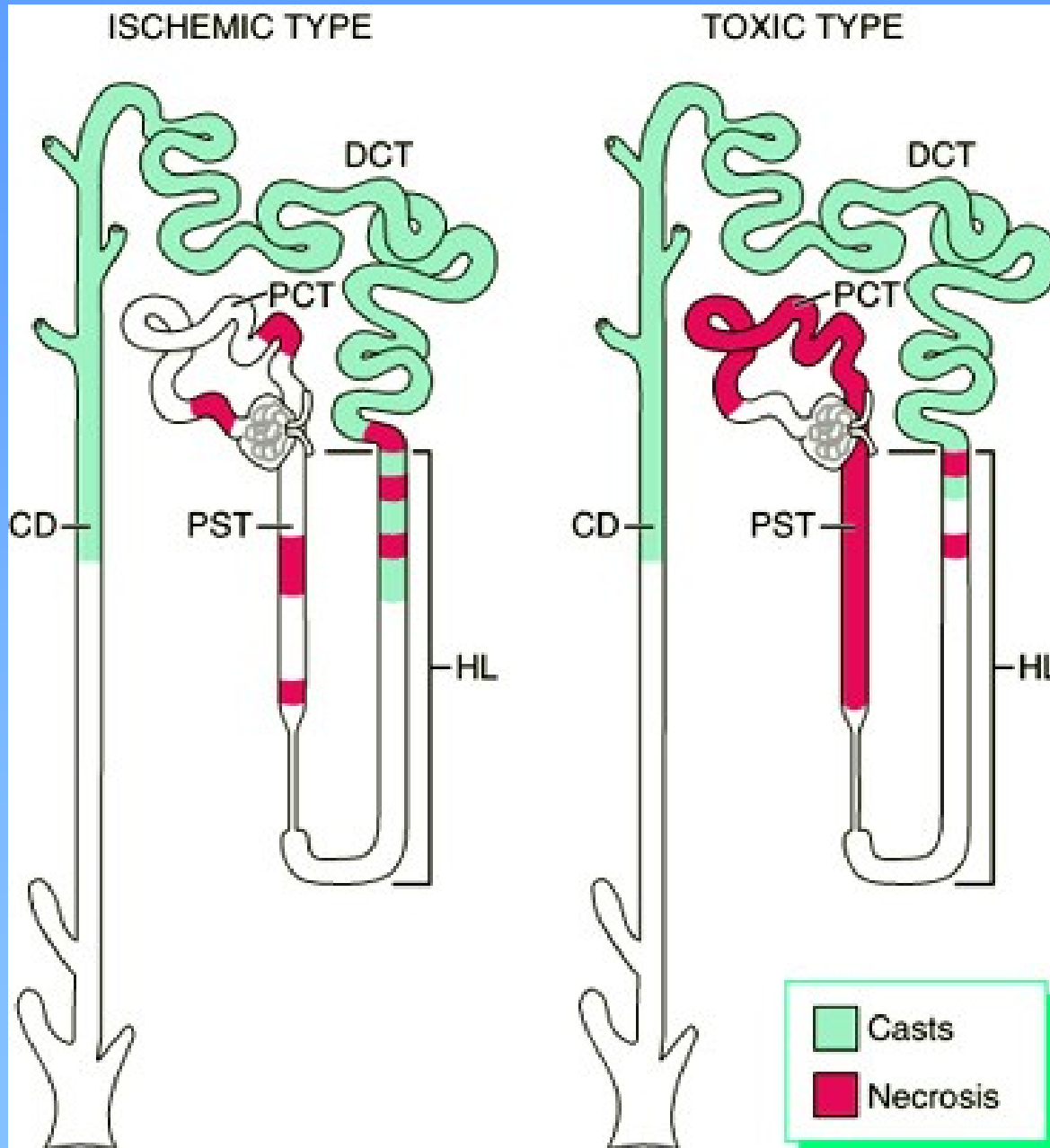
E. Course

1. Patients often require dialysis and careful management of fluids and electrolytes, particularly potassium.
2. During recovery, diuresis and electrolyte loss may be considerable.
3. Outcome is determined by the nature of the predisposing cause and the patient's general state of health.



