CRAM SLIDES
From National Emergency Medicine Board Review 2016
## Joint Fluid Analysis (2)

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Non-inflammatory</th>
<th>Inflammatory</th>
<th>Septic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clarity</strong></td>
<td>transparent</td>
<td>transparent</td>
<td>Cloudy</td>
<td>Cloudy</td>
</tr>
<tr>
<td><strong>Color</strong></td>
<td>Clear</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
</tr>
<tr>
<td><strong>WBC</strong></td>
<td>&lt;200</td>
<td>200-2000</td>
<td>200-50,000</td>
<td>&gt;50,000</td>
</tr>
<tr>
<td><strong>PMNs</strong></td>
<td>&lt;25</td>
<td>&lt;25</td>
<td>Variable</td>
<td>&gt;50</td>
</tr>
<tr>
<td><strong>Culture</strong></td>
<td>Neg.</td>
<td>Neg.</td>
<td>Neg.</td>
<td>&gt;50% pos.</td>
</tr>
<tr>
<td><strong>Crystals</strong></td>
<td>None</td>
<td>None</td>
<td>Multiple or None</td>
<td>None</td>
</tr>
<tr>
<td><strong>Associated conditions</strong></td>
<td>Osteoarthritis</td>
<td>Gout, Pseudogout, RA, psoriatic/reactive arthritis</td>
<td>Gonococcal, Staph</td>
<td></td>
</tr>
</tbody>
</table>
# Gout vs. Pseudogout (1)

<table>
<thead>
<tr>
<th></th>
<th><strong>GOUT</strong></th>
<th><strong>PSEUDOGOUT</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAUSE</strong></td>
<td>Uric acid <em>Needle-shaped</em> crystals</td>
<td>Calcium pyrophosphate <em>Rhomboid</em> crystals</td>
</tr>
<tr>
<td><strong>SOURCE</strong></td>
<td>Overproduction/over-intake or decreased renal excretion (diuretic)</td>
<td>Most idiopathic, some hypercalcemic</td>
</tr>
<tr>
<td><strong>WHERE</strong></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; MTP, knee, ankle, tarsals</td>
<td>Knee, wrist, ankle</td>
</tr>
<tr>
<td><strong>WHO</strong></td>
<td>Middle-age, M&gt;F</td>
<td>Elderly, M=F</td>
</tr>
</tbody>
</table>
Rheumatic Fever

• A noninfectious immune disease, occurring in genetically predisposed individuals caused by sensitization to certain types of group A beta-hemolytic Streptococci

• Occurs 3-4 weeks after infection

• Jones Criteria (2 major or 1 major and 2 minor)

  • **Major criteria**
    – Migratory polyarthritis
    – Carditis*
    – Chorea* (rapid face and arm movements – late)
    – Erythema marginatum*
    – Subcutaneous nodules*(back of wrist, elbow, front of knees)
    
  • **Minor criteria**
    – Fever
    – Arthralgias
    – Prior history of RF
    – Prolonged PR interval
    – Elevated acute phase reactants (CRP)
    – Evidence of group A strep infection

  *rare
# Glasgow Coma Scale

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye opening</strong></td>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Eyes open to command</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Eyes open to pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>No reaction</td>
<td>1</td>
</tr>
<tr>
<td><strong>Verbal response</strong></td>
<td>Oriented</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Confused, disoriented</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Unintelligible sounds</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>No verbal response</td>
<td>1</td>
</tr>
<tr>
<td><strong>Motor response</strong></td>
<td>Obey commands</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Localized pain</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Withdraws from pain</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Flexion posturing to pain</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Extensor posturing to pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>No reaction</td>
<td>1</td>
</tr>
</tbody>
</table>

3 = worst

15 = best
Penetrating Neck Injury (2)

- Hard signs (significant injury probably exists)
  - Hypotension
  - Arterial bleeding
  - Expanding hematoma
  - Thrill, bruit
  - Focal deficits
  - Hemothorax >1,000 mL
  - Bubbling wound
  - Hemoptysis, hematemesis

- Soft signs (require full diagnostic evaluation)
  - Stridor
  - Hoarseness
  - Vocal cord paralysis
  - Subcutaneous air
  - Facial nerve injury
Penetrating Neck Injury (3)

• Hard signs: Unstable require surgical exploration
  • Zone I: Requires thoracic surgical approach
  • Zone II: Exploration technically least difficult
  • Zone III: May require disarticulation of mandible

• Stable patients (evaluation)
  • Zone I: Angiogram, esophagram, endoscopy, bronchoscopy
  • Zone II: Exploration or angiogram, esophagram, endoscopy, bronchoscopy
  • Zone III: Angiography
Stab Wound Neck

