INTERNAL MEDICINE

PROPHYLAXIS
- DVT → lovenox (enoxaparin) 40mg subQ daily
  - Do NOT use lovenox if eGFR <30
  - Lovenox > heparin because reduce risk of HIT (heparin-induced thrombocytopenia)
  - HIT usually d/t previous exposure to heparin
- Bridging heparin→ coumadin requires 2-3 days of INR within 2-3 before stopping heparin
- GI → protonix

MAINTENANCE FLUID THERAPY
- Goals: preserve water & electrolyte balance and provide nutrition
- General rule = weight (in kg) + 40
- Base on serum Na concentration and volume status (weight pt daily, check for edema, etc.)
- 4:2:1 Rule → 4ml/kg/hr for first 10kg, 2ml/kg/hr for next 10kg, 1ml/kg/hr for each kg >20
  - Ex: 70kg man = 40 + 20 + 50 = 100cc/hr
- Start with 2L D51/2NS (~100cc/hr) with ~20mEq KCl added per liter
- Adjust to isotonic 0.9% NS if serum sodium falls

REPLACEMENT FLUID THERAPY
- Severe hypovolemia: 1-2L isotonic NS as rapidly as possible
- Mild-Mod hypovolemia: less rapidly correction ok, the rate of fluid administration must be greater than the rate of continued fluid losses, which is equal to the urine output plus estimated insensible losses (usually 30 to 50 mL/hour) plus any other fluid losses (eg, GI losses) that may be present

PAIN MANAGEMENT

<table>
<thead>
<tr>
<th>IV to PO narc conversions</th>
<th>IV Dose</th>
<th>PO dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>1 mg</td>
<td>3 mg</td>
</tr>
<tr>
<td>Dilaudid (hydromorphone)</td>
<td>1 mg</td>
<td>5 mg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equivalent narcotic PO dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilaudid</td>
</tr>
<tr>
<td>Morphine</td>
</tr>
<tr>
<td>Oxycodone</td>
</tr>
<tr>
<td>Methadone</td>
</tr>
<tr>
<td>Hydrocodone</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equivalent narcotic IV dosing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilaudid</td>
</tr>
<tr>
<td>Morphine</td>
</tr>
<tr>
<td>Fentanyl</td>
</tr>
</tbody>
</table>
ACID-BASE DISORDERS

Metabolic Acidosis
- Step 1) measure arterial pH and pCO2
- Step 2) is respiratory compensation appropriate?
  - Winter’s formula: \( \text{pCO}_2 = 1.5 \times \text{HCO}_3 + 8 \pm 2 \)
  - Other: \( \text{pCO}_2 = \text{HCO}_3 + 15 \)
- Step 3) calculate Anion Gap and \( \Delta \text{AG}/\Delta \text{HCO}_3 \)
  - Anion Gap \( \rightarrow \) “MUDPILERS”
  - Non-AG \( \rightarrow \) “DURHAM”
- For non-gap metabolic acidosis, calculate the \( U_{\text{AG}} \)
  \[
  U_{\text{AG}} = U_{Na} + U_{K} - U_{Cl}
  \]
  - If \( U_{\text{AG}} > 0 \) = renal problem
  - If \( U_{\text{AG}} < 0 \) = nonrenal problem (most commonly GI)
- \( \rightarrow \) tx metabolic acidosis with sodium bicarb if pH < 7.1

Metabolic alkalosis
- Calculate the urinary chloride to differentiate saline responsive vs. resistant
- Must be off diuretics in order to interpret urine chloride
- Na-responsive UCl < 10: *vomiting, volume depletion, diuretics, NG suction
  - \( \rightarrow \) tx chloride-sensitive alkalosis w/ normal saline
- Na-resistance UCl > 10: cushings, exogenous corticosteroids, hyperaldosteronism, chronic K+ depletion, RAS, renal failure, ↓Mg
  - \( \rightarrow \) tx chloride-resistant alkalosis: correct hypovolemia, acetazolamide, K+ as chloride salt

Respiratory Alkalosis
- CNS diseases (anxiety)
- Drugs - salicylates, opioids, sedative-hypnotics, progesterone
- Respiratory failure / lung dz - PE, pneumonia, mechanical ventilation
- hypoxia, hypoxemia, hypotension, sepsis, CHF, hypothyroidism, hepatic encephalopathy, liver failure
- pain, fever
  - \( \rightarrow \) tx: rarely life-threatening

Respiratory Acidosis
- CNS depression - salicylates, sedatives, narcotics, CVA
- Neuromuscular disorders
- Severe pneumonia, PE, pleural effusion, chronic lung dz, foreign body, tumor, reactive airway, hemotherax, pneumothorax, flail chest
- COPD, OSA, central hypoventilation
- Liver failure, CHF
  - \( \rightarrow \) tx: bronchodilators for COPD, ventilation, oxygen

<table>
<thead>
<tr>
<th>Disorder</th>
<th>pH</th>
<th>Primary Change</th>
<th>Compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory acidosis</td>
<td>↓</td>
<td>↑ ( \text{pCO}_2 )</td>
<td>↑ ( \text{HCO}_3 )</td>
</tr>
<tr>
<td>Metabolic acidosis</td>
<td>↓</td>
<td>↑ ( \text{HCO}_3 )</td>
<td>↑ ( \text{pCO}_2 )</td>
</tr>
<tr>
<td>Respiratory alkalosis</td>
<td>↑</td>
<td>↓ ( \text{pCO}_2 )</td>
<td>↓ ( \text{HCO}_3 )</td>
</tr>
<tr>
<td>Metabolic alkalosis</td>
<td>↑</td>
<td>↑ ( \text{HCO}_3 )</td>
<td>↑ ( \text{pCO}_2 )</td>
</tr>
</tbody>
</table>
UTIs & PYELONEPHRITIS

