Brigham and Women's Hospital
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Poisonings and Intoxications: What a Nephrologist Needs to Know

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- Research focus: Applications of digital health technologies in alcohol use disorder/substance use disorder, medication safety

DISCLOSURES

None

OBJECTIVES

1. Recognize key nephrotoxins
2. Understand specific indications for dialysis in toxicity
3. Review the role of the nephrologist in key high-risk toxicities and renal-specific considerations

Case 1

35-year-old man comes to the Emergency Department, appears intoxicated and minimally responsive.

EMS found the patient with a suicide note and a bottle of antifreeze.

VS: Afebrile, tachycardic, tachypnea, BP 120/60

Case 1 - Labs

11.8> 14.8/44.8 < 188

140	112	17	< 98
5.5	**<5**	0.95	

Anion gap **23**

Alk Phos 74
AST 31
ALT 21

CK 289
APAP <10
Salicylate <10

Ethanol <10

pH **6.9**/18/68/3.7

Lactate **8.9**

Measured serum osm –

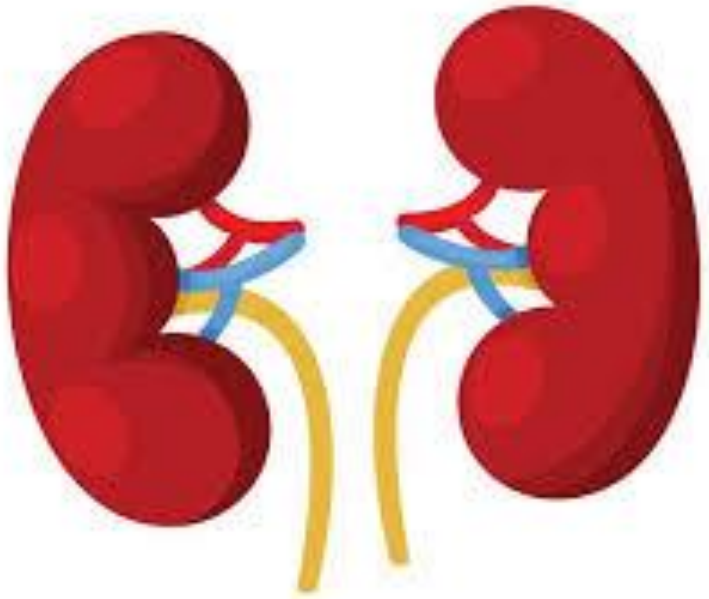
Measured Osmolal gap – 355
Calculated – 285
Osm gap – 70