Zone III
above angle of the mandible

Zone II
between mandible - cricoid

Zone I below cricoid cartilage
Abdominal Signs

- **Grey Turner’s sign**: Flank discoloration (late sign of retroperitoneal hematoma; seen in hemorrhagic pancreatitis)
- **Kehr’s sign**: Referred left shoulder pain due to subdiaphragmatic irritation or splenic rupture
- **Cullen’s sign**: Periumbilical ecchymosis (in hemorrhagic pancreatitis, ectopic pregnancy)
- **Rovsing’s sign**: RLQ pain with LLQ palpation (due to peritoneal irritation e.g. acute appendicitis)
Spleen

**Most common organ injured in blunt trauma**

- Shock, LUQ pain, Kehr’s sign
- Diagnosis: CT
- Treatment
  - Consider non-operative management
  - Give Pneumococcal and HIB vaccines post-splenectomy
  - Post-splenectomy sepsis has high mortality

Liver

**Most common organ injured in penetrating trauma**

Capsular hematoma: false-negative DPL
Diagnosis: CT scan
Contraindications to Thrombolytic Therapy

**Absolute**
- PCI immediately available
- Active bleeding from any site
- CVA within 6 months or hemorrhagic CVA at any time in the past
- Intracranial or intraspinal surgery or trauma within 2 months
- Intracranial or intraspinal neoplasm, aneurysm or AV malformation
- Suspected aortic dissection

**Relative**
- History of GI bleed
- **Prolonged CPR**
- Surgical or invasive procedure within 3 weeks
- Severe bleeding diathesis or thrombocytopenia
- **Uncontrolled** hypertension (diastolic >120 after treatment)
- Significant trauma within 4 weeks
- Pregnancy or <10 days post-partum
- Active cavitary lung disease
- Known allergy to agent
Infective Endocarditis (2)

• Valvular involvement (MATP)
  • Mitral > aortic > tricuspid (IVDA) > pulmonic

• IVDA
  • Most have normal valves (75%)
  • Tricuspid valve most common (50%)
  • Staph. aureus is the most common pathogen

• Prosthetic valves
  • Staph. aureus
Infective Endocarditis (3)

Types

• Acute IE
  • Younger, normal valves in half the cases
  • Virulent strains
  • Higher morbidity and mortality
  • *Staph. aureus*

• Subacute IE
  • Older, abnormal valves
  • Anemia of chronic disease
  • *Strep. viridans* (50-60%)
Pericarditis (4)

- EKG: four stages
  - Stage 1: Diffuse ST elevation (does not correspond to coronary artery distribution) & PR segment depression
  - Stage 2: ST-segments and PR return to baseline
  - Stage 3: T wave inversions
  - Stage 4: Normalization of EKG
Aortic Dissections:

Involves the ascending aorta with indeterminate extension into the transverse and descending aorta.

Most likely sites of origin

Variable extension into the transverse and descending aorta

Stanford Type A
Aortic Dissections:

Stanford Type B

Involves the transverse and/or descending aorta only.

Most likely sites of origin

Variable extension into the descending aorta
EKG - Hypercalcemia / Hypocalcemia

- Hypercalcemia
  - Shortened QT interval

- Hypocalcemia
  - Prolonged QT interval

Images courtesy www.EmedHome.com
EKG - Wolff-Parkinson-White Syndrome (2)

- Treatment is based on QRS width
  - Narrow-complex regular tachycardia
    - Treat like SVT
  - Wide-complex regular tachycardia
    - Treat like VTach
  - A-fib with QRS complexes that change width and have rates > 200-250
    - Procainamide, cardioversion
    - Do not use AVN blockers: digoxin, CCBs, BBs, adenosine, amiodarone
EKG - Second Degree Heart Block

• **Mobitz I (Wenckebach)**
  • Progressively longer PR and shorter RR until a beat is dropped, then starts over
  • Causes: same as 1\textsuperscript{st} degree block, common with inferior MI, often transient; treatment if hemodynamic instability
  • Atropine or transcutaneous pacemaker usually sufficient