- **Sx:** dysuria, frequency, urgency +/- hematuria, suprapubic pain
  - Pyelo = UTI sx + fever, chills, flank pain, CVA tenderness, N/V
- **Dx:** UA → pyuria (>10 WBC/hpf), bacteriuria, LE (reflects pyuria), nitrates (reflect Enterobacteria)
- **Cipro** → 500mg BID x 3-7d (1 week for elderly, complicated)
- **Bactrim (TMP-SMX)** → one double strength tablet [160/800 mg] BID x 3-7d
- **Macrobid (Nitrofurantoin)** = 100mg PO BID x 5-7d
- **Yeast infection** → Diflucan 150mg PO 1x dose (Fluconazole)
- **Pyelo** → do urine cx & susceptibility testing to determine best regimen
  - Empiric = FQ i.e. Cipro 500 BID x 7d or Levo 750mg once daily x 5-7d
- **Urethritis** → discharge & dysuria, typically d/t gonorrhea, chlamydia, or trich, dx with gram stain
  - Tx: ceftriaxone (G), doxy (C), flagyl (T)

RENAI & GU COMPLAINTS

- **Hematuria** → urine dipstick is heme positive, and urine microscopy shows ≥3 RBC/hpf
  - **Painful:** urerolithiasis, trauma, UTI
  - **Painless:** BPH, bladder cancer, GU tumor, medications
  - Signs of glomerular etiology: albuminuria, hypoalbuminemia, elevated Serum Cr, dysmorphic RBCs, RBC casts, new/worsening HTN or edema
- **Nephrolithiasis & Urolithiasis**
  - **Types of stones (in order):** calcium oxalate, struvite, uric acid, xanthine, cystine
  - **S/sx:** colicky flank pain, back/groin pain, urinary frequency, dysuria, hematuria, N/V
  - **Dx:** non-contrast CT scan (size, location), US (hydronephrosis)
  - 4-5mm has ~50% chance of passing (~3wks), >6mm unlikely to pass w/out intervention
  - Tx if <10mm: NSAIDs + opioids, straining urine, alpha blockers (Flomax/Tamsulosin)
  - Tx if >10mm: urology consult for ESWL (shock wave lithotripsy) or ureterorenoscopy
- **Glomerulonephritis** - inflammation of glomeruli, can be acute or chronic
  - **Nephrotic syndrome:** proteinuria >3.5g/d, edema, HLD, hypoalbuminemia, lipid casts
    - Minimal change dz, focal segmental GN, membranous nephropathy
  - **Nephritic syndrome:** proteinuria <3g/d, hematuria, RBC casts, oliguria, HTN
    - Post-strep GN, IgA nephropathy, HSP, Goodpasture’s dz, vasculitis disorders
- **Epididymitis** → unilateral testicular pain, dysuria, freq & urgency, fever, + Prehn’s sign
  - **Can be infectious or non-infectious (prolonged sitting, vigorous exercise)**
  - **Dx:** CBC, UA, urethral cx & gram stain → *chlamydia**, *gonorrhea, E. coli, pseudomonas*
  - **Tx:** ice, elevation, NSAIDs
    - <35yo: ceftriaxone 250mg IM x1 + doxycycline 100mg PO BID x10d
    - >35yo: ofloxacin 300mg PO BID x10d OR levofloxacin 500mg PO QD x10d
- **Orchitis** → testicular swelling and pain commonly d/t systemic infx (mumps) → urology consult
- **Testicular Torsion** → unilateral testicular pain, N/V, cryptorchidism, loss of cremasteric reflex
  - Dx w color doppler US → emergent urology consult, complication is infertility
- **Inguinal Hernias:** indirect = through internal inguinal ring, direct = through Hesselbach’s triangle
- **BPH:** LUTS → dx w/ DRE, U/A
  - Complications: bladder distention / urinary obstruction, UTIs, renal insufficiency
  - Treatment: alpha-adrenergic blockers (Tamsulosin = Flomax, prazosin, terazosin), 5-alpha reductase inhibitors (Finasteride), TURP, prostatectomy, anticholinergics
- **Prostatitis** → m/c d/t E. coli, constitutional sx + LUTS, pyuria, bacteriuria, elevated PSA
  - Do a urine gram stain & culture; Tx empirically with Bactrim or FQ
**AKI**

- **Criteria: RIFLE, AKIN, KDIGO** → based on SCr and Urine Output
  - 0.3mg/dl ↑SCr over <48hrs or 1.5x ↑SCr (50%) over <7d OR urine output <0.5ml/kg/hr for >6hrs
- Complications (to evaluate for): volume overload, metabolic acidosis, hyperkalemia, hypocalcemia, and hyperphosphatemia; with severe forms, mental status changes may be present (uremia); hyperuricemia and hypermagnesemia may also occur
- **Evaluation:**
  - Urine: output, UA, sediment, lytes, osmolality
  - FENa = (U\(_{\text{Na}}\)/P\(_{\text{Na}}\))/ (U\(_{\text{Cr}}\)/P\(_{\text{cr}}\))
  - Renal U/S or CT (r/o obstruction), renal bx may be needed