Urine – calcium oxalate crystals

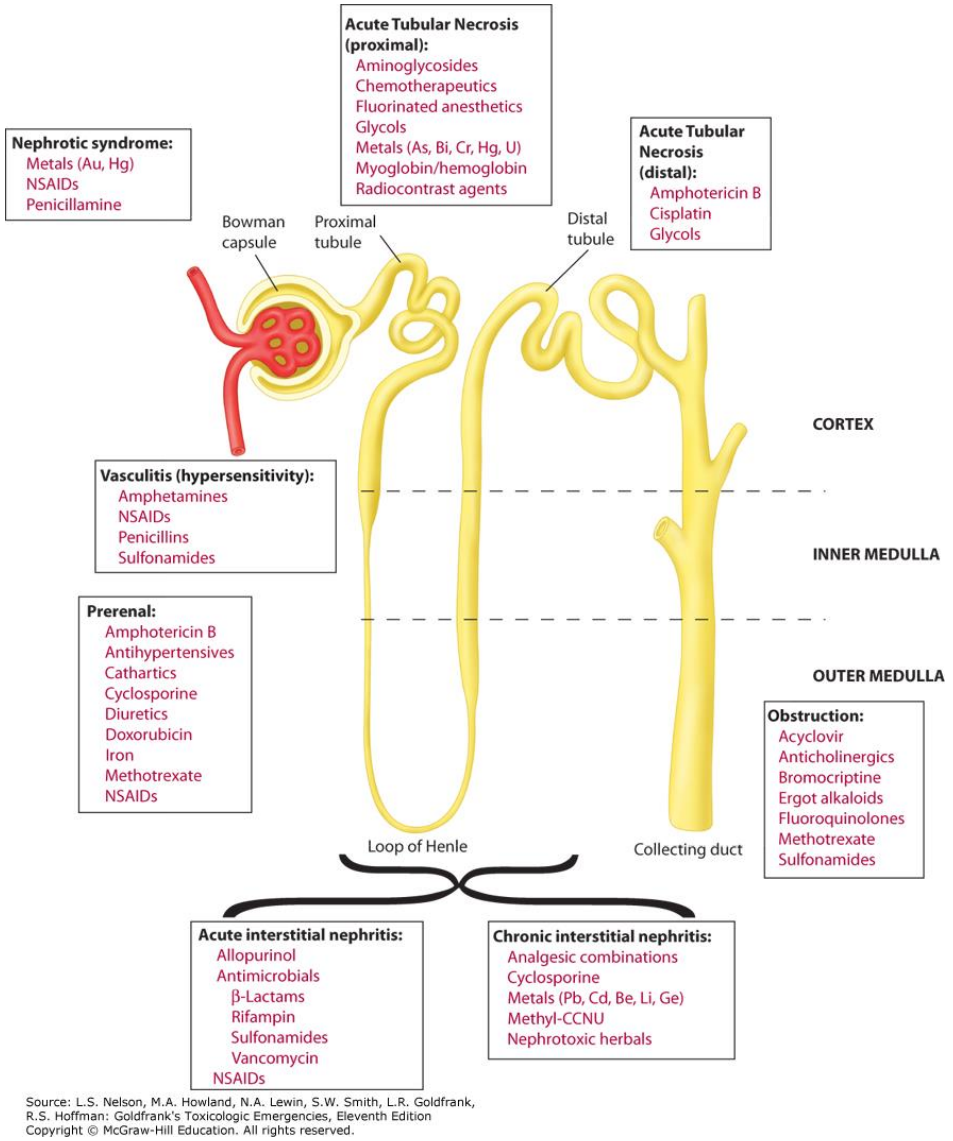
NEPHROLOGY IS CONSULTED….

Why This Matters for Nephrologists

- Toxins frequently cause AKI or require dialysis
- Nephrologists often consulted for RRT, fluid/electrolytes, or drug dosing
- Overlap with ED, ICU, and toxicology