Proposed pathogenesis of tubular damage

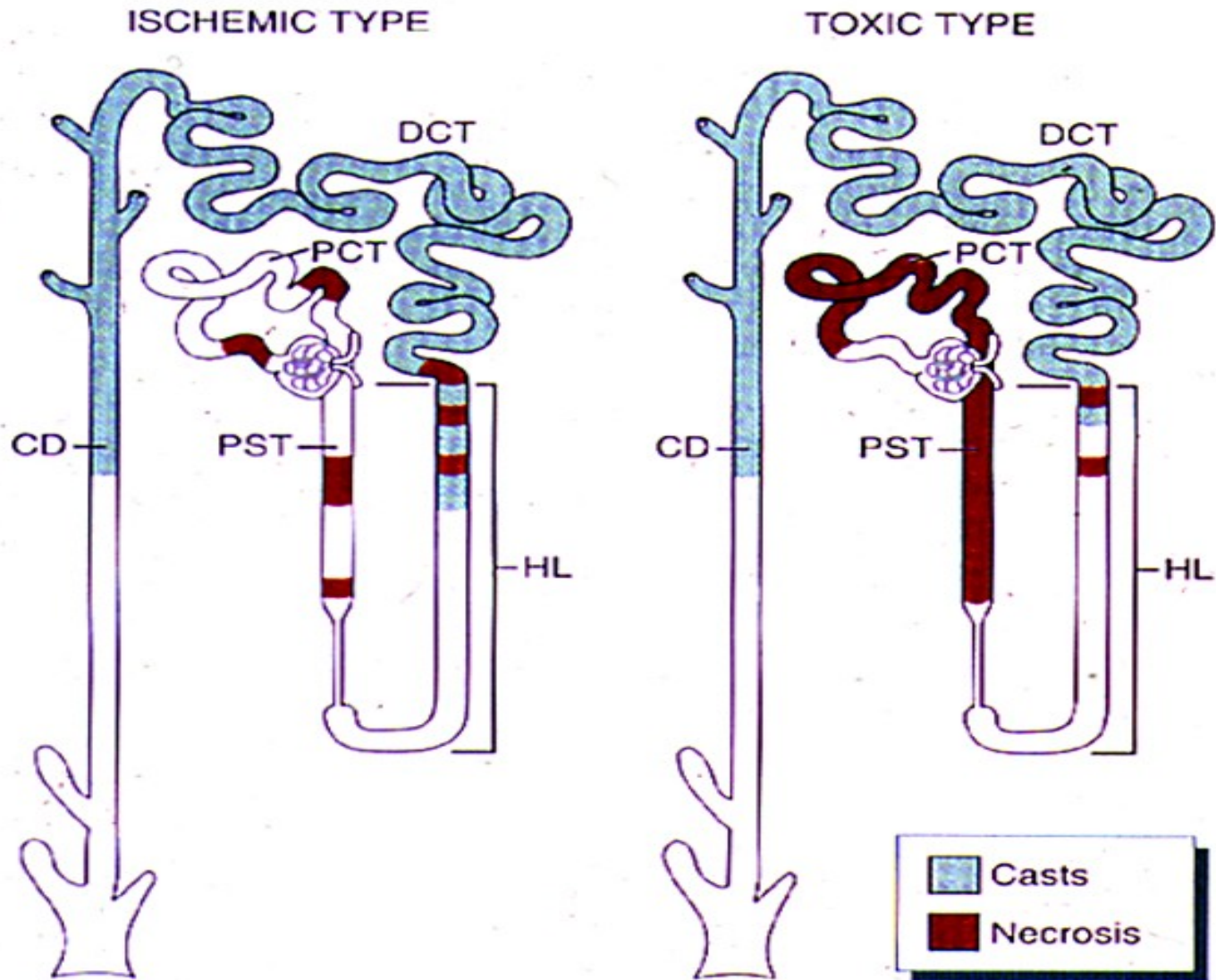




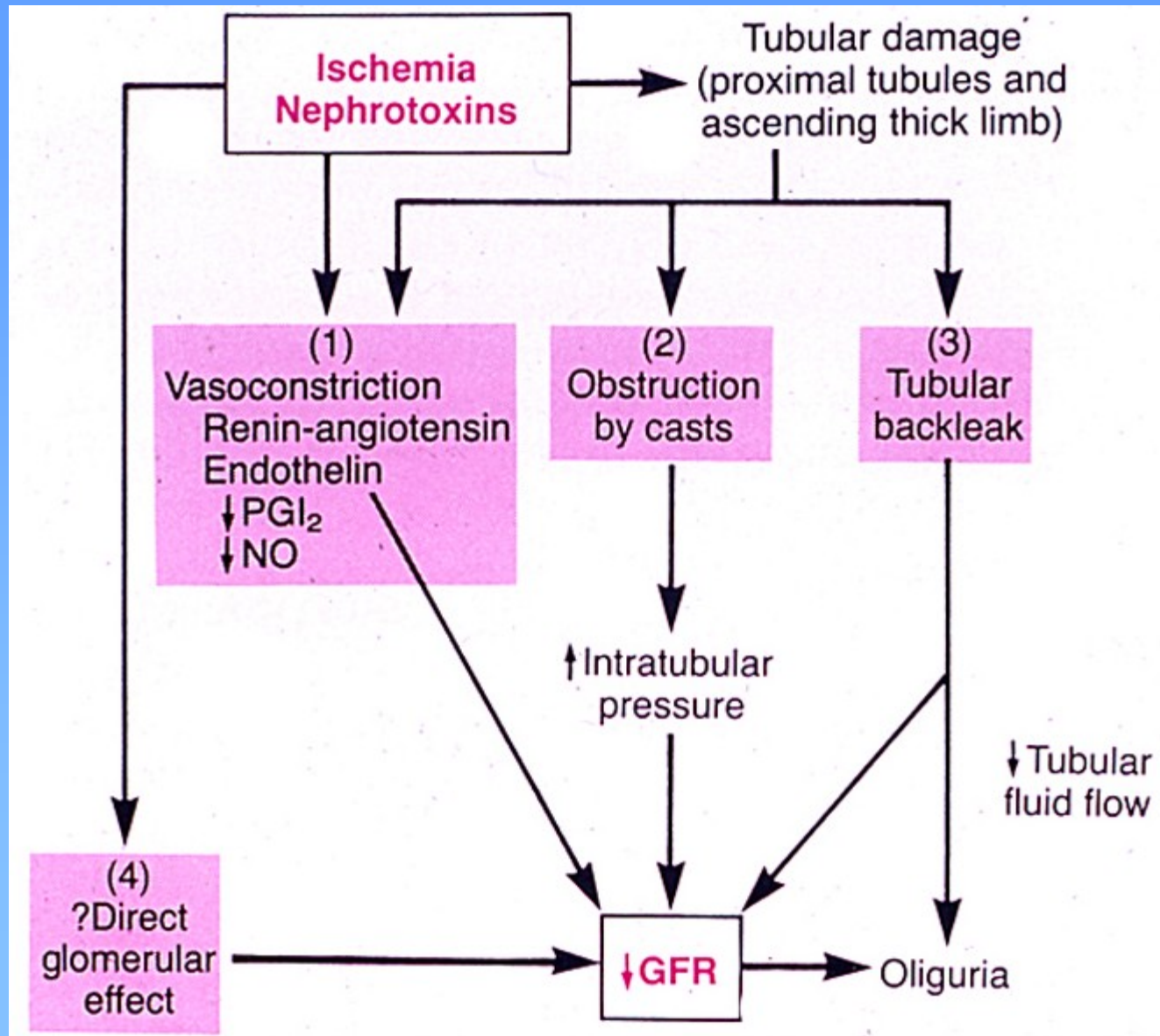
ATN :

**Acute
tubular
necrosis**

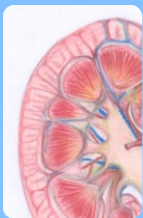
Acute tubular necrosis (ATN)

