Nephrology Consult Primer

Learning Objectives:
By the end of the inpatient nephrology rotation, residents should be proficient in:

- Diagnosis, initial workup, and management of acute kidney injury (AKI)
- Recognition and acute management of critical electrolyte disorders
- Understanding indications for renal replacement therapy (RRT) and management of acute dialysis
- Ability to interpret urinalysis, basic renal function tests, and electrolyte abnormalities

Team Structure:

- 1 Attending Nephrologist
- 1 Fellow
- 1 - 2 Residents
- 1 - 2 Medical students
- Dialysis Nurses: Manage dialysis treatment and vascular access

Workflow:

- Typically Mon–Fri, but residents are expected to work **one** Saturday per month
- Workroom: Pav H 6th floor, MN Hallway, room 672
- Residents are typically assigned to the Renal Floor service or Renal ICU service, but a clinical experience with the Transplant service may be possible depending on career goals
- Arrive around 7:00 AM. Fellow will assign patients. Rounds typically start at 9:00-9:30.
    - IM residents should be excused from clinical duties to attend didactics (12:00PM – 1:00PM)
- Residents are expected to write notes. Templates vary by specific service. Discuss with your fellow while on service.

Recommended Educational Resources:

- UpToDate
- Textbooks
    - Brenner & Rector's The Kidney (11th ed)
    - Rose & Post: Fluid, Electrolyte, and Acid-Base Disorders (5th ed)
    - Schrier's Diseases of the Kidney (10th ed)
    - Primer on Kidney Disease (KDIGO)
- Clinical Practice Guidelines/Websites
    - KDIGO.org (guidelines, updates)
    - NephSAP (Nephrology Self-Assessment Program)

Common Clinical Problems:

Acute Kidney Injury (AKI) - Rapid loss of renal function (hours to days) with rise in creatinine and/or oliguria

- KDIGO Staging:
  - Stage 1: Cr 1.5-1.9x baseline OR UOP <0.5 mL/kg/hr x 6-12 hrs
  - Stage 2: Cr 2-2.9x baseline OR UOP <0.5 mL/kg/hr x ≥12 hrs
  - Stage 3: Cr ≥3x baseline OR Cr ≥4 mg/dL (acute rise) OR UOP <0.3 mL/kg/hr x ≥24 hrs
- Differential Diagnosis
  - Prerenal (60-70% of AKI): Decreased renal perfusion
  - Intrinsic:
    - Acute Tubular Necrosis (ATN) - most common intrinsic cause (sepsis, contrast, rhabdomyolysis, nephrotoxins)
    - Glomerulonephritis/Vasculitis
    - Acute Interstitial Nephritis
    - Crystalline Nephropathy: Tumor lysis, uric acid
  - Postrenal AKI (5-10%): Obstruction from stones, BPH, malignancy
- Diagnostic Approach
  - History: PMH (kidney stones), medications (NSAIDs, ACE-I/ARB, aminoglycosides), fluid status, urine output (quality and quantity), preceding illness, systemic symptoms, family history
  - Labs:
    - Serum: Cr, BUN, electrolytes
    - Urine: Urinalysis (casts, hematuria), urine osmolality, FENa, FEUrea
  - Imaging:
    - Renal ultrasound (assess hydronephrosis)
    - CT non-con for stone disease

Hyponatremia - Na <135 mEq/L

- Diagnostic approach
  - Confirm hypoNa – serum Osm <280 mOsm/kg (correct for hyperglycemia)
  - Determine volume status - hypovolemic, euvolemic, or hypervolemic
  - Urine osmolality (surrogate of ADH activity)
    - U osm < 100 (low ADH, dilute urine)
    - U osm >100 (high ADH, concentrated urine)
  - Urine sodium (surrogate for RAAS activity)

        - U Na <20 (high RAAS activity)
        - U Na >20 (low RAAS activity or renal losses of Na)
    - Acute vs Chronic:
        - Acute (<48 hrs): Risk of seizures, cerebral edema; treat more aggressively
        - Chronic (>48 hrs): Risk of osmotic demyelination; avoid overly rapid correction
- Correction rate: No more than 8-10 mEq/L in 24 hrs to avoid osmotic demyelination syndrome

<u>Hypernatremia</u> - Na >145 mEq/L

- Causes
    - Increased free water loss – diabetes insipidus, hyperglycemia, insensible losses
    - Excessive Na intake – iatrogenic (tube feeds), hypertonic saline, or >2g in renal failure
- Management:
    - Replace free water deficit with D5W (IV) or free water (PO/NG) Free water deficit = 0.6 × weight × [(measured Na/140) - 1]
    - Correction rate: 10-12 mEq/L per 24 hrs (max)

<u>Hyperkalemia</u> - K >5.5 mEq/L

- Causes
    - Renal failure (AKI, CKD, ESRD)
    - Medications (ACE-I/ARB use, NSAIDs, K-sparing diuretics)
    - Cell death (hemolysis, rhabdo, tumor lysis)
- Management (treat if K > 6.5 mEq/L or K >5.5 mEq/L *with* EKG changes)
    - Temporize (shift K intracellular and stabilize cardiac membrane)
        - Ca gluconate
        - IV insulin + dextrose (prevent hypoglycemia)
        - Albuterol (beta agonist)
    - Definitive (remove K from body)
        - Urine – loop diuretic +/- IV saline
        - Stool – K binder (sodium zirconium cyclosilicate “Lokelma”)
        - Filter – renal replacement therapy (CRRT, iHD, PD)

<u>Renal Replacement Therapy</u>

- Absolute Indications – "**AEIOU**"
  - **A**cidosis - pH <7.1 (severe metabolic acidosis)
  - **E**lectrolytes (HyperK) - K >6.5 mEq/L (not responsive to medical therapy)
  - **I**ngestion/**I**ntoxication
    - Toxic alcohols (ethanol, ethylene glycol, isopropyl alcohol, methanol)
    - Medications (isoniazid, salicylate, theophylline, lithium, VPA, dabigatran)
  - **O**verload – symptomatic volume overload (not responsive to diuretics)
  - **U**remia – BUN typically >100 and/or symptoms (metallic taste, encephalopathy, asterixis, pericardial effusion, pericarditis)
  - Cr >10 mg/dL if rising rapidly
- Types of Renal Replacement Therapy
  - Intermittent Hemodialysis (iHD):
    - More rapid, higher volume filtration (400-500 mL/min) in fewer sessions (3-4h, 3x/week in ESRD; variable for AKI)
      - Better tolerated in hemodynamically stable patients
    - Requires access
      - Arteriovenous fistula (AVF)
      - Arteriovenous graft (AVG)
      - Central venous catheter (CVC)
  - Continuous Renal Replacement Therapy (CRRT):
    - Less rapid, lower volume filtration (100-200 mL/h) continuously (i.e. over 24h)
      - Better tolerated in hemodynamically unstable patients (septic shock, cardiogenic shock)
    - Requires access – typically CVC
  - Peritoneal Dialysis (PD):
    - Less commonly used acutely, but daily instillation and drainage from peritoneal cavity
      - Requires access
      - Risk of peritonitis
- Complications of RRT
  - Hypotension – hemodynamics (pump/pipes problem)
  - Disequilibrium syndrome - overly rapid correction of solutes → cerebral edema, seizures (prevent with slower initial dialysis)
  - Access complications
    - Thrombosis

        - Infection
        - Steal syndrome
        - Aneurysm
    - Bleeding
        - Anticoagulation in circuit
    - Electrolyte shifts: K+, Ca++, Mg++ monitoring essential