<table>
<thead>
<tr>
<th>Etiologies</th>
<th>U/A, Sediment, Indices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prerenal</strong></td>
<td></td>
</tr>
<tr>
<td>Hypoperfusion / Ineffective arterial volume</td>
<td>FENA &lt;1%</td>
</tr>
<tr>
<td>→ hypovolemia, ↓ CO (CHF), vasodilation (sepsis), dehydration, hemorrhage</td>
<td>BUN/Cr &gt;20</td>
</tr>
<tr>
<td>Renal vasoconstriction</td>
<td>UNa &lt;20</td>
</tr>
<tr>
<td>→ NSAIDs, ACEIs/ARBs, contrast, hyperCa</td>
<td>Uosm &gt;500</td>
</tr>
<tr>
<td>Large Vessel</td>
<td>Transparent hyaline casts</td>
</tr>
<tr>
<td>→ RAS, VTE, vasculitis, dissection</td>
<td>Bland</td>
</tr>
<tr>
<td><strong>Intrinsic</strong></td>
<td></td>
</tr>
<tr>
<td>ATN - acute tubular necrosis</td>
<td>Pigmented muddy brown casts</td>
</tr>
<tr>
<td>→ ischemia: progression of prerenal dz</td>
<td>WBCs, WBC casts, +/- RBCs w/ neg Ucx</td>
</tr>
<tr>
<td>→ toxins: drugs (AG, cisplatin, HES, amphotericin), pigments, proteins, crystals</td>
<td>Urine eosinophils (abx allergy)</td>
</tr>
<tr>
<td>→ contrast-induced AKI (gadolinium??)</td>
<td>Lymphocytes (NSAID allergy)</td>
</tr>
<tr>
<td>AIN - acute interstitial nephritis</td>
<td>+/- RBCs</td>
</tr>
<tr>
<td>→ infx: pyelo, TB, legionella, leptospirosis</td>
<td>+/- RBCs</td>
</tr>
<tr>
<td>→ infiltrative: sarcoid, lymphoma, leukemia</td>
<td>Urine eos (in chol emboli)</td>
</tr>
<tr>
<td>→ autoimmune: SLE, sjogrens, IgG4, TINU syn</td>
<td>Dysmorphic RBCs, RBC casts</td>
</tr>
<tr>
<td>→ allergies: PCN, B-lactams, sulfa drugs, NSAIDs, PPIs</td>
<td></td>
</tr>
<tr>
<td>Small-med vessel</td>
<td></td>
</tr>
<tr>
<td>→ thrombotic microangiopathy, chol emboli, PAN</td>
<td></td>
</tr>
<tr>
<td><strong>Glomerulonephritis</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Post</strong></td>
<td></td>
</tr>
<tr>
<td>Obstructive</td>
<td></td>
</tr>
<tr>
<td>Bladder neck → BPH, prostate CA, neurogenic bladder, anticholinergic drugs</td>
<td>FENa variable</td>
</tr>
<tr>
<td>Ureteral → nephrolithiasis, malignancy, strictures, LAN, retroperitoneal fibrosis</td>
<td>Bland</td>
</tr>
<tr>
<td></td>
<td>+/- nondysmorphic RBCs</td>
</tr>
</tbody>
</table>

- **Management**
  - Prerenal → rapid volume replacement w isotonic saline, correct cause of hypoperfusion
  - Remove toxic agents, review dosing of renally cleared drugs
  - Monitor for & correct volume overload (diuretics), lytes, acid/base status
  - Indications for dialysis: Acidemia, Electrolyte disorder (hyperK), Intoxication (methanol, aspirin, lithium), volume Overload (CHF), Uremia (pericarditis, bleeding, encephalopathy)
CKD
- 3+ mo of reduced GFR <60 and/or kidney damage (path, markers, imaging, albuminuria)
- Etiologies: DM, HTN, RAS, glomerular, interstitial, PKD, congenital, drugs, myeloma, progression of AKI
- **Stages 1-5** (nm, mild, mod, severe, kidney failure) based on GFR
- Presence and degree of albuminuria a/w worse outcomes (independent of GFR)
- Uremia - indicator for dialysis
  - Nausea, anorexia, malaise, metallic taste, pruritis, encephalopathy, seizures, fatigue, pericarditis, anemia, bleeding, secondary hyperPTH, hyperkalemia, acidosis
- Treatment
  - Nephrology referral when GFR <30
  - Rx CV risk factors (smoking, LDL-C)
  - Dietary restrictions if indicated: Na, K, PO4, protein, glucose control
  - BP goal <140/90 with ACEI/ARB → check Cr & K after 2wks and d/c if 30% ↑Cr or K>5.4
  - Hgb goal ~10g/dl (EPO or darbapoetin, iron supplementation)
  - Metabolic acidosis → sodium bicarb
  - Uremic bleeding → desmopressin (dDAVP) IV or intranasally
  - Renal replacement and dialysis

COPD
- Emphysema (pink puffer) - tend to be thin, ↑ RR, ↑ AP diameter / hyperinflation of lungs
- Chronic bronchitis (blue bloaters) = productive cough >3mo annually for at least 2 yrs → tend to be heavy set, depressed RR, use accessory muscles, acidosis, productive wet cough
- COPDers have hypercarbic/hypoxic respiratory drive – caution in giving too much O2
- Common s/sx: dyspnea, cough, chest tightness, occasional hemoptysis, increased sputum, wheezing, barrel chest (↑ AP diameter), signs of cor-pulmonale (JVD, heave, peripheral edema)
- Common triggers: infections**, PE, CHF exacerbation, tobacco use, medication non-compliance
- Common organisms: *M. catarrhalis, Strep pneumo, H. influenza*
- Tests:
  - Sputum culture
  - CXR: ↑ AP diameter, flat diaphragms, hyperinflation, +/- interstitial markings or bullae
  - ABG: ↓ pH, ↓ pO2, +/- ↑ pCO2 (respiratory acidosis)
  - EKG: dysrhythmias common in COPD (A. fib, multifocal atrial tachycardia), R-sided heart strain, RVH
- Management:
  - **SABAs** → albuterol nebulizer 2.5-5mg q1-2hr (or MDI)
    - **Duoneb q4hrs** = albuterol + ipratropium bromide
    - **Spiriva** = tiotropium (long-acting-anticholinergic)
    - **Advair** = fluticasone (glucocorticoid) + salmeterol (LABA)
  - **Steroids**
    - PO prednisone 30-60mg per day x 10-14d (taper 40 → 30 → 10 x3days each)
    - IV methylprednisolone (**Solu Medrol**) 40-125mg q6-8hr ×72hrs
    - No proven benefit in PO vs. IV
  - **O2** → only intervention proven to improve mortality in pts with baseline SpO2 <88% (to prevent cor pulmonale)
  - **ABX** if signs of infx (↑ cough, ↑ dyspnea, ↑ or purulent sputum)
    - Azithromycin (may have anti-inflammatory effects), doxycycline, fluoroquinolones
PLEURAL EFFUSIONS & EMPYEMA