• **Mobitz II**
  • Constant PR interval and dropped beats
  • Associated with anterior MI and destruction of conduction tissue
    • Usually associated with bundle branch block
  • May progress to complete heart block
  • Temporary pacer often needed in the setting of AMI
<table>
<thead>
<tr>
<th>Agent</th>
<th>Antidote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaminophen</td>
<td>Acetylcysteine (NAC)</td>
</tr>
<tr>
<td>Arsenic</td>
<td>BAL, DMS</td>
</tr>
<tr>
<td>Aspirin</td>
<td>Alkaline diuresis, hemodialysis</td>
</tr>
<tr>
<td>Beta-blocker</td>
<td>Glucagon, intralipids</td>
</tr>
<tr>
<td>Barbiturate</td>
<td>Alkaline diuresis, hemodialysis</td>
</tr>
<tr>
<td>Calcium channel blocker</td>
<td>Calcium, glucagon, gluc/insulin, intralipids</td>
</tr>
<tr>
<td>Carbamate</td>
<td>Atropine</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>100% O&lt;sub&gt;2&lt;/sub&gt;, hyperbaric O&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td>Warfarin</td>
<td>FFP / Vit K / PCCs</td>
</tr>
<tr>
<td>Cyanide</td>
<td>Sodium nitrite, sodium thiosulfate, hydroxycobalalmine</td>
</tr>
<tr>
<td>Digitalis</td>
<td>Digibind (fab antibodies)</td>
</tr>
</tbody>
</table>
## Agent / Antidote (2)

<table>
<thead>
<tr>
<th>Agent</th>
<th>Antidote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene glycol</td>
<td>Bicarbonate, ethanol, dialysis, 4-MP</td>
</tr>
<tr>
<td>Heparin</td>
<td>Protamine</td>
</tr>
<tr>
<td>Hydrofluoric acid</td>
<td>Calcium, magnesium</td>
</tr>
<tr>
<td>Iron</td>
<td>Deferoxamine</td>
</tr>
<tr>
<td>Isoniazid (INH)</td>
<td>Pyridoxine (Vit B-6)</td>
</tr>
<tr>
<td>Lead</td>
<td>BAL, DMS, EDTA</td>
</tr>
<tr>
<td>Mercury</td>
<td>BAL, DMS</td>
</tr>
<tr>
<td>Methemoglobin</td>
<td>Methylene blue</td>
</tr>
<tr>
<td>Methanol</td>
<td>Bicarbonate, ethanol, dialysis, 4-MP</td>
</tr>
<tr>
<td>Nitrites</td>
<td>Methylene blue</td>
</tr>
<tr>
<td>Opiates</td>
<td>Naloxone</td>
</tr>
<tr>
<td>Organophosphates</td>
<td>Atropine, 2-PAM</td>
</tr>
<tr>
<td>Oral hypoglycemic agents</td>
<td>Glucose, glucagon, octreotide</td>
</tr>
<tr>
<td>TCA</td>
<td>Sodium bicarbonate, intralipids</td>
</tr>
</tbody>
</table>
Formulas (1)

- Anion gap metabolic acidosis

\[(Na) - (Cl + CO_2), \text{ normal } \leq 12\]

- Increased
  - Methanol, metformin, massive ingestions
  - Uremia
  - DKA
  - Paraldehyde
  - Iron, INH
  - Lactic acidosis (CO, CN)
  - Ethylene glycol
  - Salicylates
Formulas (2)

• Osmolal gap = (measured) – (calculated)
• Normal gap <10

Calculated (nl 285-295) = 2 $\text{Na}$ + $\text{BUN}$ + $\text{Glu}$ + $\text{EtOH}$

\[
\begin{array}{c}
2.8 \\
18 \\
4.6
\end{array}
\]

• Increased gap: Acetone, isopropanol, methanol, ethylene glycol, mannitol, ketoacidosis, ethanol (most common)
Acetaminophen (2)

- Four clinical stages
  - **Stage I**  GI symptoms (N/V)
  - **Stage II**  GI symptoms resolve
    - Hepatic and renal dysfunction begins
  - **Stage III**  Peak LFTs, GI symptoms return
  - **Stage IV**  Recovery phase
Acute OD Acetaminophen (3)

- Toxic ingestion: 140 mg/kg (7-10 g in adults)
- **4 hour level** >140: Potentially toxic
- N-acetylcysteine (NAC)
  - Prevents binding of NAPQI to hepatic macromolecules
  - May also reduce NAPQI back to acetaminophen

  **NAC provides a cofactor needed to make inert metabolites of APAP**

  **Lack of this cofactor results in the production of hepatotoxic intermediary metabolites**

- Oral and IV preparations available
- Safe in pregnancy
- Charcoal does not inhibit effectiveness
- **Still indicated in late presentations >24hrs**
- Hepatotoxicity is rare in children
Alcohol (1) - Ethanol

- Ethanol intoxication should not give acidosis
- Search for other causes of altered MS (CNS)

Withdrawal
- “The shakes” (6-8 hours) / hallucinations (visual)
- Alcohol withdrawal seizures (6-48 hours)
  - Treat with benzodiazepines; no role for phenytoin
- Delirium tremens: **Confusion**, fever, tachycardia
- Treatment: Fluids, thiamine (B1), multivitamins, Mg++, folic acid, benzodiazepines