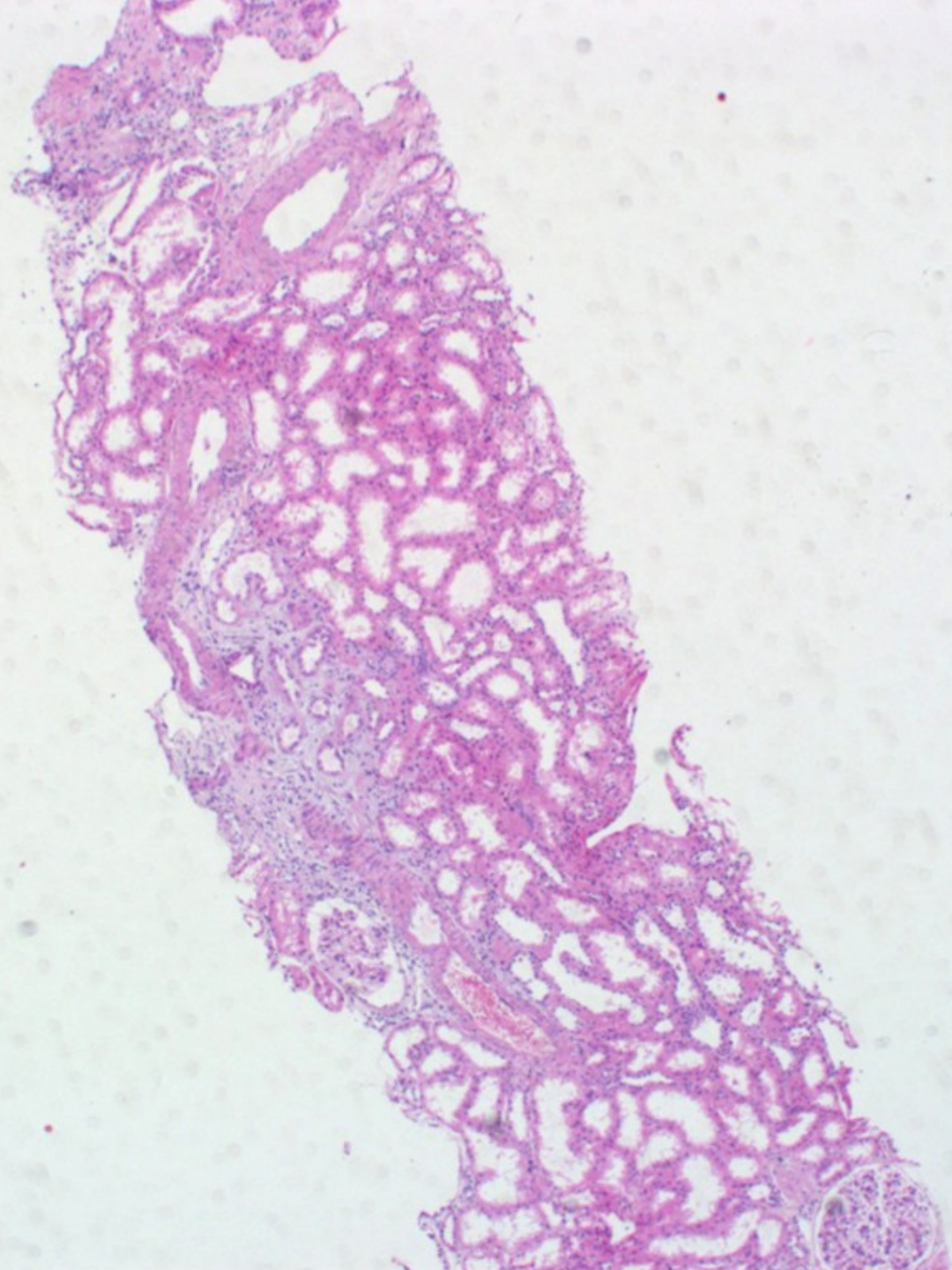


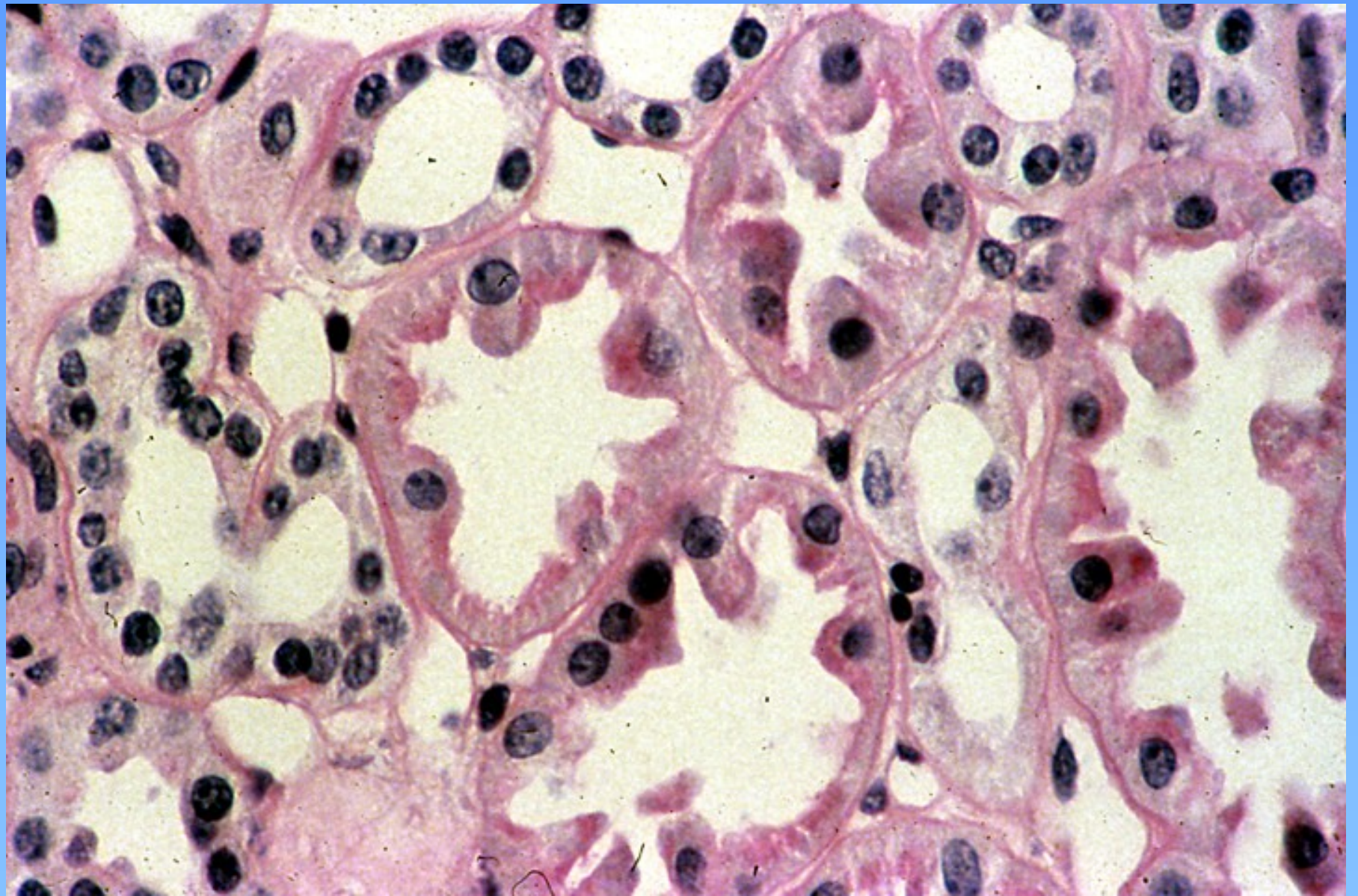
Acute tubular necrosis (ATN)