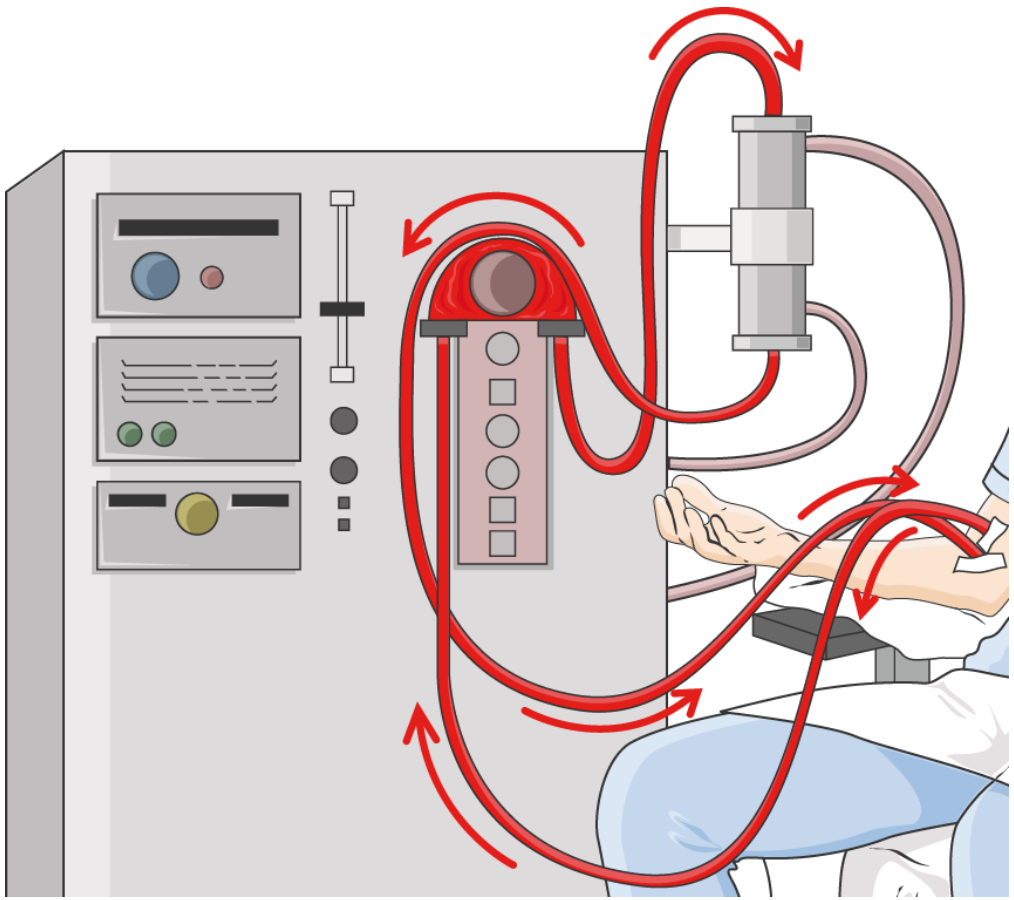
The Kidney in Toxicology - Nephrotoxins



Source: L.S. Nelson, M.A. Howland, N.A. Lewin, S.W. Smith, L.R. Goldfrank, R.S. Hoffman: Goldfrank's Toxicologic Emergencies, Eleventh Edition

Citation: Chapter 27 Renal Principles, Lewis S. Nelson, Mary Ann Howland, Neal A. Lewin, Silas W. Smith, Lewis R. Goldfrank, Robert S. Hoffman. *Goldfrank's Toxicologic Emergencies, 11e;* 2019. Available at: https://accessemergencymedicine.mhmedical.com/content.aspx?bookid=2569&sectionid=210269536 Accessed: July 14, 2025

Indications for extracorporeal removal



Methods to enhance removal:
Hemodialysis (HD)
Charcoal hemoperfusion use declining
Forced diuresis
Urinary alkalinization

Most common use of HD lithium, ethylene glycol, salicylates, acetaminophen

HD indicated for patients in cases where the responsible xenobiotics is removable AND:

- Patients fail to respond to comprehensive supportive care
- Normal route of elimination is impaired high morbidity or mortality is likely
- Correction of severe electrolyte disorders

Characteristics of a xenobiotics that can be removed by HD

Volume of distribution below 1 L/kg

Low protein binding (or large amount of free xenobiotics in overdose)

HD enhances clearance compared to endogenous clearance by a factor of 2 or overall low endogenous clearance

Low lipophilicity

**Largest factor depends on pharmacokinetics in overdose
Improved clearance prior to distribution

TABLE 6–3

Characteristics of Xenobiotics That Allow Clearance by Hemodialysis, Hemoperfusion, and Hemofiltration

For All Three Techniques	For Hemodialysis	For Hemoperfusion	For Hemofiltration
Low V_d (<1 L/kg)	MW <5,000 Da	MW <50,000 Da	MW <40,000 Da
Single-compartment first-order kinetics	Low protein binding	Adsorption by activated charcoal	Low protein binding
Low endogenous clearance (<4 mL/min/kg)			

MW = molecular weight; Vd = volume of distribution.

Intermittent Hemodialysis vs Continuous Renal Replacement Therapy (CRRT)

Intermittent HD preferred in most situations

Usually performed for 4 to 8 hours

CRRT can be used but results in slower removal rates

EXTRIP Workgroup

Extracorporeal Treatment in Poisoning (EXTRIP) is a collaboration of experts from diverse specialties

- Clinical toxicology
- nephrology
- pharmacology
- critical care
- emergency medicine

Publish recommendations regarding the indications for dialysis for overdose

https://www.extrip-workgroup.org/publications

Nephrologist role in poisonings

- Electrolyte and fluid management
- Renal dosing of antidotes
- Monitoring AKI recovery
- Preventing further renal injury
- Multi-disciplinary communication

Case 1

35-year-old man comes to the Emergency Department, appears intoxicated and minimally responsive.

EMS found the patient with a suicide note and a bottle of antifreeze.