**Wernicke’s encephalopathy**: Oculomotor crisis
  - CN VI palsy (lateral rectus), nystagmus, ataxia, global confusion
**Korsakoff’s psychosis**: Retrograde amnesia, confabulation
Alcohol (2) - Methanol

- Paint thinner, window washer solvent, wood alcohol, gas tank additive
- Anion gap acidosis, *increased osmolal gap*
- Disc hyperemia (visual symptoms common)
- Methanol itself is nontoxic but alcohol dehydrogenase forms the toxic metabolite
  - Formaldehyde
  - Formaldehyde is then broken down by formaldehyde dehydrogenase into another toxin = formic acid
- Symptoms (often delayed 12-18hrs): Seizures, respiratory failure, N/V, pancreatitis, *visual changes* or blindness
Alcohol (4) - Ethylene Glycol

- Antifreeze, paint, solvents / has a sweet taste
- CNS depression, intoxication (without alcohol odor), anion gap acidosis, anuria, ↑osmolar gap
- Metabolized by alcohol dehydrogenase to the toxic intermediate glycoaldehyde which is then broken down to:
  - Oxalic acid (precipitates in urine and blood with calcium to form calcium oxalate crystals)
  - Glycolic acid (causes profound acidosis)
- Renal failure, hematuria, hypocalcemia
Alcohol (5) - Isopropyl Alcohol

• Rubbing alcohol
• CNS depression greater than ethanol
• Metabolism: In liver > 50% metabolized to acetone; renal & pulmonary excrete unchanged isopropyl alcohol
• Hemorrhagic gastritis, pulmonary edema, hypoglycemia
• Severe hypotension
• Supportive care, don’t give alcohol.

Ketosis but no acidosis / normal anion gap / increased osmolal gap

Increasing alcohol toxicities:
ethanol < isopropyl alcohol < ethylene glycol < methanol
Methemoglobinemia (2)

- Cyanosis unresponsive to O₂
- Chocolate brown blood (also seen with SO₄Hgb)
- Pulse ox unreliable, arterial PaO₂ normal
- Definitive identification with co-oximetry

Cyanosis reversible with methylene blue
(Reduces Fe³⁺⁺⁺ to Fe²⁺⁺)

Methylene blue is contraindicated in G6PD deficiency
Salicylates (1)

- Uncouple oxidative phosphorylation, causing metabolic acidosis
- Tachypnea, coma, seizures, pulmonary edema, fever, tinnitus, tachycardia
- Acute poisoning: GI symptoms, level correlates better with toxicity - suspect in unknown OD
- Chronic poisoning: Fewer GI and more CNS symptoms, level may not correlate with toxicity
  - Consider in elderly pt with ALOC
- Children: Hyperventilation, diaphoresis, behavioral changes - caution oil of wintergreen

Anion gap metabolic acidosis and respiratory alkalosis
Toxicology Pearls (1)

- **Bradycardia**
  - **P** Propranolol (beta blockers), poppies (opioids)
  - **A** Anticholinesterase drugs
  - **C** Clonidine, calcium channel blockers
  - **E** Ethanol, other alcohols
  - **D** Digoxin

- **Tachycardia**
  - **F** Freebase (cocaine)
  - **A** Anticholinergics, amphetamines
  - **S** Sympathomimetics, solvent abuse
  - **T** Theophylline
Toxicology Pearls (2)

- **Hyperthermia**
  - **N** NMS, nicotine
  - **A** Antihistamines
  - **S** Salicylates, sympathomimetics
    - Serotonin syndrome
  - **A** Anticholinergics, antidepressants
Toxicology Pearls (3)

- **Hypothermia**
  - C Carbon monoxide
  - O Oral hypoglycemics, insulin
  - O Opioids
  - L Liquor
  - S Sedatives, hypnotics

- **Hypotension**
  - C Clonidine, calcium channel blockers
  - R Reserpine (antihypertensive agents)
  - A Antidepressants, aminophyline
  - S Sedatives, hypnotics
  - H Heroin (opioids)
Toxicology Pearls (4)

• **Hypertension**
  - Cocaine
  - Thyroid supplements
  - Sympathomimetics
  - Caffeine
  - Anticholinergics, amphetamines
  - Nicotine

• **Hypoventilation**
  - Sedatives, hypnotics
  - Liquor
  - Opioids
  - Weed (marijuana)
Toxicology Pearls (5)

• Hyperventilation
  P  PCP, pneumonitis (chemical)
  A  ASA (salicylates)
  N  Noncardiogenic pulmonary edema
  T  Toxic metabolic acidosis

• Miosis
  C  Cholinergics, clonidine
  O  Opioids, organophosphates
  P  Phenothiazines, pilocarpine, pontine ble
  S  Sedatives, hypnotics
Toxicology Pearls (6)

