

The 4-1-1 On Acute Renal Failure

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Acute renal failure (ARF) is more frequent in hospital patients, with a higher prevalence in intensive-care units. The mortality rate of ARF, which depends mainly on non-renal complications and concomitant illnesses, has remained around 50% over the last several decades.¹ Characterized by a rapid fall in glomerular filtration rate, ARF may or may not be accompanied by oliguria or a urine output of < 20 mL/hour. The reduced urinary excretion of nitrogenous waste products increases plasma urea and creatinine concentrations.

What causes ARF?

Although frequently multifactorial in origin, the causes of ARF are classified into three major categories (Table 1).

Prerenal factors

Prerenal factors are the most frequent causes of ARF and include hemodynamic instability with arterial hypotension, contraction of the extracellular fluid volume, and low cardiac output. Given that a hydrostatic pressure of 50 mmHg is required for glomerular filtration, it is easy to understand that any significant fall in arterial pressure, especially in elderly patients, can induce prerenal ARF.

Renal

Nephrotoxic drugs, radiographic contrast agents, and malignancy-induced hypercalcemia are most often responsible for ischemic or nephrotoxic acute tubular necrosis (ATN). Table 2 lists the nephrotoxic drugs most frequently involved.

Table 1

Categories of acute renal failure

1. Prerenal:

Hypovolemia
Hypotension
Congestive heart failure

2. Renal:

Acute tubular necrosis

- Drugs
- Radiocontrast agents
- Hypercalcemia (with cancer)
- Hemoglobinuria, myoglobinuria

Acute nephropathy

3. Post-renal:

Urinary tract obstruction



Table 2

Drug-induced acute renal failure

- Angiotensin-converting enzyme inhibitors
- Angiotensin II receptor antagonists
- Non-steroidal anti-inflammatory drugs
- Aminoglycosides (gentamycin)

Table 3

Prevention of acute renal failure

- Adequate hydration
- Saline administration and acetylcysteine (if radiocontrast agents)
- Avoid nephrotoxic drugs if important chronic renal failure

Caused by either hemoglobinuria (due to hemolysis) or myoglobinuria (due to rhabdomyolysis), a reddish-brown urine in the absence of red blood cells is indicative of pigment-induced ATN. When ARF results from an acute glomerulonephritis, vasculitis, or interstitial nephritis, a renal biopsy may be necessary.

Post-renal

Urinary tract obstruction, which represents between 5% and 10% of all ARF cases, must always be ruled out by ultrasonography, as it is most often reversible.

Some urinary indices may be used to discriminate between prerenal ARF and ischemic ATN. While the ratio of urinary to plasma creatinine is high in patients with prerenal ARF, the ratio is low with ATN. In the absence of diuretics, urinary sodium is low and urine-specific gravity is high in prerenal ARF, whereas in ATN urinary sodium is higher and the specific gravity is 1.010.

How can ARF be prevented?

The maintenance of an effective intravascular volume, through adequate hydration and other measures, is the most important prevention technique (Table 3). Since volume depletion is an important risk factor for nephrotoxicity, should radiocontrast agents need to be administered, or if hemoglobinuria or myoglobinuria are present, the intravenous administration of saline may protect the renal function.² In patients undergoing radiocontrast procedures, the oral administration of the antioxidant acetylcysteine, 600 mg twice daily, may also help in preventing renal failure.³ Potentially nephrotoxic drugs should be avoided in high-risk patients with pre-existing chronic renal insufficiency when their renal function is < 20% to 25% of normal value.

What are the complications?

Table 4 lists the major complications of ARF. The most life-threatening complication is hyperkalemia, especially with rhabdomyolysis and oligoanuria.

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How is ARF managed?

The continuous intravenous infusion of high-dose loop diuretics, such as 1 g of furosemide every 24 hours, or 40 mg per hour, is commonly used in an attempt to maintain urine flow and allow a more liberal fluid intake. A daily dose of 50 mg to 100 mg of hydrochlorothiazide may also be added. However, in oliguric patients, the intake of fluid, sodium, and potassium should be restricted to avoid volume expansion and hyperkalemia (Table 5). In several hypercatabolic patients, total parenteral nutrition may be required to provide an adequate protein and caloric intake and to avoid protein catabolism or malnutrition.⁴

Should a major complication occur, especially in oliguric patients, intermittent hemodialysis must be performed for three to four hours on a daily, or every other day, basis.^{5,6} When the critically ill patient is hemodynamically unstable (sepsis or multiple organ dysfunction), continuous renal replacement therapy is the preferred management because slower fluid removal is accompanied by a better hemodynamic tolerance. When the risk of hemorrhagic complication is too high, regional anticoagulation can be achieved by using citrate, a chelator of the ionized calcium.

What's the prognosis?

If patients survive the concomitant illnesses and further complications of ARF, they often completely recover their renal function. Non-oliguric ARF is less severe and has a better prognosis than oliguric ARF. However, when ARF is superimposed on a severe chronic renal failure, recovery may not be observed and end-stage renal disease will require dialysis on a chronic basis. CME

References

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Table 4

Major complications of acute renal failure

- Hyperkalemia
- Volume expansion
- Nitrogen retention
- Sepsis, bleeding, respiratory failure

Table 5

Management of acute renal failure

- Fluid and dietary restriction if oliguria
- Total parenteral nutrition, if necessary
- Hemodialysis
- CRRT (with heparin or citrate) if hemodynamic instability

CRRT: Continuous renal replacement therapy

Take-home message



- Acute renal failure (ARF) is more frequent in hospitalized patients and has a mortality rate around 50%.
- Adequate hydration remains the best way to prevent ARF.
- Hyperkalemia remains the most dangerous complication of ARF.