TABLE 334-1 MAJOR CAUSES, CLINICAL FEATURES, AND DIAGNOSTIC STUDIES FOR PRERENAL AND INTRINSIC ACUTE KIDNEY INJURY

Etiology	Clinical Features	Laboratory Features	Comments
Prerenal azotemia	History of poor fluid intake or fluid loss (hemorrhage, diarrhea, vomiting, sequestration into extravascular space); NSAID/ACE-I/ARB; heart failure; evidence of volume depletion (tachycardia, absolute or postural hypotension, low jugular venous pressure, dry mucous membranes), decreased effective circulatory volume (cirrhosis, heart failure)	BUN/creatinine ratio above 20, FeNa <1%, hyaline casts in urine sediment, urine specific gravity >1.018, urine osmolality >500 mOsm/kg	Low FeNa, high specific gravity and osmolality may not be seen in the setting of CKD, diuretic use; BUN elevation out of proportion to creatinine may alternatively indicate upper GI bleed or increased catabolism. Response to restoration of hemodynamics is most diagnostic.
Sepsis-associated AKI	Sepsis, sepsis syndrome, or septic shock. Overt hypotension not always seen in mild to moderate AKI	Positive culture from normally sterile body fluid; urine sediment often contains granular casts, renal tubular epithelial cell casts	FeNa may be low (<1%), particularly early in the course, but is usually >1% with osmolality <500 mOsm/kg
Ischemia-associated AKI	Systemic hypotension, often superimposed upon sepsis and/or reasons for limited renal reserve such as older age, CKD	Urine sediment often contains granular casts, renal tubular epithelial cell casts. FeNa typically >1%.	
Nephrotoxin-Associated AKI: Endogenous			
Rhabdomyolysis	Traumatic crush injuries, seizures, immobilization	Elevated myoglobin, creatine kinase; urine heme positive with few red blood cells	FeNa may be low (<1%)
Hemolysis	Recent blood transfusion with transfusion reaction	Anemia, elevated LDH, low haptoglobin	FeNa may be low (<1%); evaluation for transfusion reaction
Tumor lysis	Recent chemotherapy	Hyperphosphatemia, hypocalcemia, hyperuricemia	
Multiple myeloma	Age >60 years, constitutional symptoms, bone pain	Monoclonal spike in urine or serum electrophoresis; low anion gap; anemia	Bone marrow or renal biopsy can be diagnostic
Nephrotoxin-Associated AKI: Exogenous			
Contrast nephropathy	Exposure to iodinated contrast	Characteristic course is rise in SCr within 1–2 d, peak within 3–5 d, recovery within 7 d	FeNa may be low (<1%)
Tubular injury	Aminoglycoside antibiotics, cisplatin, tenofovir, zoledronate, ethylene glycol, aristolochic acid, and melamine (to name a few)	Urine sediment often contains granular casts, renal tubular epithelial cell casts. FeNa typically >1%.	Can be oliguric or nonoliguric
Interstitial nephritis	Recent medication exposure; can have fever, rash, arthralgias	Eosinophilia, sterile pyuria; often nonoliguric	Urine eosinophils have limited diagnostic accuracy; systemic signs of drug reaction often absent; kidney biopsy may be helpful
Other Causes of Intrinsic AKI			
Glomerulonephritis/vasculitis	Variable **(Chap. 338)** features include skin rash, arthralgias, sinusitis (AGBM disease), lung hemorrhage (AGBM, ANCA, lupus), recent skin infection or pharyngitis (poststreptococcal)	ANA, ANCA, AGBM antibody, hepatitis serologies, cryoglobulins, blood culture, decreased complement levels, ASO titer (abnormalities of these tests depending on etiology)	Kidney biopsy may be necessary
Interstitial nephritis	Nondrug-related causes include tubulointerstitial nephritis-uveitis (TINU) syndrome, *Legionella* infection	Eosinophilia, sterile pyuria; often nonoliguric	Urine eosinophils have limited diagnostic accuracy; kidney biopsy may be necessary
TTP/HUS	Neurologic abnormalities and/or AKI; recent diarrheal illness; use of calcineurin inhibitors; pregnancy or postpartum; spontaneous	Schistocytes on peripheral blood smear, elevated LDH, anemia, thrombocytopenia	"Typical HUS" refers to AKI with a diarrheal prodrome, often due to Shiga toxin released from *Escherichia coli* or other bacteria; "atypical HUS" is due to inherited or acquired complement dysregulation. "TTP-HUS" refers to sporadic cases in adults. Diagnosis may involve screening for ADAMTS13 activity, Shiga toxin–producing *E. coli*, genetic evaluation of complement regulatory proteins, and kidney biopsy.
Atheroembolic disease	Recent manipulation of the aorta or other large vessels; may occur spontaneously or after anticoagulation; retinal plaques, palpable purpura, livedo reticularis, GI bleed	Hypocomplementemia, eosinophiluria (variable), variable amounts of proteinuria	Skin or kidney biopsy can be diagnostic
Postrenal AKI	History of kidney stones, prostate disease, obstructed bladder catheter, retroperitoneal or pelvic neoplasm	No specific findings other than AKI; may have pyuria or hematuria	Imaging with computed tomography or ultrasound

Abbreviations: ACE-I, angiotensin-converting enzyme inhibitor-I; AGBM, antiglomerular basement membrane; AKI, acute kidney injury; ANA, antinuclear antibody; ANCA, antineutrophilic cytoplasmic antibody; ARB, angiotensin receptor blocker; ASO, antistreptolysin O; BUN, blood urea nitrogen; CKD, chronic kidney disease; FeNa, fractional excretion of sodium; GI, gastrointestinal; LDH, lactate dehydrogenase; NSAID, nonsteroidal anti-inflammatory drug; TTP/HUS, thrombotic thrombocytopenic purpura/hemolytic-uremic syndrome.