• **Mydriasis**
  - **A** Antihistamines
  - **A** Antidepressants
  - **A** Anticholinergics, atropine
  - **S** Sympathomimetics (cocaine, amphetamines)

• **Diaphoretic skin**
  - **S** Sympathomimetics
  - **O** Organophosphates
  - **A** ASA (salicylates)
  - **P** PCP
Toxicology Pearls (7)
Skin Findings

- **Red skin:** Anticholinergics, boric acid, carbon monoxide

- **Blue skin:** Cyanosis, methemoglobinemia
  (nitrates, nitrites, aniline dyes, dapsone, phenazopyridine)

- **Blistering:** Barbiturates, CO, spider bites, snakes envenomations
Toxicology Pearls (8)

Seizures

- **O** Organophosphate
- **T** Tricyclic antidepressants
- **I** INH, insulin
- **S** Sympathomimetics

- **C** Cocaine, camphor
- **A** Amphetamines
- **M** Methylxanthines (theophylline)
- **P** Phencyclidine (PCP)
- **B** Benzo withdrawal, botanicals
- **E** Ethanol withdrawal
- **L** Lindane, lidocaine
- **L** Lead, lithium
Tox Odors: Pearls (9)

• Bitter almonds or “silver polish”: Cyanide
• Mothballs: Camphor
• Garlic: Arsenic, organophosphate, DMSO
• Rotten eggs: Sulfur dioxide, hydrogen sulfide
• Wintergreen: Methyl salicylate
• Peanuts: Vacor (rat poison)
• Carrots: Water hemlock
• Gasoline: Hydrocarbons
• Fruity: DKA, isopropanol
• Pears: Chloral hydrate
Toxicology Pearls (10)

- **Radiopaque Drugs**
  - **C** Chloral hydrate
  - Cocaine packets
  - **O** Opiate packets
  - **I** Iron
    - (Heavy metal: Pb, As, Hg)
  - **N** Neuroleptic agents
  - **S** Sustained release products, enteric coated preparations
Toxicology Pearls (11)

• **Noncardiogenic pulmonary edema**
  - **M** Meprobamate, methadone
  - **O** Opioids
  - **P** Phenobarbital, propoxyphene
  - **S** Salicylates
# Toxicology Pearls (12)

<table>
<thead>
<tr>
<th>Charcoal Not Useful</th>
<th>Charcoal Contraindicated</th>
<th>Multidose Charcoal</th>
<th>Whole Bowel Irrigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Alcohols</td>
<td>• Caustics</td>
<td>• Theophylline</td>
<td>• Sustained release drugs</td>
</tr>
<tr>
<td>• Cyanide</td>
<td></td>
<td>• Sustained release drugs</td>
<td>• Not absorbed by charcoal</td>
</tr>
<tr>
<td>• Iron</td>
<td></td>
<td>• Phenobarbital</td>
<td>• Body packer</td>
</tr>
<tr>
<td>• Lithium</td>
<td></td>
<td>• Salicylates</td>
<td></td>
</tr>
<tr>
<td>• Arsenic</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Charcoal is contraindicated in the presence of caustics.
Toxicology Pearls (13)

- **Dialysis**
  - Methanol
  - Isopropyl alcohol
  - Ethylene glycol
  - Lithium
  - Salicylate
  - Theophylline
  - Phenobarbital

- **Nondialyzable**
  - CN
  - TCAs
  - Iron
  - Benzodiazepines
  - Phenothiazines
  - Hallucinogens
Toxicology Pearls (14)

• **Delayed toxicity**
  • Acetaminophen
  • Digoxin
  • Ethylene glycol
  • Heavy metals
  • Methanol
  • Mushrooms
  • Narcotics
  • Iron
  • Salicylates
  • Slow release compounds
Some Fundamentals

Hypoxemia

Alveolar-arterial gradient = Calculated PAO₂ — Measured PaO₂

(150 – 1.2 × PaCO₂) — PaCO₂

Elevated A-a gradient

V/Q Mismatch
– (PE, pneumonia, asthma)

Impaired O₂ diffusion
– (interstitial pneumonia, PCP)

Right to Left Shunt
– (congenital heart disease)

Normal A-a gradient
(10-15 mm Hg)

Hypoventilation
– (opioid OD)

Decreased FiO₂
– (high altitude)
Some Fundamentals

**Cyanosis**

Central cyanosis only clinically apparent with >5g/dL desaturated Hb

Cannot be both anemic *and* cyanotic at the same time

Conversely, cyanosis is *more* likely if also polycythemic (e.g. the blue bloater)

Central cyanosis (seen in the tongue)

The “blue bloater”
Asthma Therapy (5)

Asthma Arrest / Extraordinary Therapies

Asthma Arrest

1. **Disconnect ventilator**
2. Compress chest
3. Bilateral chest tubes
4. Fluid bolus

