THE KIDNEY IS YOUR FRIEND: ACUTE RENAL FAILURE DEMYSTIFIED

Definitions:

- **Acute renal failure**: all definitions are arbitrary.
  - Commonly used definition is ≥0.5 mg/dl increase in creatinine over 24 hours.
  - Increasing data exists that even minor elevations in creatinine (0.1-0.2 mg/dl) during hospitalization correlate to increased morbidity and mortality.
  - Remember to correlate creatinine with GFR (creatinine increase from 1 → 2 mg/dl = 50% reduction in GFR; creatinine increase from 4 → 5 = 5% reduction in GFR).

- **Chronic kidney disease**: use this term for any form of chronic renal failure, chronic renal insufficiency, etc.
  - Stage 1 CKD: kidney damage but normal GFR (>90 ml/min)
  - Stage 2 CKD: mild kidney damage (GFR 60-89 ml/min)
  - Stage 3 CKD: moderate kidney damage (GFR 30-59 ml/min)
  - Stage 4 CKD: severe kidney damage (GFR 15-29 ml/min)
  - Stage 5 CKD: kidney failure (GFR < 15 ml/min, or ESRD on renal replacement therapy)

- **End-stage renal disease (ESRD)**: this term isn't great because it implies a horrible, morbid disease (bad for pt. morale)

- **Oliguria**: < 500 cc/day urine output; definition has to do with the fact that the healthy kidney, if maximally concentrating the urine, will have to excrete 500 cc urine/day to get rid of the daily osmotic load (from dietary intake and metabolism byproduct)

- **Anuria**: < 100 cc/day urine output (arbitrary definition)

Thinking about the cause of ARF:

- **First step**: Pre-renal, intrinsic renal, or post-renal
  - Pre-renal: true volume depletion, effective volume depletion, hypotension, etc.
  - Intrinsic renal: see below
  - Post-renal: obstruction of any kind (BPH, prostate cancer, retroperitoneal fibrosis, tumor, intrarenal obstruction

- **Intrinsic renal failure**: think about the basics of kidney anatomy…
  - Glomerulus: nephrotic syndrome, glomerulonephritis, or both
  - Tubules: acute tubular necrosis (ATN), rhabdomyolysis, contrast nephropathy, etc.
  - Intersitium: acute interstitial nephritis (AIN), severe pyelonephritis, etc.
  - Vessels: vasculitis, atheroembolic kidney disease, polyarteritis nodosa, etc.

Toolbox:

- **Estimated creatinine clearance (CrCl)**: \( \frac{(140 - \text{age}) \times \text{weight (kg)}}{\text{k} \times \text{creatinine}} \)
  
  **Normal CrCl** = 100-120 ml/min

- **Fractional excretion of sodium (FENa)**: only useful in oliguric patients = \( \frac{\text{UNa}/\text{PNa} + \text{UCr}/\text{PCr}}{100} \)
  
  \( \text{FENa < 1% (pre-renal, acute GN, contrast nephropathy, hepatorenal, some cases of post-renal ARF)} \)
  
  \( \text{FENa > 1% (intrinsic renal, ATN)} \)

- **Proteinuria evaluation**: spot protein/creatinine ratio ≈ grams protein per day

- **Urinalysis**: see attached sheet

- **Renal ultrasound**: rule out hydronephrosis; small kidneys = chronic renal disease; if unilateral, think of renal artery stenosis; large kidneys = diabetes, HIV nephropathy, amyloid, infiltrative diseases, PCKD
Glomerulonephritis:
- Definition: U/A with RBCs and protein (you may see RBC casts or dysmorphic RBCs, but don’t count on these to make the diagnosis). Also, look for HTN, edema.
- Differential diagnosis: based on complement levels. See “Glomerulonephritis for dummies” coversheet

Nephrotic syndrome:
- Definition: U/A is bland except for heavy proteinuria (> 3.5 g/day). You may see hyperlipidemia, lipiduria, hypoalbuminemia, and hypercoagulable state (most often in membranous glomerulopathy). You should see edema; HTN can be variable.
- Differential diagnosis:
  - Primary: (= idiopathic); membranous, FSGS, minimal change dz, MPGN
  - Secondary: use the pneumonic THIS LAD HAS nephrotic syndrome
    Tumor (NHL can cause minimal change dz)
    Heroin (FSGS; other drugs such as gold, penicillamine can also cause nephrotic syndrome)
    Infection (see below)
    Systemic (see below)

    Lupus (membranous)
    Amyloid (membranous; also think of myeloma causing heavy proteinuria)
    Diabetes (Kimmelsteil-Wilson lesions)

    Hepatitis B (membranous, PAN), HCV (MPGN)
    AIDS (HIV-associated nephropathy, FSGS)
    Syphilis (membranous)