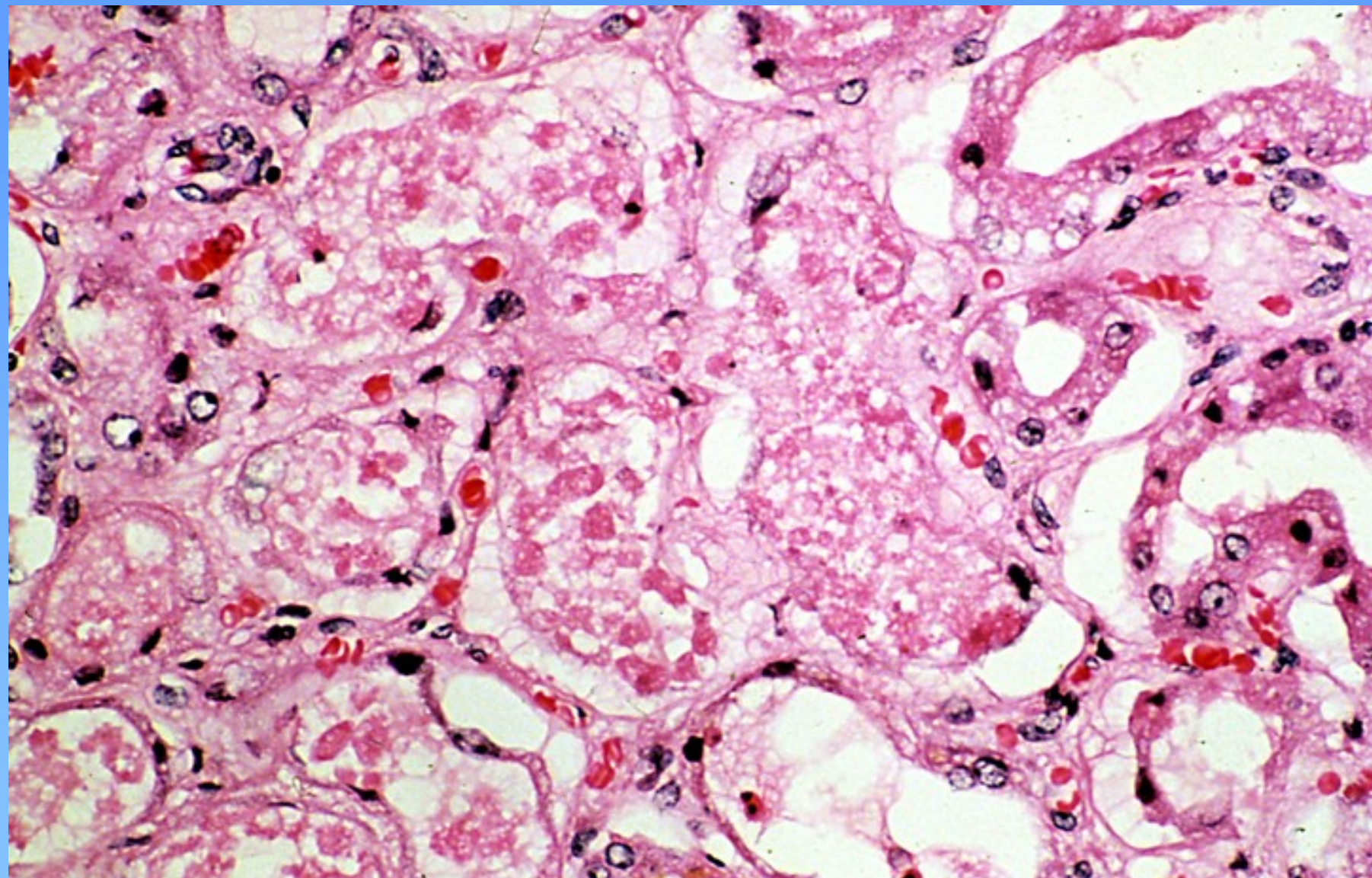


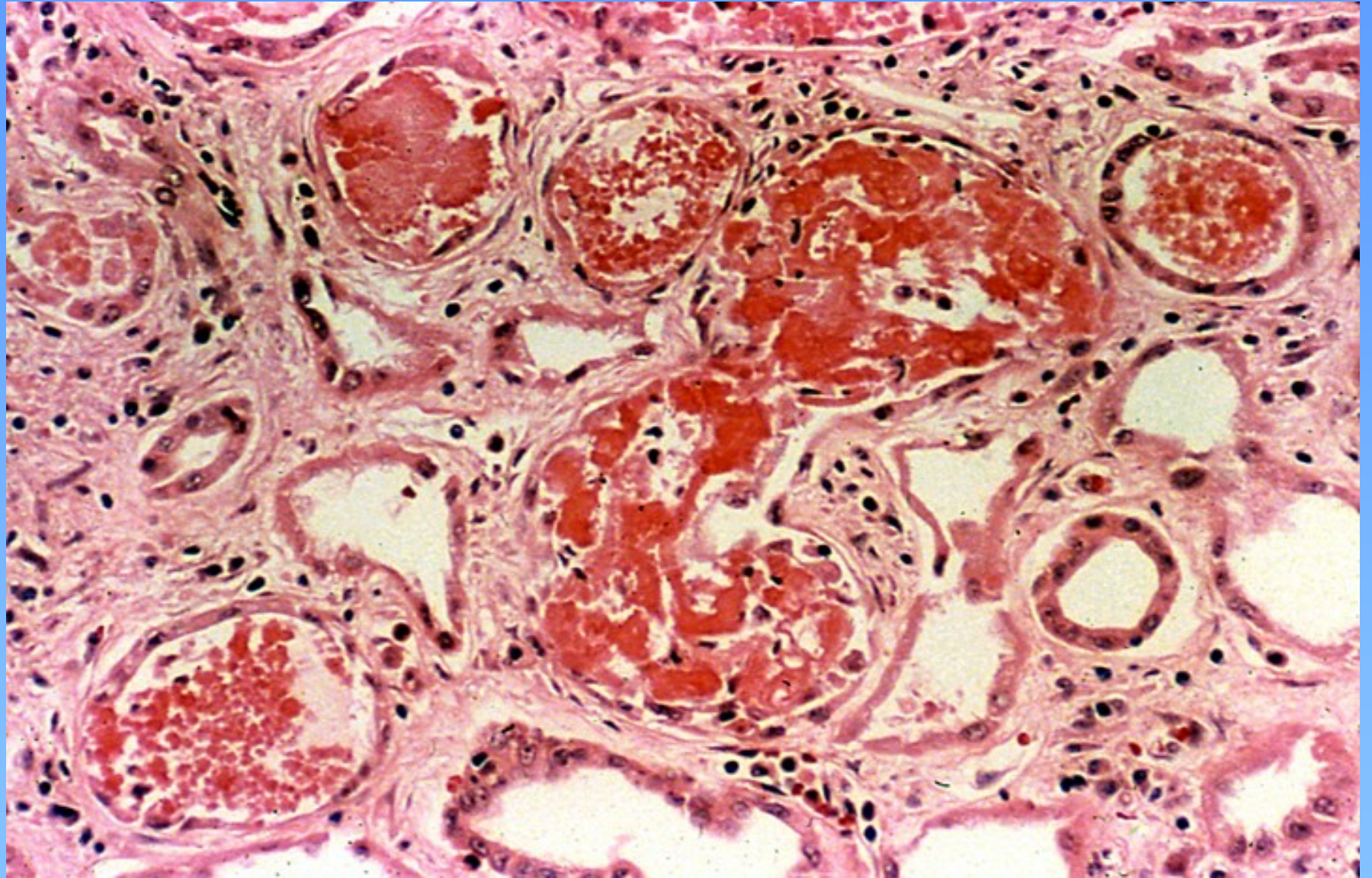
Acute tubular necrosis, a pale swollen kidney with congested medullary parenchyma. This is the typical shock kidney, the kidney of the individual who develops oliguria two or three days following an episode of shock.