Anesthetic gases

ECMO

External chest compression

Asthmatic in the OR
<table>
<thead>
<tr>
<th>ORGANISM</th>
<th>TYPICAL PATTERN</th>
<th>TYPICAL HOST</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Streptococcus pneumoniae</em></td>
<td>Lobar</td>
<td>Everyone</td>
</tr>
<tr>
<td></td>
<td>(Rusty sputum, Single Rigor)</td>
<td>Community-acquired</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Most common overall</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em></td>
<td>Lobar or patchy</td>
<td>COPD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Smokers</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em> (including MRSA)</td>
<td>Pleural Effusion Necrotizing (Abscesses, Cavitation, Empyema)</td>
<td>Post-viral IVDA</td>
</tr>
<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>Lobar (esp. RUL) Bulging minor fissure (Currant jelly sputum)</td>
<td>Alcoholics COPD, Diabetics</td>
</tr>
<tr>
<td><em>Pseudomonas and Enterobacter</em></td>
<td>Patchy, multilobar, necrotizing, fulminant (sickly sweet odor)</td>
<td>Hospital acquired Immunocompromised Cystic fibrosis</td>
</tr>
<tr>
<td>Anaerobes</td>
<td>Patchy (esp. lower lobes) (foul smelling sputum)</td>
<td>Alcoholics Poor dentition</td>
</tr>
</tbody>
</table>
Pneumonia with Effusion

Pneumonia
- *Strep. pneumoniae* (most common)
- *Staph. aureus, H. flu, Legionella*
- **TB** (think HIV)

Important Non-Infectious Effusions

<table>
<thead>
<tr>
<th>Left sided (&gt;R)</th>
<th>Right sided (&gt;L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic dissection</td>
<td>Congestive heart failure</td>
</tr>
<tr>
<td>Boerhaave’s syndrome</td>
<td>Pancreatitis, hepatitis</td>
</tr>
<tr>
<td>(esophageal rupture)</td>
<td></td>
</tr>
</tbody>
</table>
Lung Cavitation

Cavities

• Anerobes
  (commonest cause of lung abscess)
• Staph
  Pseudomonas
• TB
# Atypical Pneumonias

<table>
<thead>
<tr>
<th>ORGANISM</th>
<th>CLINICAL FEATURES</th>
<th>SPECIAL FEATURES</th>
</tr>
</thead>
</table>
| **Mycoplasma pneumoniae** | “Walking pneumonia”  
Young adults  
CXR: Patchy interstitial | Extrapulmonary findings  
Guillain-Barré, encephalitis, hemolysis, cold agglutinins, bullous myringitis, erythema multiforme |
| **Chlamydia pneumoniae**    | Non-toxic appearing  
Infants at 3-20 weeks  
Outbreaks in young adults  
CXR: Patchy interstitial | Staccato cough  
Conjunctivitis  
(in infant group) |
| **Legionella pneumophila**    | Contaminated water sources, air conditioning  
Older, sickly men  
Toxic patients, altered with relative bradycardia  
CXR: Unilateral lobar infiltrates | GI symptoms (N,V,D)  
Low serum sodium  
Abnormal LFTs  
No person-to-person transmission  
No organisms on standard smear |
# Really Atypical Pneumonias

<table>
<thead>
<tr>
<th>ORGANISM</th>
<th>RISK GROUPS</th>
<th>CLINICAL FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fungi</strong></td>
<td>Southwest US (Coccidioidomycosis)</td>
<td>Chest pain</td>
</tr>
<tr>
<td></td>
<td>Mississippi River Valley (Histoplasmosis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Southeast US (Blastomycosis)</td>
<td>Erythema nodosum</td>
</tr>
<tr>
<td></td>
<td><strong>CXR</strong>: Hilar adenopathy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diffuse patchy infiltrates</td>
<td></td>
</tr>
<tr>
<td><strong>Q fever</strong></td>
<td>Vets, farmers</td>
<td>Hepatitis</td>
</tr>
<tr>
<td>(Coxiella burnetii)</td>
<td></td>
<td>Endocarditis</td>
</tr>
<tr>
<td></td>
<td>Sheep, goats, cattle</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>CXR</strong>: Highly variable</td>
<td></td>
</tr>
<tr>
<td><strong>Psittacosis</strong></td>
<td>Bird handlers</td>
<td>Epistaxis</td>
</tr>
<tr>
<td>(Chlamydia psittaci)</td>
<td></td>
<td>Relative bradycardia</td>
</tr>
<tr>
<td></td>
<td><strong>CXR</strong>: Highly variable</td>
<td>Sepsis and shock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low WBC count</td>
</tr>
</tbody>
</table>
## Pneumonia: Gram’s Stain

