

Renal Failure, Acute

Risk

- Incidence in USA: 1% of all hospital admissions (community-acquired); 5% of all general hospital pts (hospital-acquired); 10–30% of all ICU pts.
- Acute tubular necrosis (45%) is most common cause in hospitalized pts.
- Population with highest prevalence: Elderly (>65 y).
- Two most common definitions:
 - RIFLE criteria: Risk, injury, failure, loss, ESRD.
 - AKIN criteria: Stage 1, stage 2, stage 3.

Perioperative Risks

- Overall mortality of periop ARF: 60–90%
- Hyperkalemia (and arrhythmias), metabolic acidosis, acute pulm edema
- Aspiration
- Bleeding (plt dysfunction)

Worry About

- Metabolic acidosis and hyperkalemia (pH decrease of 0.1 causes K⁺ increase of 0.5 mEq/L).
- Ventricular arrhythmias (may occur without warning).

- Encephalopathy (aspiration risk, increased sensitivity to all sedatives and anesthetics).
- GI symptoms and aspiration (N/V, bleeding, and encephalopathy).
- Coagulopathy (plt dysfunction) and surgical bleeding.
- Hemodynamic intolerance of hemodialysis; peritoneal dialysis compromises FRC.

Overview

- Elective surgery is contraindicated with new-onset ARF; procedures are urgent or emergency.
- Consider hemodialysis for severe hyperkalemia prior to nonemergent surgery.
- RA Regional anesthesia is relatively contraindicated (plt dysfunction, encephalopathy).
- Repetitive hemodynamic insults markedly impair renal recovery.
- Dialysis partially controls thrombocytopeny and enteropathy but does not decrease risk of sepsis and poor wound healing.
- Dopamine is not renally protective at low doses, and data are mixed about fenoldopam as a protective agent.

Etiology

- Prerenal disease: Hypovolemic states (acute hemorrhage, diarrhea, unreplenished insensible losses, heart failure, cirrhosis, distributive shock).
- Renal vascular disease: Microangiopathic hemolytic anemia, atheroemboli, compartment syndrome.
- Tubular and interstitial disease: ATN, acute interstitial nephritis, rhabdomyolysis, radiocontrast nephropathy, medications.
- Glomerular disease: Acute glomerulonephritis, vasculitis.
- Obstructive nephropathy.

Usual Treatment

- Treat underlying cause (e.g., shock, rhabdomyolysis).
- Medical therapy:
 - Fluid and electrolyte restriction, loop diuretics.
 - Hyperkalemia: Beta-adrenergic agonists, hyperventilation, bicarbonate, Ca²⁺, insulin-glucose, sodium-polystyrene sulfonate (kayexalate).
 - Kayexalate is relatively contraindicated in critically ill pts owing to colonic necrosis.
- Dialysis: IHD or CRRT.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Edema Coagulopathy	Epistaxis, GI bleeding	Airway edema Petechial hemorrhages	
CV	VTach, VFIB Pericardial effusion Hypertensive crisis	Syncope, cardiac arrest Dyspnea, pleuritic chest pain Headache, visual changes	Muffled heart sounds	ECG, serum K ⁺ , Mg ²⁺ ECG, CXR, TTE
RESP	Pulm edema	Dyspnea, orthopnea	Frothy sputum, crackles	CXR
GI	Reflux Ileus Serositis Ulceration, bleeding	Reflux Abdominal discomfort Acute abdomen Hematemesis, melena	Absent bowel sounds, tympany Tenderness, guarding Same	Esophagogram KUB series KUB, CT scan Stool guaiac, endoscopy
HEME	Plt dysfunction	Excessive bleeding	Petechial hemorrhages	
RENAL	AKI	Oliguria, anuria	Edema	Urinalysis, BUN, Cr, Cr clearance Renal US, scintigraphy
CNS	Encephalopathy	Confusion, disorientation, coma	Same plus asterixis	EEG CT scan
MS	Rhabdomyolysis	Crush injury, limb ischemia	“Red urine”	Urine myoglobin Serum CK

Key References: Ricci Z, Cruz DN, Ronco C: Classification and staging of acute kidney injury: beyond the RIFLE and AKIN criteria. *Nat Rev Nephrol* 7(4):201–208, 2011; Stafford-Smith, Raja A, Shaw AD: Evaluation of the patient with renal disease. In Longnecker DE, editor: *Anesthesiology*, ed 2, New York, 2012, The McGraw-Hill Companies, pp 166–179.

Perioperative Implications

Preoperative Preparation

- Dialysis to control fluid overload, hyperkalemia, metabolic acidosis, acute uremia.
- Consider metoclopramide, H₂ blocker, and rapid sequence induction to reduce reflux risk.
- Consider DDAVP 0.3 µg/kg to enhance Plt function (effective for 8–12 h).
- Regional techniques may be contraindicated by coagulopathy.

Monitoring

- Standard ASA monitoring.
- For large fluid shift operations with or without LV dysfunction, consider:
 - Arterial line ± CVP.
 - PA catheter or TEE.
 - Pulse pressure variation or stroke volume variation monitoring.

Airway

- Consider awake fiberoptic intubation with airway edema.
- Avoid nasal intubation (epistaxis).
- Treat as for full stomach: Head up, cricoid pressure.
- Succinylcholine is relatively contraindicated (avoid if K⁺ concentration ≥5.0 mEq/L).

Preinduction/Induction

- Manage induction and/or replacement fluids as if renal function were normal (risk of hypovolemia).
- Anticipate enhanced pharmacodynamic effects of all sedative and/or anesthetic agents (encephalopathy).

Maintenance

- Restrict maintenance fluids; replace losses appropriately guided by hemodynamic monitoring.
- Euvolemia is key.
- Avoid morphine, meperidine, and pancuronium.
- Avoid nephrotoxic agents such as NSAIDs (ketorolac), antimicrobials (gentamicin), and ACEI/ARB
- Consider agents independent of renal elimination (volatile anesthetics, propofol, fentanyl, remifentanyl, cisatracurium, esmolol, devidipine).
- Increase minute ventilation to compensate for metabolic acidosis; sedative-hypnotic administration may lead to acidosis by eliminating compensatory resp alkalosis in spontaneously breathing pt
- Anticipate increased volume of distribution but decreased clearance of most drugs.
- Check ABGs and serum K⁺

Extubation

- Anticipate delayed emergence, vomiting, aspiration.
- Treat as for full stomach.
- Neostigmine elimination is delayed in ARF.

- Consider a short period of postop mechanical ventilation if pt has intraop acidosis (will not be able to generate adequate spontaneous resp compensation).

Postoperative Period

- Careful assessment of CV and respiratory status; check ABG and serum K⁺.
- Morphine and meperidine contain active metabolites that are renally excreted. Use with caution.
- May require IHD, CRRT, or sustained low efficiency dialysis for excess fluid, hyperkalemia, and/or acidosis in early postop period.

Anticipated Problems/Concerns

- Major concerns are always hyperkalemia, acidosis, and pulm edema.
- Hyperkalemic arrhythmias may occur without premonitory ECG signs.
- Rapid K⁺ flux more ominous than stable high serum K⁺.

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