- Abnormal accumulation of fluid in the pleural space
- S/sx: pleuritic chest pain, cough, SOB, dullness to percussion, pleurisy, decreased BS
- Dx: CXR (lateral decubitus best), thoracentesis, gram stain & cx, pleural fluid LDH & protein, serum LDH + protein + glucose
- Drain fluid w/ thoracentesis (unless CHF!) and analyze fluid
  - Total protein, LDH, glucose, pH, cell count, gram stain & cx
- Exudative vs. Transudative → Light's criteria → 1 of 3 criteria diagnoses exudative
  - Pleural fluid protein : serum protein >0.5
  - Pleural fluid LDH : serum LDH >0.6
  - Pleural fluid LDH >⅔ serum LDH
- Exudative = **parenchymal infx (strep pneumo, s. aureus, pseudomonas, H. flu, etc.), *malignancy, *PE, collagen vascular dz (RA, SLE), GI, hemothorax, drug-induced, uremia
- Transudative = *CHF, constrictive pericarditis, cirrhosis, nephrotic syn
- Empyema = complicated effusion
  - pH <7.2, glucose <60
- Treatment:
  - Uncomplicated → abx for pneumonia
  - Complicated or empyema → drainage with tube thoracostomy
  - Loculated → chest tube or VATS, intrapleural tPA
  - Malignant effusion → serial thoracenteses vs tube thoracostomy + pleurodesis vs. indwelling pleural catheter

CELLULITIS

- = infx of superficial and deep dermis and subq fat
- Common organisms: GAS, MSSA, MRSA (GNRs in diabetics)
- Clinical dx: erythema, edema, warmth, pain (lymphangitis & regional LAD)
  - Blood cx low yield, can get aspirate of bulla or pus
- Predisposing factors: disruption to skin barrier (trauma, IV drug use), preexisting skin infection, venous insufficiency, lymphedema
- Other etiology: community-acquired MRSA (rx bactrim), TSS, cat bites (P. multocida), dog bites (P. multocida, C. canimorsus), penetrating injuries, gardening (sporothrix)
- Treatment
  - elevation, hydration of wound
  - I & D if abscess also present
  - OP / non-purulent: cover GAS & MSSA → 1st generation cephalosporin (Keflex) x5-10d
  - purulent: cover for MRSA → clindamycin, Bactrim, doxy, linezolid x5-10d
  - Inpatient: vancomycin, linezolid, daptomycin, ceftaroline or strep rx (IV unasyn → PO augmentin) x7-14d
**PNEUMONIA**

- **Path:** infx of alveoli
- **Etiology**

| CAP       | S. pneumoniae**  
|-----------|------------------|
|           | Atypicals: Mycoplasma, Chlamydia, viral (esp in young & healthy) 
|           | H. influenza, M. catarrhalis (esp. In COPD) 
|           | Legionella (esp in elderly, smokers, low immunity, TNF inh) 
|           | Klebsiella & other GNR (esp alcoholics and respirators) 
|           | S. aureus (esp postviral infx) 
|           | Influenza A & B 
|           | B. pertussis (whooping cough) in unvaccinated or adults w/ waning immunity 
|           | No organism identified in 40-60% of cases |
| HCAP      | GNR i.e. pseudomonas, S. aureus, klebsiella, E. coli, Enterobacter, Acinetobacter |
| Aspiration| Typically polymicrobial 
|           | Chemical pneumonitis d/t aspiration of gastric contents 
|           | Bacterial pneumonitis >1-3d later d/t aspiration of oropharyngeal microbes 
|           | Outpt - typical oral flora (strep, S. aureus, anaerobes) 
|           | Inpt or chronically ill: **GNR, anaerobes, and S. aureus** 
|           | RFs: alcoholics, dementia, esophageal dysmotolity, neuromuscular i.e. MG |
| Immuno-suppressed | HCAP orgs + PCP, fungi, Nocardia, non-TB mycobacteria, CMV, HSV |

- **“Typical”** - Fever, cough +/- purulent sputum, SOB, fatigue, malaise, pleuritic chest pain 
- **“Atypical”** - insidious onset, dry cough, N/V/D, HA, myalgias, sore throat 
- HCAP: in hosp >48hrs, admitted within last 90d, from NH, dialysis or chemo pt, IV abx within 30d 
- Signs: wheezes, inspiratory crackles/rales, decreased breath sounds, dullness to percussion, egophony, tactile fremitus ("consolidation") 
- **Diagnosis = clinical + radiographic evidence required**
  - CBC, BMP, RVP 
  - Sputum culture & gram stain (consider blood cultures - before abx!) 
  - CXR ("infiltrates" or "consolidation") 
- CURB-65 (confusion, uremia = BUN >7, RR >30, BP <90/60, >65yo, pleural effusion) 
  - 0-1 → outpatient 
  - >2 → consider hospitalization 
- **Treatment**
  - **Outpatient; non-complicated, no abx 3mo prior:**
    - **Augmentin** 500mg q8hrs (amox+clav) 
    - **Azithromycin** x5d (zpak OR 500mg x3d) 
    - **Doxycycline** 100mg BID 
    - **Levaquin** good for elderly 
  - **Comorbidities or recent abx:** FQs (levo/moxi) 
  - **CAP:** 3rd generation cephalosporin (ceftriaxone) + macrolide (azithromycin) 
  - **HCAP = zosyn, vanco, cefepime, ceftazidime, meropenem** 
  - **Aspiration:** (3rd gen ceph OR FQ) +/- (clinda or metronidazole)