<table>
<thead>
<tr>
<th>Gram’s Stain</th>
<th>Organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram positive diplococci</td>
<td>Streptococcus pneumoniae</td>
</tr>
<tr>
<td>Gram positive cocci in chains</td>
<td>Group A streptococcus</td>
</tr>
<tr>
<td>Gram positive cocci in clusters</td>
<td>Staph. aureus</td>
</tr>
<tr>
<td>Gram positive rods</td>
<td>Bacillus anthracis (Anthrax)</td>
</tr>
<tr>
<td>Small Gram neg rods</td>
<td>H. Influenza</td>
</tr>
<tr>
<td>Short, fat Gram neg paired rods</td>
<td>Klebsiella pneumonia</td>
</tr>
<tr>
<td>Gram neg rods</td>
<td>Pseudomonas, Enterobacter</td>
</tr>
<tr>
<td>Intracellular, Gram negative</td>
<td>Chlamydia</td>
</tr>
<tr>
<td>No bacteria, large PMNs only</td>
<td>Legionella</td>
</tr>
<tr>
<td>No bacteria, mononuclear cells</td>
<td>Mycoplasma</td>
</tr>
</tbody>
</table>

- **Legionella**: No bacteria, large PMNs only
- **Chlamydia**: Intracellular, Gram negative
- **Pseudomonas, Enterobacter Yersinia pestis (Plague)**: No bacteria, mononuclear cells
- **Streptococcus pneumoniae**: Gram positive diplococci
- **Group A streptococcus**: Gram positive cocci in chains
- **Staph. aureus**: Gram positive cocci in clusters
- **Bacillus anthracis (Anthrax)**: Gram positive rods
- **H. Influenza**: Small Gram neg rods
- **Klebsiella pneumonia**: Short, fat Gram neg paired rods
- **Chlamydia**: Intracellular, Gram negative
- **Legionella**: No bacteria, large PMNs only
- **Mycoplasma**: No bacteria, mononuclear cells
# Pneumonia Treatment

<table>
<thead>
<tr>
<th></th>
<th>Organisms</th>
<th>Antibiotics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outpatient</strong></td>
<td><em>Strep. pneumoniae</em></td>
<td><strong>Macrolide</strong></td>
</tr>
<tr>
<td>Young, healthy</td>
<td>Atypicals</td>
<td></td>
</tr>
<tr>
<td><strong>Inpatient</strong></td>
<td>Add: Gram negatives</td>
<td>Macrolide + Cephalosporin</td>
</tr>
<tr>
<td>Older, sicker</td>
<td></td>
<td>OR Fluoroquinolone</td>
</tr>
<tr>
<td><strong>Health care</strong></td>
<td>Add: Pseudomonas</td>
<td>Antipseudomonal cephalosporin</td>
</tr>
<tr>
<td>associated</td>
<td></td>
<td>OR carbapenem</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OR Aminoglycoside</td>
</tr>
<tr>
<td></td>
<td>MRSA</td>
<td>Vancomycin / Linezolid</td>
</tr>
</tbody>
</table>
### AIDS: Pulmonary Manifestations (2)

<table>
<thead>
<tr>
<th>CD4 COUNT</th>
<th>PATHOGENS</th>
<th>NOTES</th>
</tr>
</thead>
</table>
| **200+**  | Community acquired pneumonia (CAP) e.g. *H. flu, S. pneumo*  
Tuberculosis (TB) | Atypical CXR appearances with bacterial pathogens  
TB – may have minimal CXR findings |
| **<200**  | ADD: Pneumocystis carinii pneumoniae (PCP) | PCP  
Subacute presentation  
Bilateral interstitial infiltrates (*may be lobar*)  
Hypoxemia  
↑ LDH |
| **<50**   | ADD:  
Cytomegalovirus (CMV)  
*Mycobacterium avium complex* (MAC)  
Fungi (*Cryptococcus*, etc.) | CMV, fungi and other pathogens in end stage disease often disseminated  
Malignancy (Kaposi’s sarcoma) may mimic pneumonia |
## Pleural Effusion