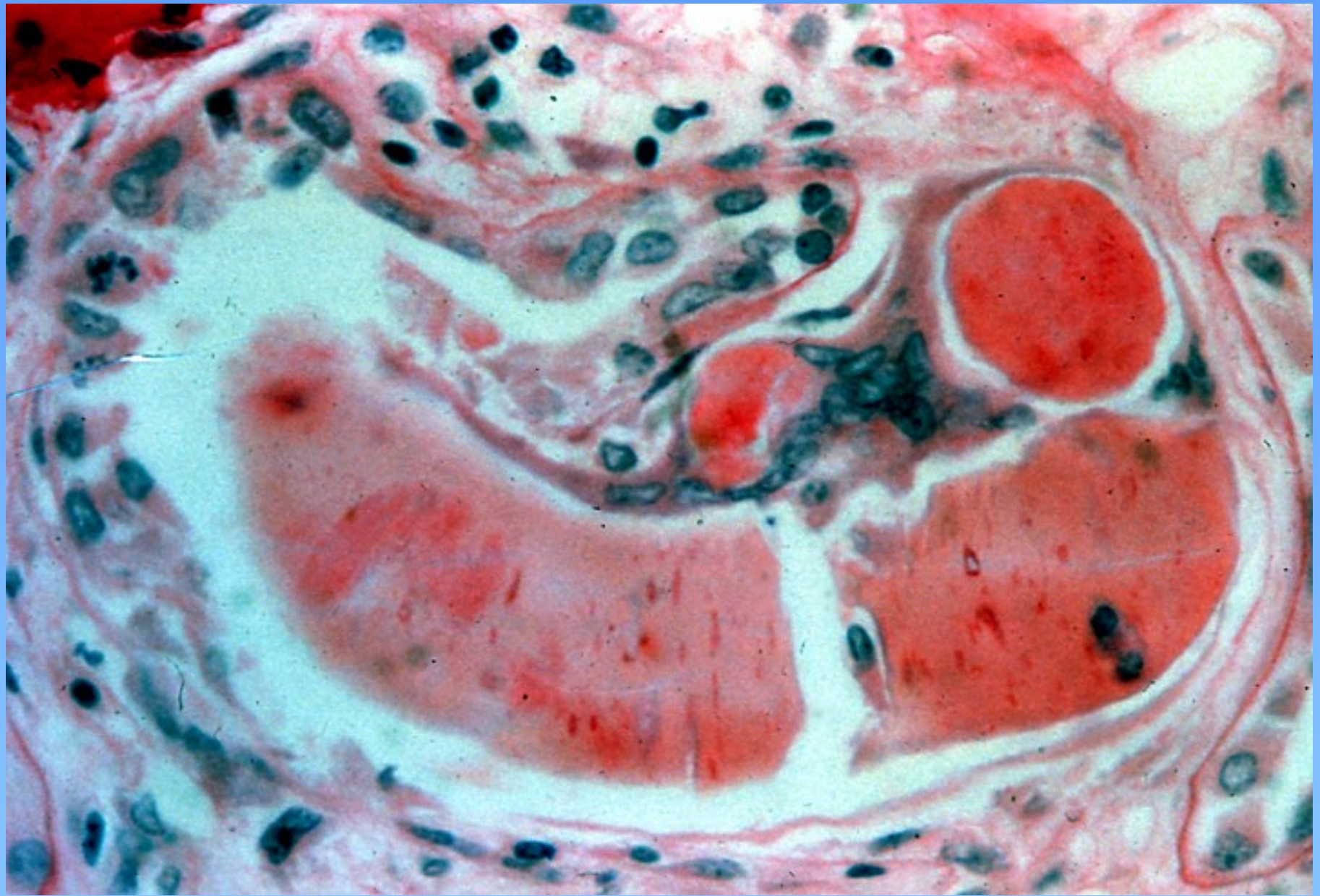


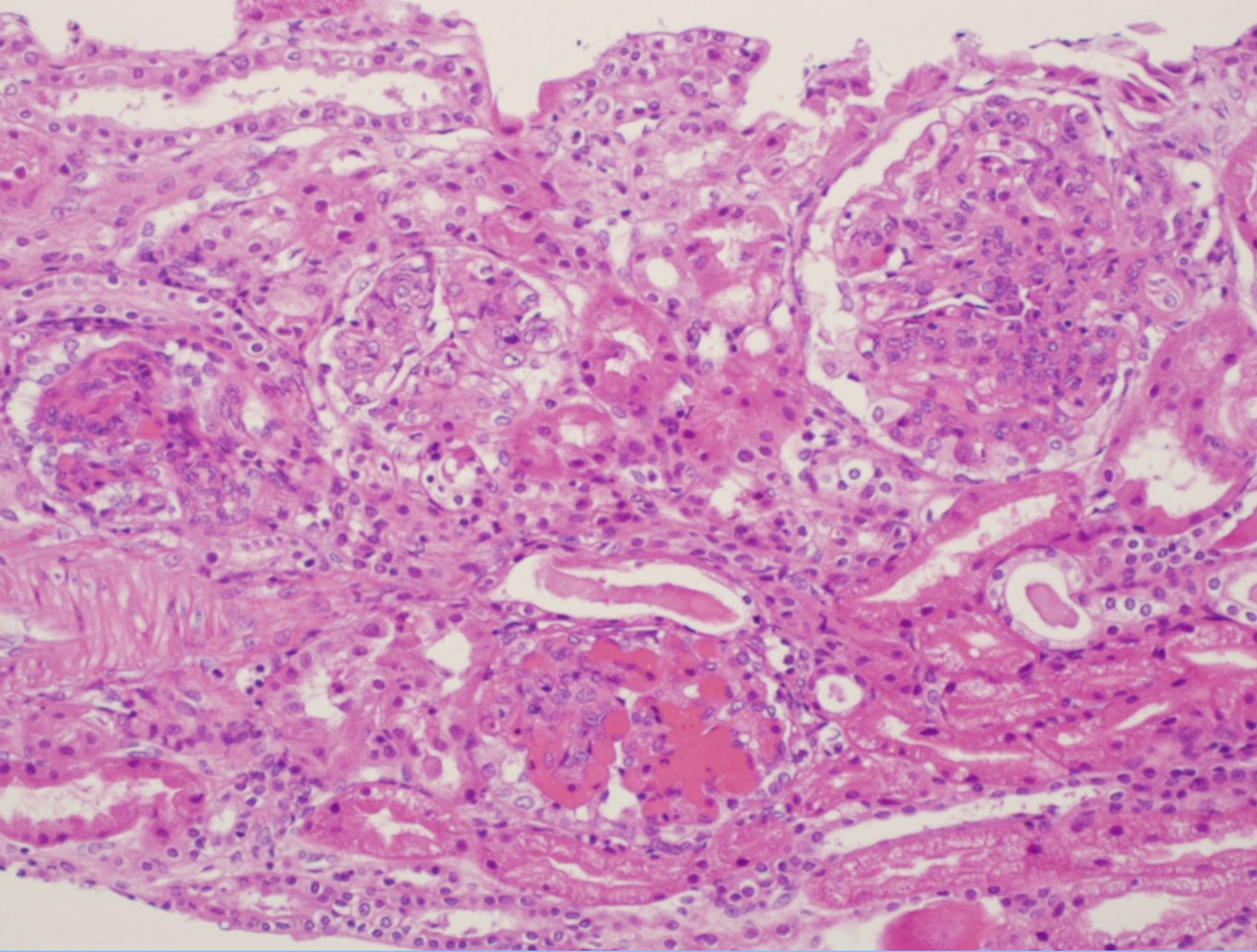


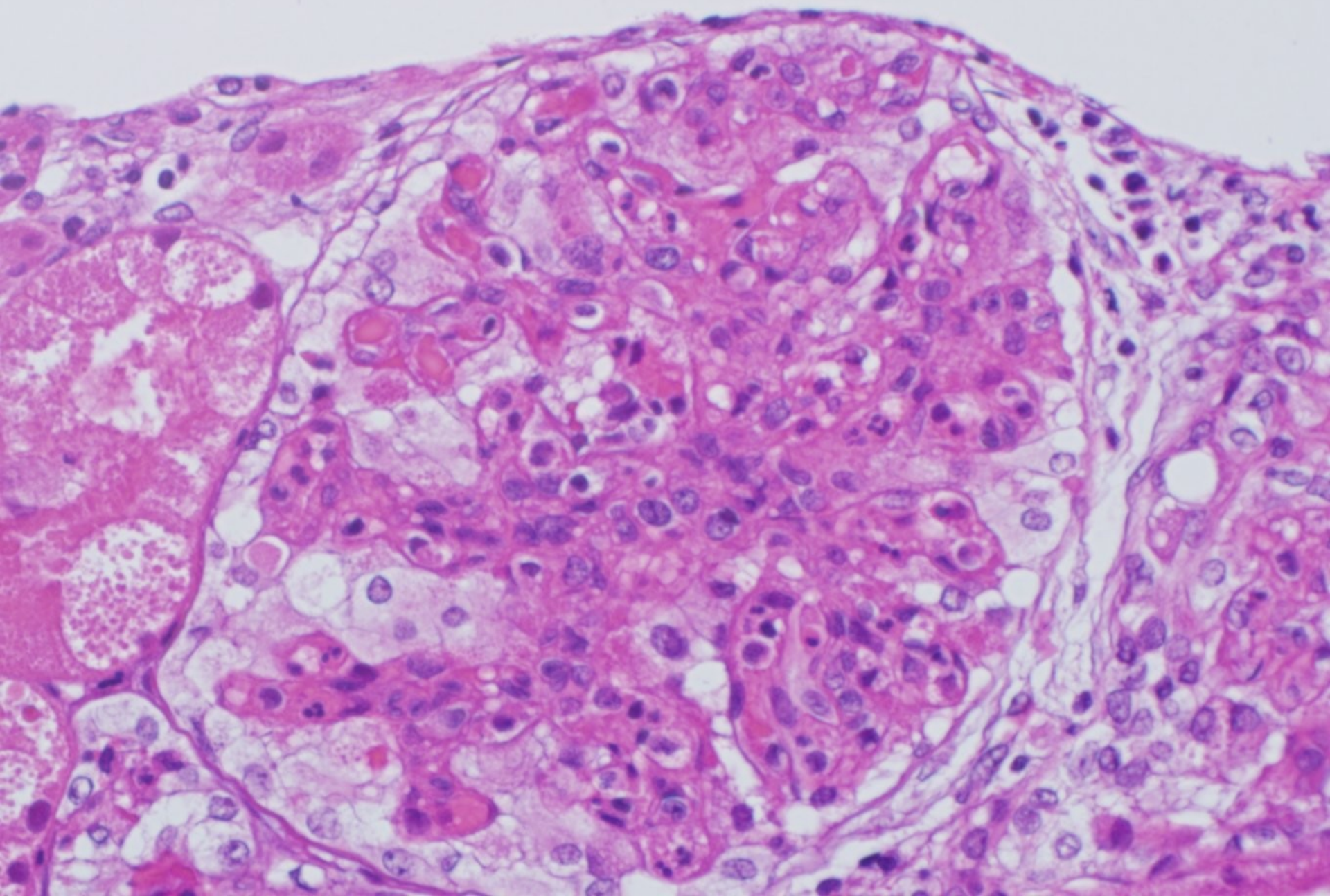