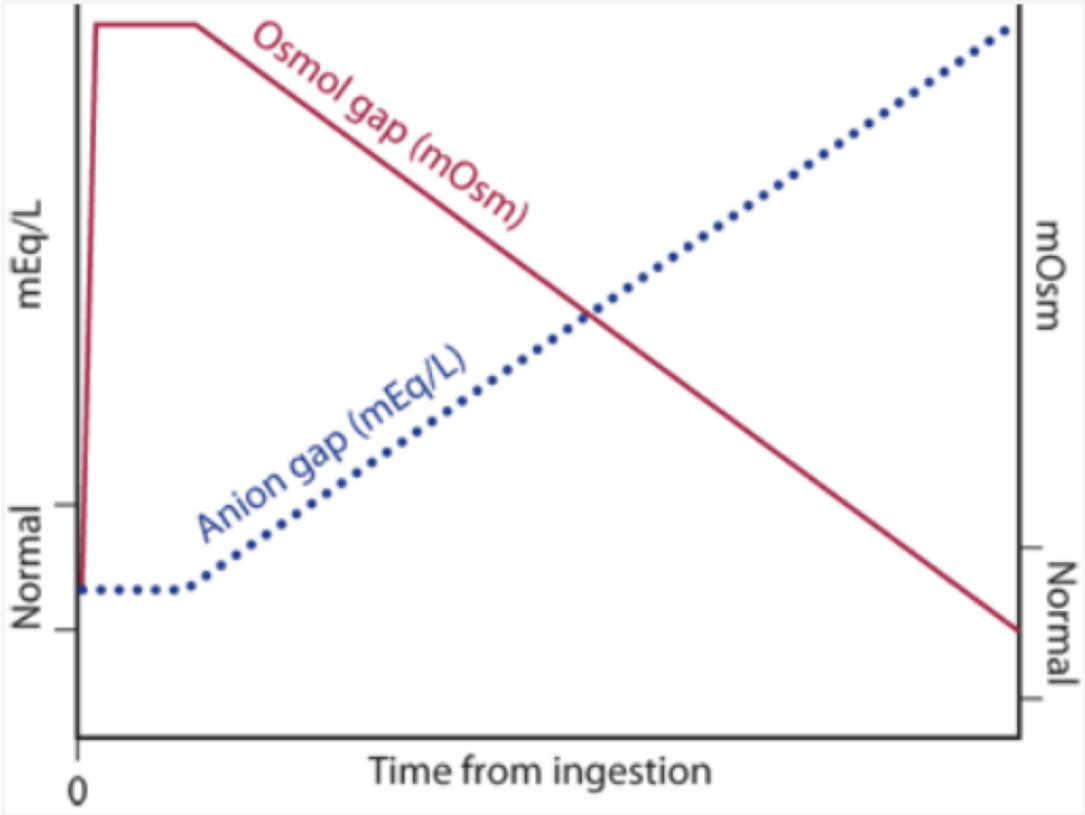
VS: Afebrile, tachycardic, tachypnea, BP 120/60

Ethylene Glycol: 277.3 mg/dL

Specific Toxins – Ethylene glycol

Ethylene glycol

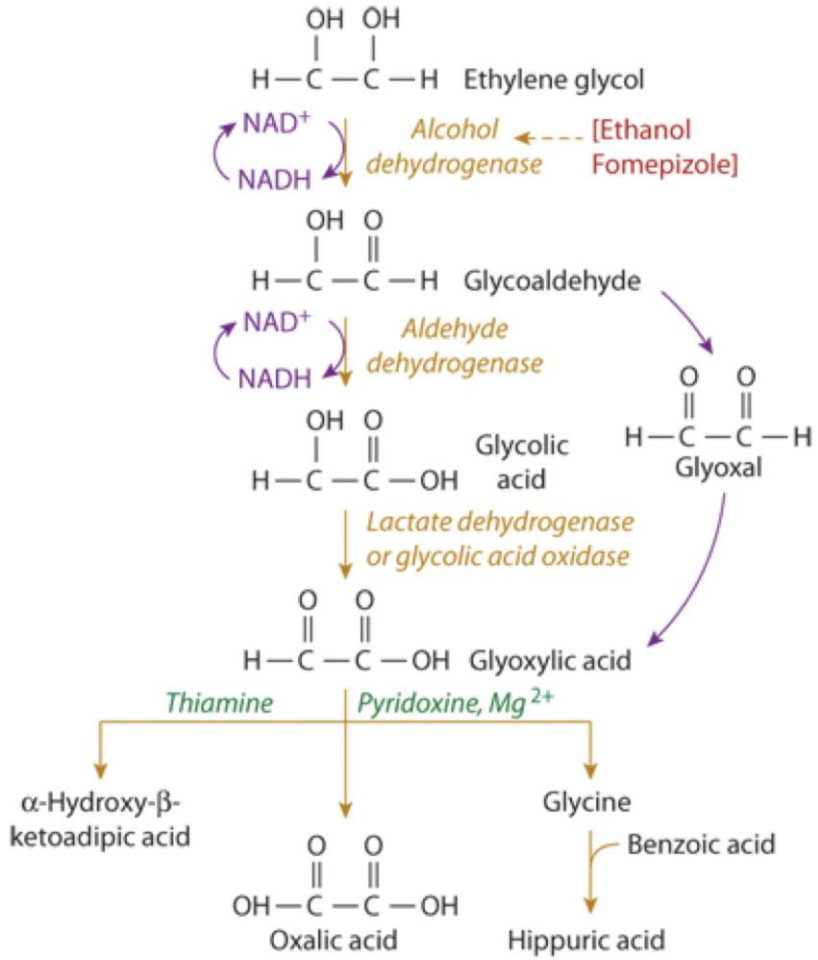
- Symptoms – intoxication, nephrotoxicity, hypocalcemia, metabolic acidosis, cerebral edema
- Labs – elevated serum osm gap, large anion gap acidosis, elevated lactate,