*CAP = Ceftriaxone + Azithromycin (gram neg + strep/atypicals) 
PCN = Ceftriaxone (broader spectrum) 
Azithromycin 
Levofloxacin (strept+atypicals) 
If allergies: doxy 
vancomycin + Zosyn (pseudomonas + MRSA) 
Gram neg → Cefepime, Ceftazidime 
PCN + pseudo coverage → Zosyn, levo/cipro, meropenem 
Unasyn (GNR + anaerobes) 
Clindamycin 
Augmentin (PO)
**PE / DVT**

- **Risks:** cancer, pregnancy & postpartum, trauma or surgery, estrogen, obesity, protein C & S deficiency.
- **Virchow’s triad:**
  - Hypercoagulable state - pregnancy, OCP, HRT, HIT, tamoxifen, protein C & S deficiency
  - Venous stasis - bed rest, inactivity, CHF, CVA, w/in 3mo, air travel >6hrs
  - Vascular endothelial injury - trauma, surgery, inflammation, prior DVT
- **DVT s/sx:** calf pain, leg swelling, tenderness, erythema, warmth, venous distention, palpable cord, Homans sign (stagnant blood - edema, pain, cyanosis)
- **PE s/sx:** dyspnea*, pleuritic chest pain, hemoptysis (classic triad), cough, tachycardia, sweating, fever, crackles (+ syncope/hypotension in massive PE)
- **PE Sources:** venous thrombi from LEs & pelvis**, renal & ovarian veins, L-R shunts from emboli originating in left atrium, right side of heart

**WORK UP BASICS**

- Wells criteria to identify risk
  - Moderate or high risk patient → D-dimer → CTA
  - PERC rule can r/o need for further testing IF pt has low clinical probability of PE
- Labs: D-Dimer (<500 helps r/o DVT), ABG (elevated A-a gradient, mild respiratory alkalosis)
  - May see troponin leak secondary to right heart strain
- Imaging: duplex US, EKG (sinus tach, signs of RV strain i.e. RAD or S1Q3T3 pattern, transient nonspecific ST-T wave changes), V/Q scan, CTA with contrast***, CT pulmonary angiography (gold standard but invasive, infrequently performed)
- **Tx:**
  - Anticoagulation: LMWH (lovenox), fondaparinux, IV UFH, rivaroxaban
  - Thrombolitics: TPA / Alteplase, streptokinase
    - Only if hemodynamically unstable, massive PE, and low bleed risk
  - Others: early ambulation, IVC filter, thrombectomy
- **Thromboprophylaxis:** UFH SC or LMWH, mechanical prophylaxis

---

**Wells criteria and modified Wells criteria: clinical assessment for pulmonary embolism**

<table>
<thead>
<tr>
<th>Clinical feature</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical symptoms of DVT (leg swelling, pain with palpation)</td>
<td>3.0</td>
</tr>
<tr>
<td>Other diagnosis less likely than pulmonary embolism</td>
<td>3.0</td>
</tr>
<tr>
<td>Heart rate &gt;100</td>
<td>1.5</td>
</tr>
<tr>
<td>Immobilization (≥23 days) or surgery in the previous four weeks</td>
<td>1.5</td>
</tr>
<tr>
<td>Previous DVT/PE</td>
<td>1.5</td>
</tr>
<tr>
<td>Homoptysis</td>
<td>1.0</td>
</tr>
<tr>
<td>Malignancy</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Probability</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>&gt;6.0</td>
</tr>
<tr>
<td>Moderate</td>
<td>2.0 to 6.0</td>
</tr>
<tr>
<td>Low</td>
<td>&lt;2.0</td>
</tr>
</tbody>
</table>

**Pretest probability of deep vein thrombosis (Wells score)**

<table>
<thead>
<tr>
<th>Clinical feature</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active cancer (treatment ongoing or within the previous six months or palliative)</td>
<td>1</td>
</tr>
<tr>
<td>Paralysis, paresis, or recent plaster immobilization of the lower extremities</td>
<td>1</td>
</tr>
<tr>
<td>Recently bedridden for more than three days or major surgery, within four weeks</td>
<td>1</td>
</tr>
<tr>
<td>Localized tenderness along the distribution of the deep venous system</td>
<td>1</td>
</tr>
<tr>
<td>Entire leg swollen</td>
<td>1</td>
</tr>
<tr>
<td>Calf swelling by more than 3 cm when compared to the asymptomatic leg (measured below tibial tuberosity)</td>
<td>1</td>
</tr>
<tr>
<td>Pitting edema (greater in the symptomatic leg)</td>
<td>1</td>
</tr>
<tr>
<td>Collateral superficial veins (nonvaricose)</td>
<td>1</td>
</tr>
<tr>
<td>Alternative diagnosis as likely or more likely than that of deep venous thrombosis</td>
<td>-2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Score</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High probability</td>
<td>3 or greater</td>
</tr>
<tr>
<td>Moderate probability</td>
<td>1 or 2</td>
</tr>
<tr>
<td>Low probability</td>
<td>0 or less</td>
</tr>
</tbody>
</table>

**Modification:**

This clinical model has been modified to take one other clinical feature into account: a previously documented deep vein thrombosis (DVT) is given the score of 1. Using this modified scoring system, DVT is either likely or unlikely, as follows:

| DVT likely | 2 or greater |
| DVT unlikely | 1 or less |
### ANEMIA

- **Fe** low Hgb, Hct, RBC
- **Factors** affecting Hgb (plasma:blood volume): hydration, pregnancy, environment, age, gender
- **S/sx:** dyspnea, DOE, fatigue, weakness, dizziness, palpitations, bounding pulses, roaring pulses in ears, pallor, tachycardia, hypotension, pica (in Fe-def)
  - Look for jaundice, murmur, splenomegaly, AMS
- **Microcytic (MCV <80):** Iron deficiency, thalassemia, chronic blood loss (GI bleed, menometrorrhagia), chronic dz/inflammation (late), lead poisoning, sideroblastic (EtOH abuse)
- **Normocytic (80-100):** chronic dz (infx, inflammation, malignancy), acute blood loss, sickle cell, BM suppression, aplastic anemia, nephrogenic, hypothyroidism, iron def (early)
- **Macrocytic (MCV >100):** B12 def, folate def, EtOH abuse (target cells), liver disease, reticulocytosis / hemolytic anemia, AML, drug-induced, hypothyroidism (less common)
- **Reticulocyte Index** indicates if bone marrow is responding appropriately to anemia

