Learning Objectives

- Identify the risk factors and causes of acute kidney injury.
- Identify the clinical definition and signs of acute kidney injury.
- Select appropriate interventions for prevention and management of acute kidney injury.

How big is the problem?

Most data is available from ICU patients

- 1% to 25% Incidence
- 15% to 60% Mortality

Why should we be concerned?

Outcomes of AKI

- Decreased life expectancy
- Readmissions
- Worsening chronic kidney disease
- Progression to end stage renal disease
- Higher health care costs

Top 3 Causes of AKI

1. Decreased perfusion
2. Nephrotoxic drugs
3. Intravenous contrast dye

Decreased Kidney Perfusion

Causes of Decreased Kidney Perfusion
- Myocardial Infarction
- Health failure
- Cardiovascular Surgery
- Cerebrovascular Accident
- Hypovolemia
- Trauma, blood loss

Nephrotoxic Drugs
Nephrotoxicity: Clinical Definition

A decrease in renal function as evidenced by a rise in serum creatinine levels following the initiation of a drug signals the possibility of drug-induced renal injury.

Nephrotoxic agents that alter intraglomerular hemodynamics
- Angiotensin Converting Enzyme Inhibitors
- Angiotensin Receptor Blockers
- NSAIDs
- Transplant / Immunosuppressants: Cyclosporine or tacrolimus

Nephrotoxic agents associated with tubular cell toxicity
- Amphotericin B
- Aminoglycosides: Gentamicin, vancomycin, tobramycin
- Contrast dye
Nephrotoxic drugs associated with chronic interstitial nephropathy
- Acetaminophen
- Aspirin
- NSAIDs

Non-prescription / Over-the-Counter Pain Medications

Nephrotoxicity related to crystal nephropathy
- Acyclovir
- Methotrexate
- Sulfa antibiotics
- Triamterene

Intravenous Contrast Dye
Contrast-induced AKI Risk Factors

- Older adult > 75 years \(^1,2\)
- Concurrent administration of nephrotoxic agents \(^1,2\)
- Preexisting / chronic kidney disease \(^1,2\)
- Intra-Aortic Balloon Pump \(^1\)
- Anemia \(^1\)
- Diabetes mellitus \(^1,2\)
- Cirrhosis \(^2\)
- Heart failure \(^1,2\)
- Other history of impaired renal perfusion \(^2\)


Acute Kidney Diseases

- Acute Glomerulonephritis
- Nephritis
- Vasculitis
- Thrombotic microangiopathy
- Urinary Tract Obstruction

What do rifles have to do with AKI?
R.I.F.L.E. – Diagnosis and Staging

- Risk
- Injury
- Failure
- Loss
- End-Stage Renal Disease

Definition of Acute Kidney Injury

- Increase in SCr by X0.3 mg/dl (X26.5 lmol/l) within 48 hours
- Increase in SCr to X1.5 times baseline, which is known or presumed to have occurred within the prior 7 days;
- Urine volume <0.5 ml/kg/h for 6 hours.

Normal Range = Creatinine: 0.8 to 1.4 mg/dL

**Stages of AKI**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Serum Creatinine</th>
<th>Urine Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.5 - 2 x baseline (or rise ≥ 26.4 μmol/L)</td>
<td>&lt; 0.5 ml/kg/hour for &gt; 6 hours</td>
</tr>
<tr>
<td>2</td>
<td>&gt;2 - 3 x baseline</td>
<td>&lt; 0.5 ml/kg/hour for &gt; 12 hours</td>
</tr>
<tr>
<td>3</td>
<td>&gt; 3 x baseline (or &gt; 354 μmol/L with acute rise ≥ 44 μmol/L)</td>
<td>&lt; 0.3 ml/kg/hour for 24 hours or anuria for 12 hours or on RRT</td>
</tr>
</tbody>
</table>

**AKIN**
- Acute Kidney Injury Network
- Another valid diagnostic and staging tool

**PREVENTION**
Focus on the preventable causes

Key recommendations by KDIGO Guidelines
- Early detection – monitoring of hemodynamic stability
- Volume expansion with isotonic crystalloids
- Vasopressors in the presence of vasomotor shock
- Avoid use of diuretics unless there is volume overload
- Insulin to control hyperglycemia
- Monitor aminoglycoside levels
- Discontinue other nephrotoxic drugs
- Monitor serum creatinine and urine output

International AKI Management Guidelines

Management of AKI Secondary to Nephrotoxic Agents

- Monitor for elevated serum creatinine \(^1,2\)
- Involve a clinical pharmacist to assist with medication management \(^2\)
  - Review medication list to identify nephrotoxic agents
  - When more than one nephrotoxic drug is discontinue the drug most recent drug added.
  - Consider replacing all other possible nephrotoxins with less toxic medications
- Provide supportive care: \(^1,2\)
  - Monitor blood pressure
  - Monitor intake and output
  - Maintaining adequate hydration
- AKI resolves; follow-up in 3 months \(^2\)


Continuous Renal Replacement Therapy

- Severe renal disease
- Utilizes a double lumen central venous catheter
- Indicated for patients who are hemodynamically instable for hemodialysis
- Mechanism

CASE STUDIES