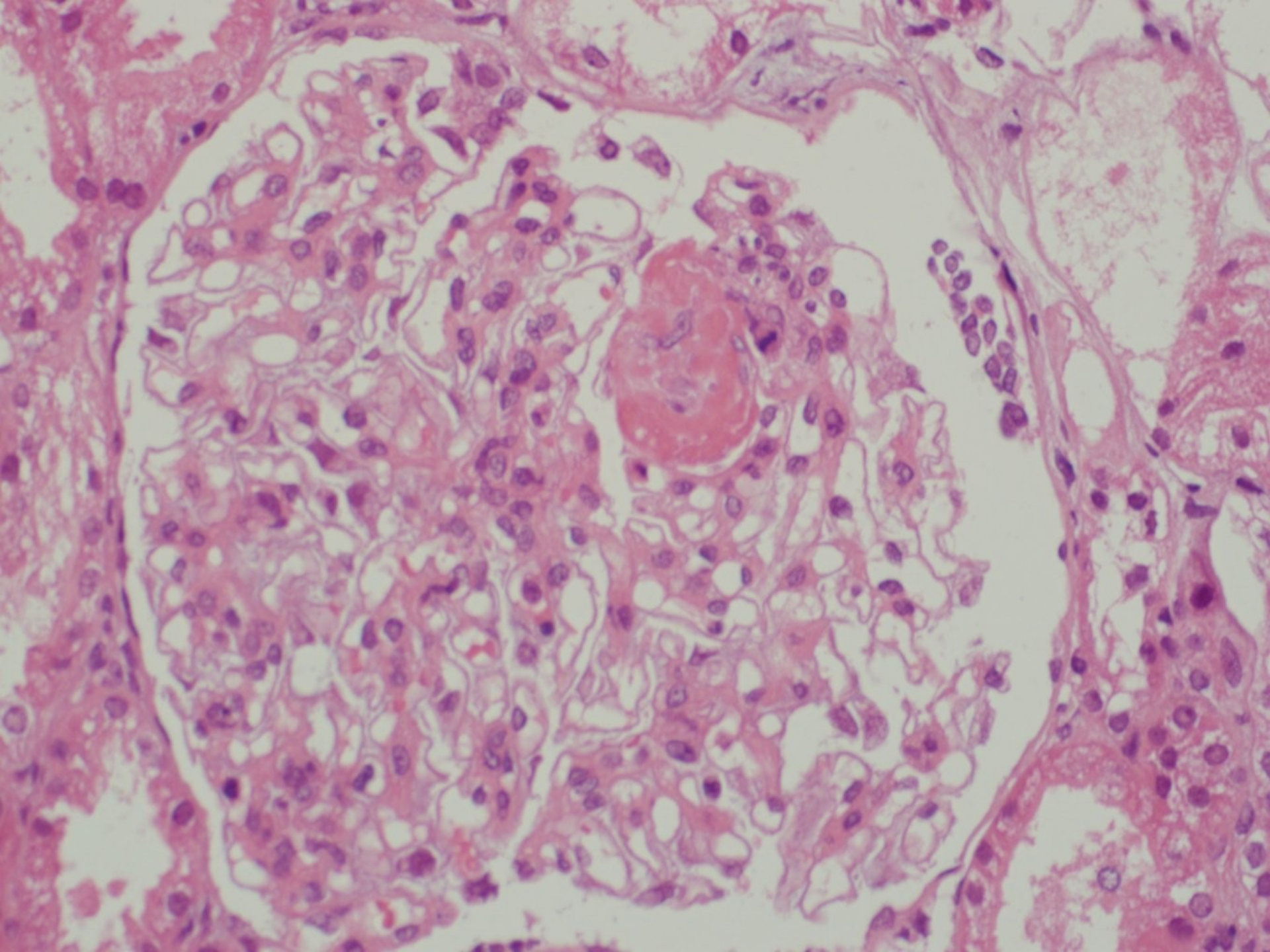


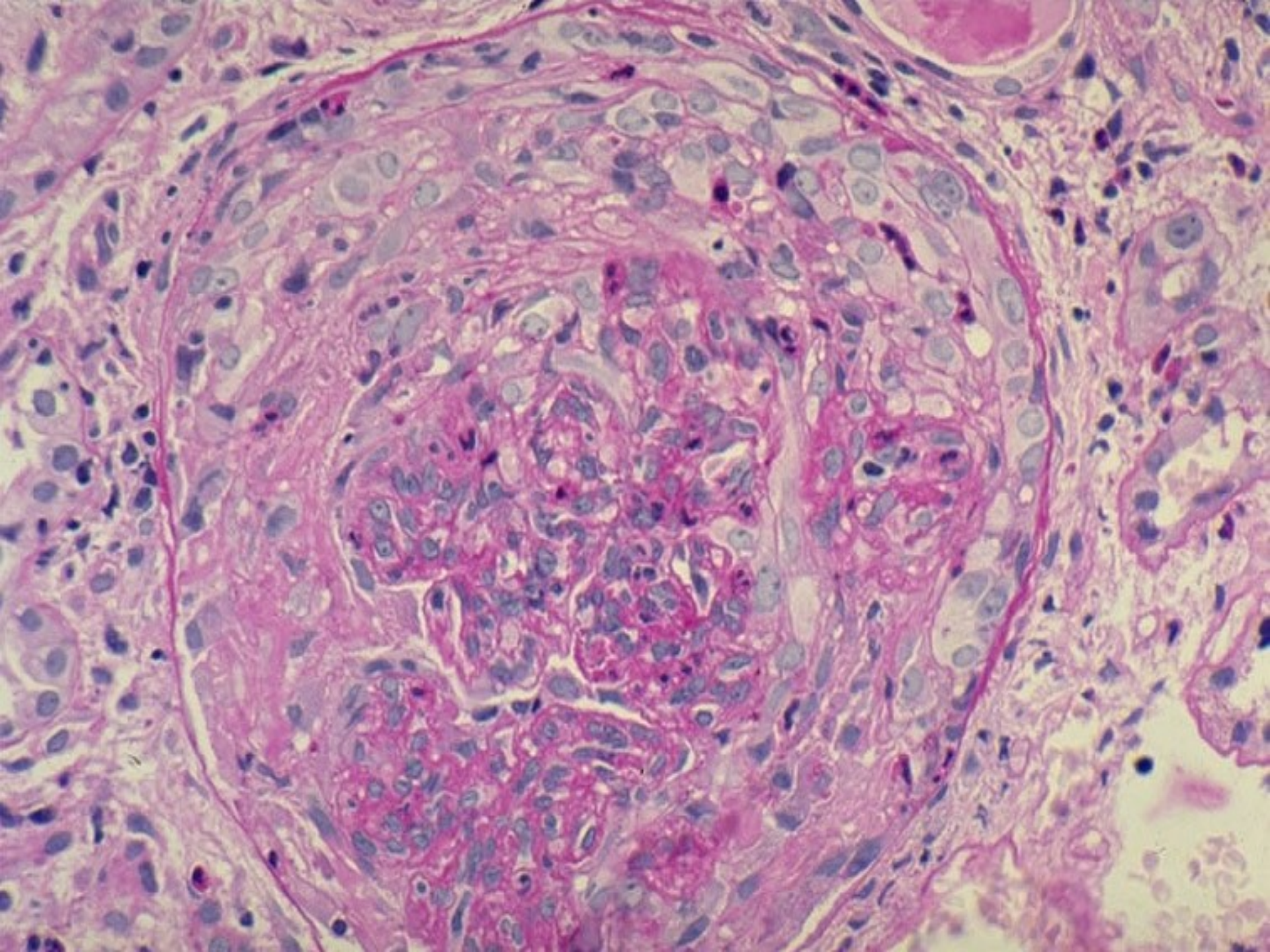


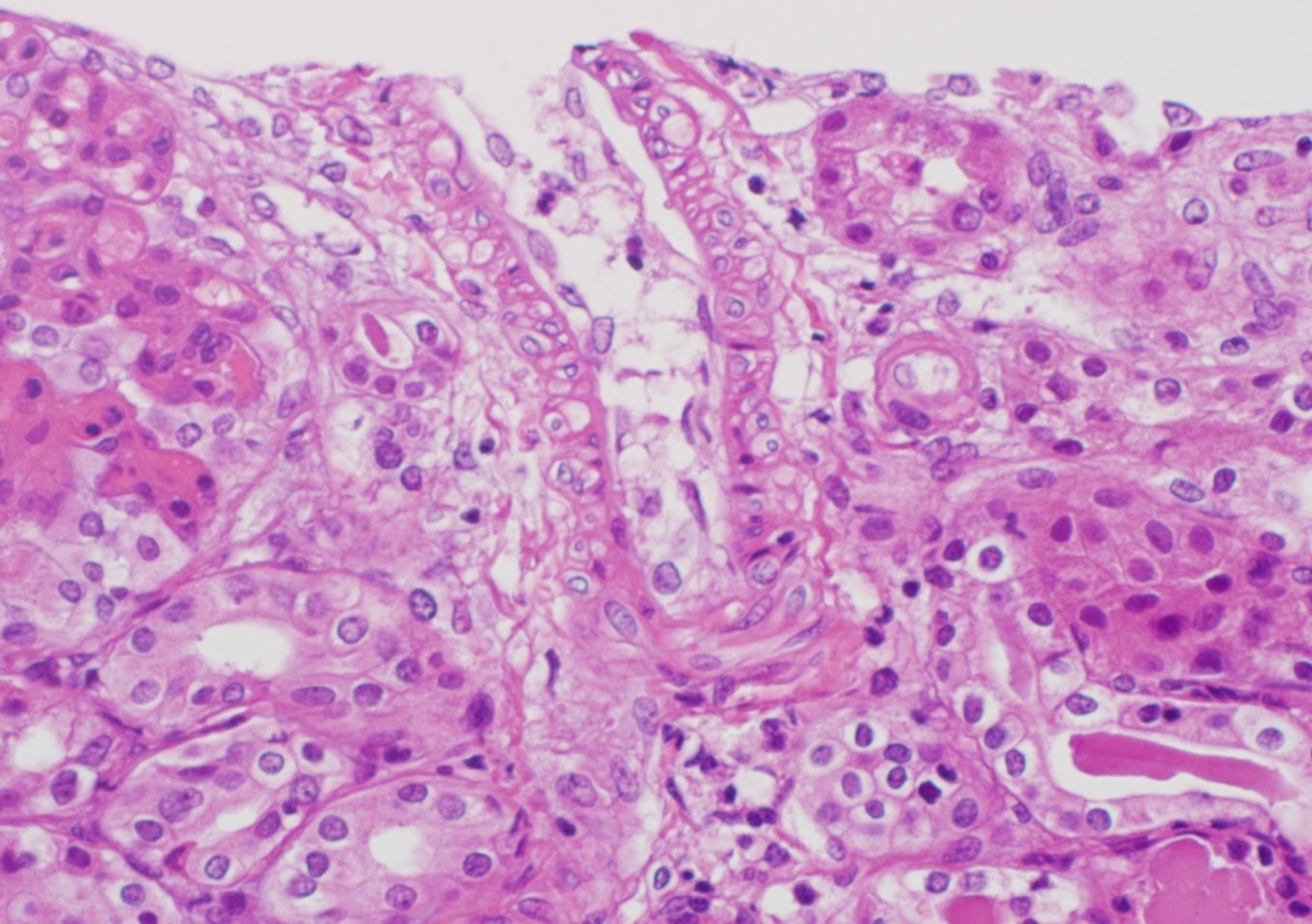