<table>
<thead>
<tr>
<th>Iron Deficiency Anemia</th>
<th>Fe deficiency, poor diet, chronic blood loss (GI bleed, menometrorrhagia), malabsorption, increased requirements (pregnancy) ↓ serum iron, ferritin, transferrin sat (serum Fe/TIBC), MCV, MCH, retic count ↑ TIBC, platelet count (slightly) Tx: iron replacement therapy with ferrous sulfate (PO preferred, IV available)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemia of Chronic Dz / Inflammation</td>
<td>Infx, inflammation, malignancy → decreased RBC production vs. increased loss ↓ serum iron, TIBC, transferrin sat, retic count ↑ ferritin Tx: transfusion of packed RBCs, EPO, treat underlying disorder</td>
</tr>
<tr>
<td>B12 and Folate Deficiency</td>
<td>B12 &amp; Folate are co-factors for thymine which is needed for DNA Clues → GI sx, diarrhea, weight loss, paresthesia B12 malabsorption due to: pernicious anemia, alcoholism, GI disorders, dietary deficiency, disease of parietal cells Pernicious anemia = abs against gastric intrinsic factor (associated with hypothyroidism) Folate malabsorption due to: alcoholism, malabsorption syn, dietary def, increased requirements (pregnancy, hemolysis), meds ↓ retic count, MCH, platelets (slightly) ↑ MCV, bili, Fe Hypersegmented PMNs and/or megaloblasts (large immature RBCs) on smear Schilling Test Tx: PO B12 if dietary etiology, parenteral B12 shot q1mo otherwise (lifelong therapy) Tx: PO and aqueous folate replacement therapies</td>
</tr>
<tr>
<td>Hemolytic Anemias</td>
<td>Clues → brown urine, splenomegaly, jaundice, scleral icterus ↑ retic count, indirect (bili), urinary bilinogen, LDH Autoimmune Hemolytic Anemias (AHAs) = warm vs. cold autoabs (Direct Coombs Test) Sickle Cell → sickled cells on peripheral smear --Sickledex test detects abnormal HbS → will detect both carrier &amp; disease, but does not differentiate between the two (AS vs. SS) → need to do hemoglobin gel electrophoresis to determine if heterozygote or homozygote G6PD Deficiency → episodes of anemia instigated by factors increasing ROS (fluoroquinolones, ibuprofen, fava beans); see Heinz bodies on smear Thalassemia → reduced globin synthesis, m/c in Asian &amp; Mediterranean descent, microcytic megaloblastic, target morphology</td>
</tr>
</tbody>
</table>
MULTIPLE MYELOMA

- Neoplastic proliferation of plasma cells that usually produce monoclonal immunoglobulins
- “CRAB”
  - Hypercalcemia (w. low PTH)
  - Renal insufficiency (AKI)
  - Anemia (normocytic)
  - Bone pain (lytic lesions)
- Additional features: thrombocytopenia, high protein (but low albumin → “protein gap”), hyperviscosity (rouleaux), lytic lesions
- Diagnostic tests:
  - SPEP & UPEP (electrophoresis looking for M protein) → shows M spike
  - Serum free light chain assay → shows light chains in urine
  - Xray → lytic lesions
  - Gold standard = bone marrow bx (>10% clonal plasma cells)
- Therapies:
  - “Smoldering MM” = no bone lesions or other end-organ damage → may be observed without treatment for many years
  - Symptomatic MM → dexamethasone + chemo (vincristine/doxorubicin or thalidomide)
    - Autologous stem cell transplant may be possible for some pts
- Ddx: MGUS (monoclonal gammopathy of undetermined significance)
- Prognostic indicators: serum Beta-2 microglobulin, LDH

ALCOHOLIC CIRRHOSIS W/ ASCITES

- Paracentesis w/ albumin, lasix, spironolactone, atenolol, lactulose, cx ascites (r/o SBP)
- Thiamine and folic acid
- EGD variceal screening
- RUQ US screening for hepatic carcinoma (consider AFP?)
- Immunizations for hepatitis and HIV
- Hold nephrotoxic drugs
- Complications
  - Varices → octreotide (somatostatin analog, vasoconstrictor), ceftriaxone ppx
  - Encephalopathy → lactulose, rifaximin
**HYPONATREMIA**

- Serum Na concentration <135, severe if <120 (normal plasma osm = 275–295 mosm/kg)
- S/sx: HA, confusions, seizures; may be asymptomatic
- Causes:
  - **low plasma osmolality, elevated ADH:** (low plasma osm usually <275-290mOsm/L)
    - Decrease in effective circulating volume (GI bleeding, exercise, heart failure / decreased cardiac output, cirrhosis, thiazide diuretics) → ADH secretion by posterior pituitary
    - SIADH (lung cancer, drugs, infections i.e. brain abscess, TBI, malignancy)
    - Adrenal Insufficiency
    - Hypothyroidism
  - **low plasma osmolality, low ADH:**
    - advanced renal failure
    - primary polydipsia (d/t psychogenic or hypothalamic lesions)
    - low dietary solute intake → beer drinkers or other malnourished pts
  - **normal serum osmolality:** hyperglycemia, mannitol, renal failure
  - **pseudohyponatremia**
- Lab tests: urine osmolality, plasma osmolality, urine sodium concentration
- Treatment = sodium chloride NaCl
  - correction rate: no more than 10mEq/L/day
  - asymptomatic volume depletion: 1-2L of 0.9% NaCl (if serum Na declines & urine Na increases, think SIADH rather than volume depletion)
  - Acute (<24hrs) severe (<120mEq/L) OR symptomatic (seizures, coma): 3% NS 1-2mEq/L/h
- Complications:
  - correcting too rapidly can cause osmotic demyelination syndrome (target <8meq/24hrs)

