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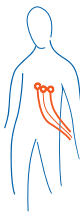

Acute Kidney Injury

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DEFINITION

Acute kidney injury (AKI) is a syndrome defined as an abrupt decrease in glomerular filtration rate (GFR) sufficient to promote the retention of nitrogenous waste products (blood urea nitrogen [BUN] and creatinine); disturb the regulation of extracellular fluid volume, electrolyte balance, and acid-base homeostasis; and impair drug excretion. Importantly, even mild abnormalities in kidney structure and function are associated with other end-organ complications and increased mortality.

AKI includes a spectrum of clinical conditions. The numerous causes of AKI vary based on individual comorbidities (and risk for AKI) and whether kidney injury develops in the outpatient setting or in hospital. The incidence of AKI is rising, and its complications include progression to more severe kidney failure, need for renal replacement therapy (RRT), chronic kidney disease (CKD), and death. Several consensus groups have produced definitions and diagnostic criteria for AKI. Table 31-1 describes the diagnostic criteria for the Risk, Injury, Failure, Loss, and End-stage renal disease (ESRD) (RIFLE); Acute Kidney Injury Network (AKIN); and Kidney Disease: Improving Global Outcomes (KDIGO) classifications.

In 2004, the RIFLE classification was put forth to standardize the definition of AKI. Changes in serum creatinine concentration (over 7 days), reductions in estimated glomerular filtration rate (eGFR), and urine output parameters were used in this diagnostic system. The Risk (R), Injury (I), and Failure (F) categories were applicable to AKI, whereas the Loss (L) and ESRD (E) categories were CKD stages. In 2007, the AKIN group modified the RIFLE criteria definition of AKI by adding an absolute increase in serum creatinine of only 0.3 mg/dL, eliminating the eGFR criteria, and changing the time frame for AKI to develop (to 48 hours, compared with the 7 days for RIFLE diagnosis). Focusing on AKI, the AKIN criteria replaced the R, I, and F categories from the RIFLE criteria with stages 1, 2, and 3 and eliminated the L and E categories. In 2012, the KDIGO group combined parts of the RIFLE and AKIN criteria to capture AKI with increased sensitivity.

Understanding of the pathophysiology underlying development of AKI has advanced, and better diagnostic tools have moved the field forward. However, specific directed therapies remain limited for the most common forms of AKI. Although technical advances in RRT and supportive care have improved, patients commonly develop other end-organ disease in the setting of AKI. More concerning is the relatively high mortality rate associated with AKI, particularly when it develops in the hospital setting and requires RRT. E-Table 31-1 shows some of the clinically important outcomes associated with AKI.

ETIOLOGY

In most cases, more than one process contributes to AKI, but for ease of classification, three broad categories (Fig. 31-1) are used: (1) *prerenal AKI*, the result of a decrease in renal blood flow and perfusion of the kidney; (2) *intrinsic AKI*, the result of disease affecting one of the renal parenchymal compartments; and (3) *postrenal AKI*, the result of obstruction to urinary flow anywhere along the urinary tract starting from the renal calyces/pelves and involving the ureters, bladder, or urethra.

The most common form of AKI is due to prerenal physiology, particularly in the outpatient setting, but also in the hospital. Postrenal AKI is more common in elderly men with prostatic

TABLE 31-1 CLASSIFICATION OF ACUTE KIDNEY INJURY

STAGE	SERUM CREATININE INCREASE WITHIN 7 DAYS	URINE OUTPUT
KIDNEY DISEASE: IMPROVING GLOBAL OUTCOMES (KDIGO) CLASSIFICATION (2012)		
1	1.5-1.9 times baseline *or* ≥0.3 mg/dL within 48 hr	<0.5 mL/kg/hr × 6-12 hr
2	2-2.9 times baseline	<0.5 mL/kg/hr × ≥12 hr
3	3 times baseline *or* an increase in the serum creatinine to ≥4 mg/dL with an absolute increase ≥0.3 mg/dL within 48 hr or 1.5 times baseline within 7 days *or* initiation of RRT *or* in patients aged <18 yr, eGFR decreased to <35 mL/min/1.73 m^2	<0.3 mL/kg/hr × ≥24 hr
ACUTE KIDNEY INJURY NETWORK (AKIN) CLASSIFICATION (2007)		
1	1.5-1.9 times baseline *or* ≥0.3 mg/dL within 48 hr	<0.5 mL/kg/hr × 6-12 hr
2	2-2.9 times baseline	<0.5 mL/kg/hr × ≥12 hr
3	3 times baseline *or* increase in serum creatinine ≥4 mg/dL with an increase ≥0.5 mg/dL *or* initiation of RRT	<0.3 mL/kg/hr × ≥24 hr *or* anuria ≥12 hr
RIFLE CLASSIFICATION (2004)		
Risk	1.5-1.9 times baseline *or* GFR decrease >25%	<0.5 mL/kg/hr × 6 hr
Injury	2-2.9 times baseline *or* GFR decrease >50%	<0.5 mL/kg/hr × 12 hr
Failure	3 times baseline *or* GFR decrease >75% *or* serum creatinine ≥4 mg/dL with an increase ≥0.5 mg/dL	<0.3 mL/kg/hr × 24 hr *or* anuria × 12 hr
Loss	Complete loss of renal function for >4 wk	
ESRD	End-stage renal disease >3 mo	

eGFR, Estimated glomerular filtration rate; GFR, glomerular filtration rate; RRT, renal replacement therapy.