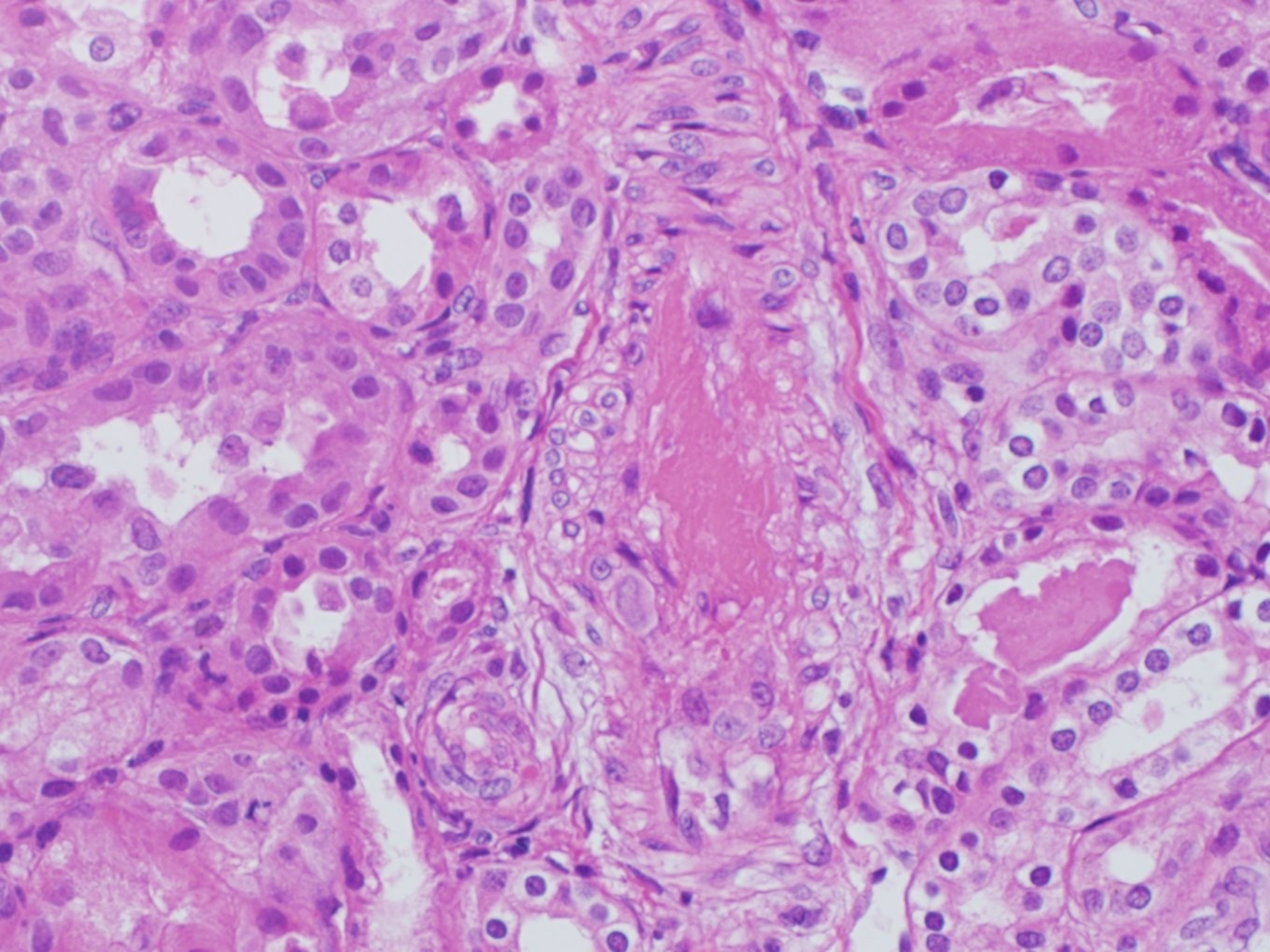


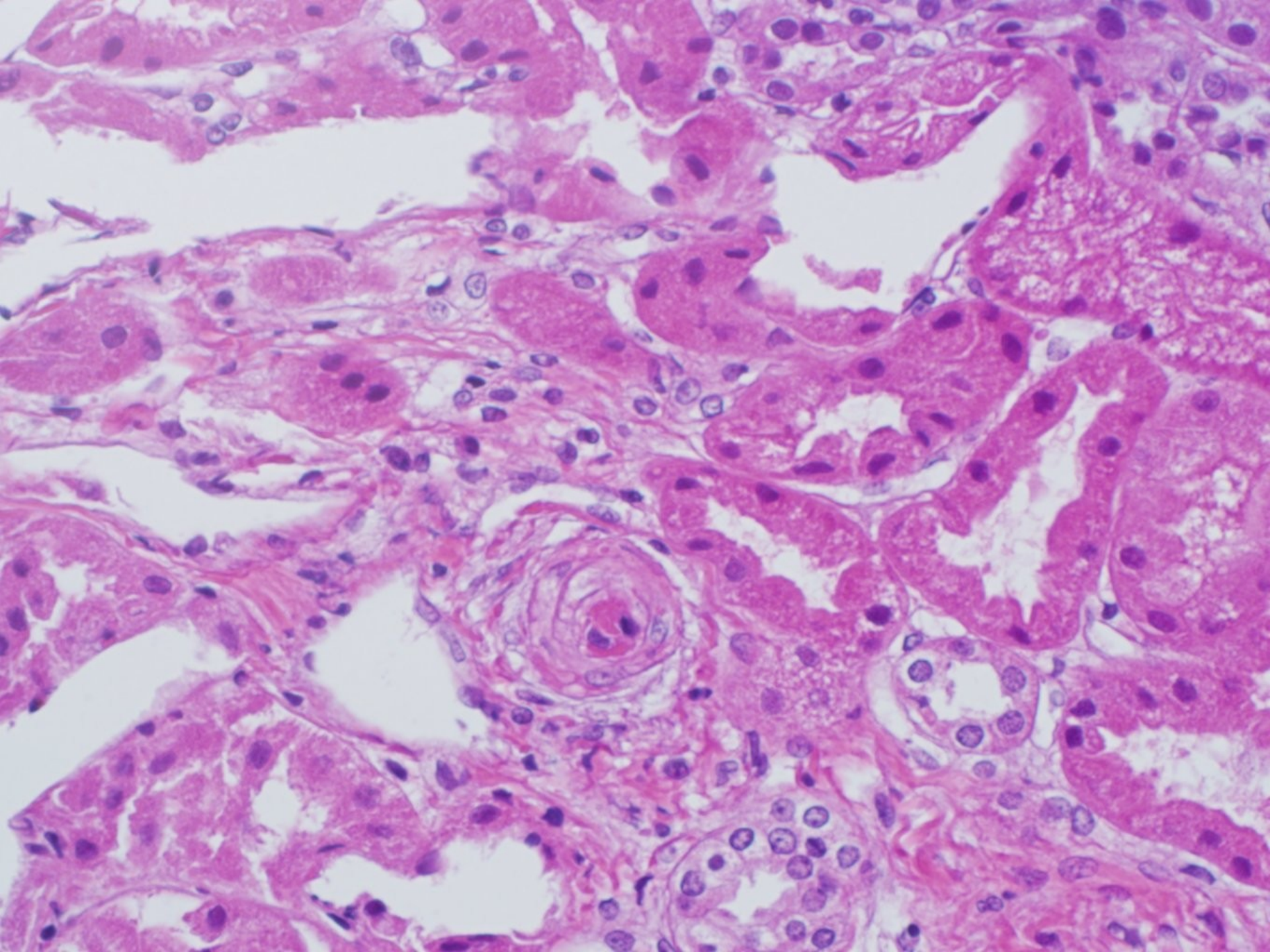


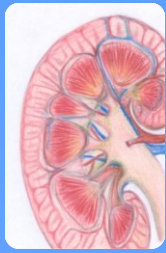












Acute Kidney Injury

- Conclusion :
- 1- Specify the cause of the acute kidney injury
- 2- Specify the effects of the kidney tubular injury