**HYPERNATREMIA**

- Na >145 mEq/L, severe if >155
- S/sx: AMS, confusion, dehydration, seizures
- Causes: sodium gain vs. water loss
  - **Water loss**
    - decreased water intake → see low urine output (<20mL/hr) and high urine osm
    - osmotic diuresis (DM)
    - Diabetes Insipidus → low urine osm, low urine Na
      - central: ADH not released from post. Pituitary (TBI, neoplasm, surgery)
      - nephrogenic: insensitivity of kidneys to ADH (hypoK, malnutrition, renal dz)
    - GI losses
    - Insensible & sweat loses
    - hypothalamic lesions impairing thirst or osmoreceptor function - primary hypodipsia
    - severe exercise (water loss into cells)
    - seizures (water loss into cells)
  - **Sodium overload**
    - intake of hypertonic sodium solutions (saline, hypertonic bicarb)
    - hypertonic dialysis or hypertonic feedings
- Treatment: volume repletion, sodium restriction, consider vasopressin, dialysis
HYPOKALEMIA
- K <3.5, severe if <2.5
- **EKG Findings:** flat T-waves, U waves, ST depression, prolonged QT
- S/sx: pronounced weakness, hyporeflexia, ileus, paralysis, dysrhythmias
- Causes:
  - GI: emesis, diarrhea, laxative abuse, starvation
  - Renal: renal tubular acidosis, diuretics, cushing syndrome, hypoMg
  - Hypothyroidism & intracellular shift
- Management: K+ (PO>IV replacement preferred), 40mEq will ↑ [K] by 1mEq/L
  → increase it until reaches 4+ with PO (preferred) vs. IV (sclerosing)
  → 0.1 units increases K by 10meq

HYPERKALEMIA
- K >4.5, severe if >6.5
- **EKG Findings:** peaked T’s → QRS widening, prolonged PR, flat P’s → Vfib, sine wave (>8)
- S/sx: lethargy, weakness, hypotension, dysrhythmias, paralysis
- Causes:
  - ↓ cellular uptake: drugs (beta blockers), diabetic ketoacidosis
  - ↑ K level (cellular breakdown): GI bleeding, hemolysis, trauma, rhabdomyolysis, lysis
  - Renal: renal failure, aldosterone insufficiency, K-sparing diuretics, renal tubular acidosis
- Management:
  - Hyperkalemic emergency (symptomatic, >6.5, renal dz, ongoing breakdown, etc.)
    - rapidly acting therapy: IV calcium (gluconate or chloride), insulin +/- glucose
    - Removing calcium: Furosemide, dialysis +/- GI cation exchanger (patiromer)
  - Kayexalate ???
  - Sodium bicarb → questionable, seems to be beneficial with metabolic acidosis
  - Renal disease → dialysis +/- GI cation exchanger (patiromer)
  - Non-emergent → diuretic +/- patiromer

MAGNESIUM → increase it until 2+ with slow Mg vs. Mg oxide

HYPOCALCEMIA
- Ca <8.5 mg/dL, severe if <7
- S/sx: neuromuscular → paresthesias, carpopedal spasms, hyperreflexia, seizures
  - **Chvostek sign** = tapping of facial n. elicits tetany
  - **Trousseau sign** = occluding brachial artery (BP cuff) elicits carpal spasm
- Causes:
  - PTH low: hypoparathyroidism, autoimmune disorders, genetic disorders,
  - PTH high: Vit D def, renal failure, acute pancreatitis, sepsis
  - Misc: hypoMg, rhabdo
- Management if symptomatic or acute decrease <7.5
  - IV calcium gluconate 1-2g in 50ml 5% dextrose over 10-20min OR
  - IV CaCl 10% soln over 20min if acutely symptomatic
  - Mildly symptomatic or chronic → oral Ca supplementation via calcium carbonate or calcium citrate (1500-2000mg of elemental calcium daily)
  - Hypoparathyroidism → calcitrol (0.5-1mcg daily) + oral Ca (1-4g daily)
  - Hypomagnesemia → magnesium sulfate
HYPERCALCEMIA

- Ca >10.5 mg/dL, severe if >12 (admit if >13?)
- Free calcium is ionized, protein-bound calcium (~45%) is principally bound to albumin
- **EKG changes:** short QT interval, widening T-wave, heart block
- **S/sx:** moans, groans, stones, bones, psychic overtones
  → nausea, abd pain, N/V, constipation, kidney stones, bone pain, AMS
- **Diagnostic approach:**
  - Labs to order: Ca, LFTs (albumin), Phos, ionized Ca, Vit D 1-25
  - Step 1) Is it real? How bad is it? Is the patient symptomatic?
  - Step 2) correct for albumin: Corrected Calcium = Serum Calcium+0.8(4-serum albumin)
  - Step 3) Measure PTH to route etiology of hyperparathyroidism
  - Step 4) Consider measuring PTHrp if other tests unyielding
- **Etiologies:**
  - High PTH: hyperparathyroidism
  - Normal PTH: FHH
  - Low PTH: malignancy*, vit D intoxication, granulomatous dz (sarcoid, TB)
    - *lymphoma, boney mets, lung cancer
  - Misc: drugs, hyperthyroid, pheo, adrenal insufficiency, milk alkali syndrome
- **Management:**
  - Considerations: Altered? Acute vs. chronic? Symptomatic?
  - IV Fluids NS 200-300cc/hr +/- Furosemide (if no renal dysfunction)
    - + Calcitonin - ↓ Ca within 12-48hrs
    - + Bisphosphonates (Zolendronic Acid) - ↓ Ca with 48-96hrs
  - Dialysis for pts with Ca >18, renal failure, neuro sx