Specific Toxins – Toxic Alcohols

Ethylene Glycol and Methanol

- Converted to toxic metabolites by alcohol dehydrogenase
- Renal crystal injury (EG), visual symptoms (methanol)
- Treatment: Fomepizole/ethanol, dialysis



Ethylene glycol – Indications for HD

Suspected EG ingestion with osmol gap greater than 50 mOsm/L and acidosis (pH <7.25-7.30)

Renal Failure

End organ toxicity

EG concentration greater than 50 mg/dL

Severe metabolic acidosis

Case 2

38-year-old man with past medical history of bipolar disorder presented for increasing tremors

First noticed in his bilateral hands, which seemed to be worsening over the past two days as well as generalized “muscle spasms”

VS: BP 112/76 HR 124 RR 20 O2 96% T 98.2

Labs: Na+ 129
Cr 5.9

You get one more lab….
Lithium level 4.2 mmol/L

Specific Toxins - Lithium

Acute:

Predominately GI symptoms, nausea, vomiting

Chronic:

Predominately neuro symptoms

Acute-on-chronic:

GI and neuro effects

Other effects: chronic tubulointerstitial nephropathy, hypothyroidism, hyperparathyroidism, hypercalcemia, Ebstein anomaly, leukocytosis
SILENT - Syndrome of irreversible lithium-effectuated neurotoxicity
Nephrogenic Diabetes Insipidus

Specific Toxins 2 – Lithium

Treatment – IV fluids and dialysis

Dialysis indications:

- Concentration > 5.0 mEq/L
- Concentration > 4.0 mEq/L with AKI or CKD
- Decreased level of consciousness, seizures, or life-threatening dysrhythmias at any lithium concentration
- Estimated time to reach lithium concentration < 1 mEq/L exceeds 36 hours

Specific Toxins – Salicylates

Mixed acid-base disturbance

Clinical signs: confusion, tinnitus, hyperventilation

Treatment: fluid resuscitation, urine alkalinization

Dialysis Indications:

- Concentration > 7.2 mmol/L (90 mg/dL)
- Concentration > 6.5 mmol/L (80 mg/dL) with AKI or CKD
- Concentration > 6.5 mmol/L (90 mg/dL) after IV Altered mental status
- Respiratory distress or new hypoxemia requiring supplemental oxygen
- pH ≤ 7.2

Specific Toxins – Acetaminophen

Frequent cause of overdoses and toxicity
Causes hepatotoxicity

Reasons for nephrology involvement:

- Severe metabolic acidosis
- Acute kidney injury
- Hemodialysis considerations

Treatment – n-acetylcysteine
Dialysis indications:

•Acetaminophen concentration >1000 mg/L and NAC is NOT administered
•Presence of altered mental status, metabolic acidosis, with an elevated lactate, and an [APAP] > 700 mg/L and NAC is NOT administered
•If the patient presents with an altered mental status, metabolic acidosis, an elevated lactate, and an [APAP] > 900 mg/L <u>even if NAC is administered</u>

Specific Toxins – Metformin-associated lactic acidosis

Rare presentation with high mortality

Risk factors – renal injury, hepatic failure, critical illness

Presentation - Profound acidosis, shock

Treatment:

- Dialysis clears metformin and acid
- CRRT useful in unstable patients

Case 3

28-year-old male found unresponsive at a party. Per EMS bystanders reported cocaine and alcohol use. Arrives to ED confused, agitated, diaphoretic