HEMATOLOGY

- Vit K necessary for the activation of coagulation factors II (prothrombin), VII, IX, X
- Common pathway = I, II, V, X
- PT → extrinsic & common pathway = Factor VII
  - Prolonged with coumadin, vitamin K, liver disease
- PTT → intrinsic & common pathway = Factor XII, XI, IX, VIII
  - Prolonged with heparin, coumadin, hemophilia, VWD, sepsis, DIC
- Hemophilia A → Factor VIII ↓ activity → prolonged PTT, normal PT, BT, platelet count
- Von Willebrand dz → abnormal PTT and bleeding time, normal PT and platelet count
- DIC → excessive small vessel thrombosis causes consumption of fibrinogen and results in excessive bleeding tendency → prolonged PT, PTT, thrombin time; low platelet & fibrinogen, schistocytes on peripheral smear
- Iron-deficiency anemia (hypochromic microcytic) → do serum ferritin, fasting level of serum iron, total iron-binding capacity → tx with ferrous sulfate
- Sickle Cell Disease: anemia, jaundice, frequent infx, vision problems, swelling
  - Acute chest syndrome, vaso-occlusive crisis (pain crisis), aplastic crisis (RBCs not produced), CVA, renal papillary necrosis, priapism
HYPERTENSIVE CRIOSES

• Precipitating causes: sympathomimetic drugs, drug withdrawal (rebound HTN), renal artery stenosis, glomerulonephritis, pheochromocytoma

→ HYPERTENSIVE URGENCY → no acute end-organ damage (pt may be asymptomatic)
  • Require prompt treatment over 1-2 days, can be monitored in outpatient setting
  • Goal of <160/100 (usually associated with BP >180/120 but not necessary)
  • PO medications
    ○ Lowering over several hours:
      ■ Oral **furosemide** (if the patient is volume overloaded) at a dose of 20 mg (or higher if the renal function is not normal)
      ■ Oral **clonidine** (but not intended as long-term therapy) at a dose of 0.2 mg
      ■ Oral **captopril** (if the patient is not volume overloaded) at 6.25 or 12.5 mg
    ○ Lowering over several days
      ■ Reinstate previously used med, at higher dose, with diuretic
      ■ Not treated before: CCB, BB, ACEI/ARB (i.e. nefedipine 30mg long acting)
  • Be cautious of pts in danger of cardiac or cerebral ischemia

→ HYPERTENSIVE EMERGENCY → acute end-organ damage
  • Require immediate tx over minutes to hours, and monitoring in ICU
  • Goal tx: ↓ MAP by up to 25%, or diastolic BP 100-110 (? 160/100-110)
    ○ ↓ MAP by 10-20% in first hour, then 5-15% more in next 23hrs
    ○ Monitor BP with arterial catheter
  • Medications: **IV labetalol, sodium nitroprusside + beta blocker, nicardipine, nitro**
    ○ Renal → fenoldopam
    ○ Neurologic → labetalol & *nicardipine
    ○ Cardiac → nitro, esmolol, nicardepine, loop diuretics + nitroprusside/nicardepine
    ○ Avoid beta blocker w/ cocaine (though may consider IV labetalol)
  • Exceptions to gradual BP lowering over first day:
    ○ Acute aortic dissection – SBP is rapidly lowered to a target of 100 to 120 mmHg (to be attained in 20 minutes) → esmolol + nitroprusside
    ○ Intracerebral hypertension
    ○ The acute phase of an ischemic stroke – BP is usually not lowered unless it is ≥185/110 mmHg in patients who are candidates for reperfusion therapy or ≥220/120 mmHg in patients who are not candidates for reperfusion therapy.
  • Sx: confusion, agitation, headaches, palpitations, lightheaded
  • Signs: papillededema, scattered retinal hemorrhages, tachycardic with bounding pulses, possible tremulousness
  • Ex: encephalopathy, ICH, SAH, aortic dissection, MI, LV failure, glomerulonephritis, withdrawal of short-acting antihypertensives, pheochromocytoma
MISC
- LUNG CANCER (small cell) can present with SIADH
- DENTAL INFX → strep (PCN) & anaerobes (Flagyl)
- RHABDO → fluids
- UTI → cipro 400mg or Bactrim
- DIVERTICULITIS → Cipro + Flagyl (vs. Zosyn if severe)
- ACUTE LIVER FAILURE → consider when you have AMS + increased LFTs → NAC
- PSEUDOGOUT → chondrocalcinosis, polyarticular arthritis → tx w/ prednisone
- Vitamin K reversal → are they bleeding?? K Centra
- ASCITES DDx → cirrhosis, CHF, malignancy, nephrotic syndrome
  - Concern for SBP in alcoholics with fever and Abd distension
  - Serum-to-ascites albumin gradient (SAAG) accurately identifies the presence of portal hypertension and is more useful than the protein-based exudate/transudate concept → calculated by subtracting the ascitic fluid albumin value from the serum albumin value, which should be obtained the same day
  - <1.1 indicates pt does not have portal hypertension (infx, malignancy)
  - ≥1.1 predicts that the patient has portal hypertension (likely cirrhosis)

<table>
<thead>
<tr>
<th>Blood Glucose range</th>
<th>Type I</th>
<th>Type II</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-150</td>
<td>0 units</td>
<td>0 units</td>
</tr>
<tr>
<td>150-200</td>
<td>0 units</td>
<td>0 units</td>
</tr>
<tr>
<td>200-250</td>
<td>1 unit</td>
<td>2 units</td>
</tr>
<tr>
<td>250-300</td>
<td>2 units</td>
<td>4 units</td>
</tr>
<tr>
<td>300-350</td>
<td>3 units</td>
<td>6 units</td>
</tr>
<tr>
<td>&gt;350</td>
<td>Call MD</td>
<td>Call MD</td>
</tr>
</tbody>
</table>