VS: T: 38.6°C; BP: 92/58 mmHg; HR: 136 bpm; RR: 26/min; SpO_2: 96% on room air

Labs:
Creatinine: 3.2 mg/dL (baseline 0.9)
CK: 112,000 U/L
K+ 6.5

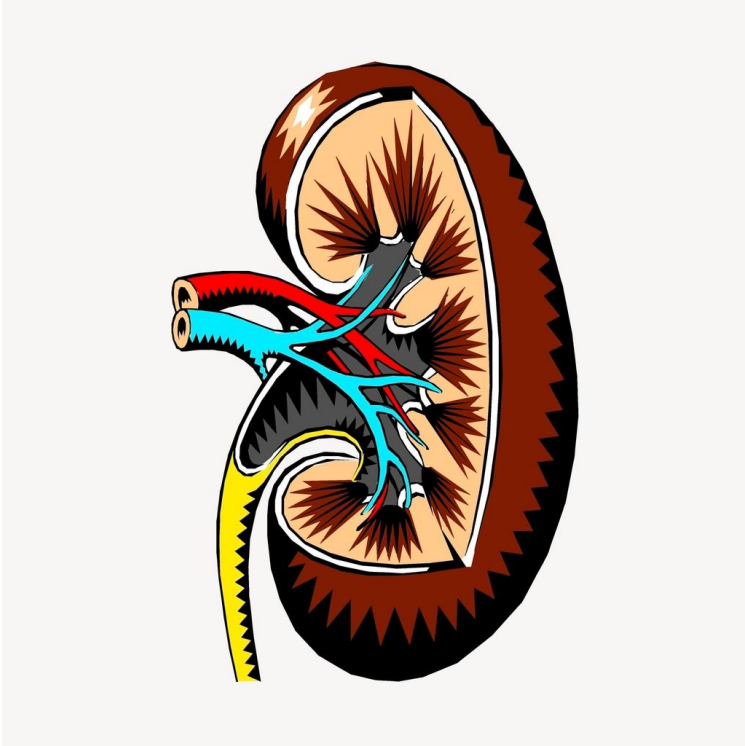
Rhabdomyolysis-Induced AKI

Causes: drugs (cocaine, statins), trauma, seizures

Fluid resuscitation key

Manage electrolyte abnormalities

Dialysis if severe AKI or electrolyte derangements



TAKE HOME MESSAGES

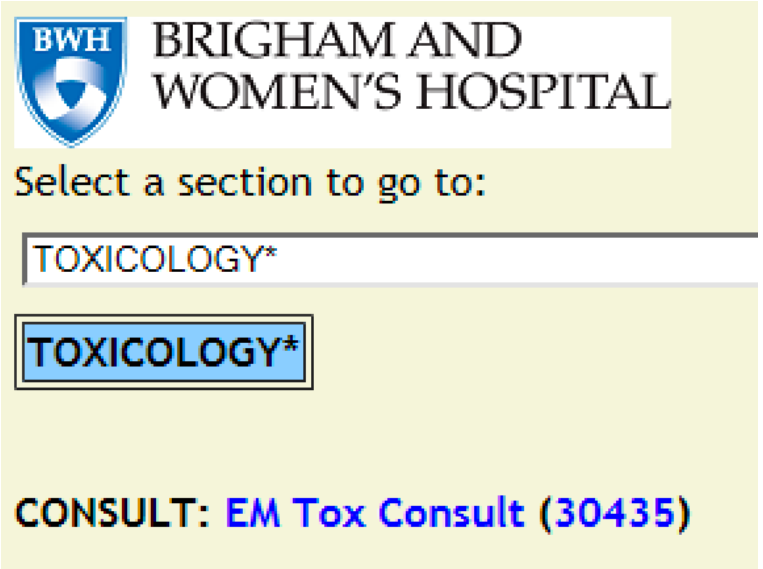
1. Know the dialyzable toxins. Ethylene glycol, methanol, lithium, salicylates, metformin, and in selected cases, acetaminophen may require extracorporeal removal.

2. Nephrologists are key in the acute phase. Your expertise in fluid and electrolyte optimization, renal dosing of antidotes, and AKI recovery monitoring is critical to patient outcomes.

3. Leverage expert guidance. EXTRIP's consensus recommendations can be useful to make timely, evidence-based decisions on initiating dialysis for toxin removal.

Resources for Clinicians

EXTRIP.org
Poison Control
BWH Toxicology



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Thank you!