*Transudative vs. Exudative*

<table>
<thead>
<tr>
<th></th>
<th>Transudate</th>
<th>Exudate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pathophysiology</strong></td>
<td>↑ hydrostatic pressure or ↓ oncotic pressure</td>
<td>Neoplastic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inflammatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Infectious</td>
</tr>
<tr>
<td><strong>Common Causes</strong></td>
<td>CHF</td>
<td>Lung cancer</td>
</tr>
<tr>
<td></td>
<td>Cirrhosis</td>
<td>RA</td>
</tr>
<tr>
<td></td>
<td>Nephrotic syndrome</td>
<td>Pneumonia, TB, abscess</td>
</tr>
<tr>
<td><strong>Pleural Fluid</strong></td>
<td>Total protein &lt;3 mg/dL</td>
<td>Total protein &gt;3 mg/dL</td>
</tr>
<tr>
<td>Analysis</td>
<td>Pleural/serum protein &lt;0.5</td>
<td>Pleural/serum protein &gt;0.5</td>
</tr>
<tr>
<td></td>
<td>LDH &lt;200 IU/mL</td>
<td>LDH &gt;200 IU/mL</td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td>Directed at underlying cause</td>
<td>Therapeutic thoracentesis or tube if resp. distress</td>
</tr>
<tr>
<td></td>
<td>May need further work-up (exudates)</td>
<td></td>
</tr>
</tbody>
</table>

Pulmonary Embolus (3)

Diagnosis – The Role of Pretest Probability

Well's Criteria for PE

<table>
<thead>
<tr>
<th>Clinical Signs and Symptoms of DVT?</th>
<th>Yes</th>
<th>+3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE Is #1 Diagnosis, or Equally Likely</td>
<td>Yes</td>
<td>+3</td>
</tr>
<tr>
<td>Heart Rate &gt; 100?</td>
<td>Yes</td>
<td>+1.5</td>
</tr>
<tr>
<td>Immobilization at least 3 days, or Surgery in the Previous 4 weeks</td>
<td>Yes</td>
<td>+1.5</td>
</tr>
<tr>
<td>Previous, objectively diagnosed PE or DVT?</td>
<td>Yes</td>
<td>+1.5</td>
</tr>
<tr>
<td>Hemoptysis?</td>
<td>Yes</td>
<td>+1</td>
</tr>
<tr>
<td>Malignancy w/ Rx within 6 mo, or palliative?</td>
<td>Yes</td>
<td>+1</td>
</tr>
</tbody>
</table>

**SCORE**

- **Diagnostic workup involves Bayesian approach**
  - **Definition:** incorporation of *pre-test probability* to guide aggressiveness of workup

- **Pretest probability can be:**
  - estimated by MD - or -
  - calculated using a scoring system (e.g. Wells criteria)
## Procedural Sedation (2)

<table>
<thead>
<tr>
<th>ASA Class</th>
<th>Description</th>
<th>Example</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Normal, healthy patient</td>
<td>No medical problems</td>
<td>Minimal</td>
</tr>
<tr>
<td>II</td>
<td>Mild systemic disease</td>
<td>Controlled DM, mild asthma</td>
<td>Low</td>
</tr>
<tr>
<td>III</td>
<td>Severe systemic disease, functional limitations</td>
<td>Pneumonia, Poorly controlled seizure d/o</td>
<td>Intermediate</td>
</tr>
<tr>
<td>IV</td>
<td>Severe systemic disease, constant threat to life</td>
<td>Sepsis, renal failure, advanced CHF</td>
<td>High</td>
</tr>
<tr>
<td>V</td>
<td>Moribund, not expected to survive without procedure</td>
<td>Septic shock, severe trauma</td>
<td>Extremely High</td>
</tr>
</tbody>
</table>

Class III/IV may require consultation with anesthesiologist
Medical Malpractice Terms

1. Duty to treat
   • Established when patient presents to the ED

2. Standard of care
   • Actions a reasonable similar physician with similar training would take under similar circumstances

3. Proximate cause/causation
   • An event sufficiently be held to be the injury

4. Damages
   • Wages, medical expenses, pain and suffering (non-economic damages – sometimes “capped” depending on state)

These 4 criteria are used by the courts to establish negligence
Apparent Life-Threatening Event (3)

High Risk ALTE

- Greater than 10 seconds
- Occurs during sleep
- Associated with seizure activity
- Hypotonia (“looked dead”)
- Associated with feeding (possible reflux)
- Trauma / abuse
- It has now been changed to Brief Resolved Unexplained Event (BRUE)
Characteristics of Febrile Seizures

• Simple febrile seizures
  • Fever (usually > 39C [102.2])(rate of rise important)
    • *Age 6 months to 6 years*
      • Brief, generalized seizures
      • Resolve without treatment
      • Seizures occur in the first 24 hours of illness
    • *Duration 5 minutes or less*
      • Minimal postictal phase
      • Previously normal neurologically
      • No other cause
      • Tend to occur in families

• Complex febrile seizures
  • Longer than 15 minutes, recurs within 24 hrs, focal, age < 6mo or > 5yr without signs of serious infection
  • Full septic work-up advised
Tetralogy of Fallot

- Tetralogy of Fallot (TOF) (problem)

- Underdeveloped artery
- Aorta just above hole
- Hole between chambers
- Thickened
- Narrow opening
Kawasaki Disease (1)

- Also **mucocutaneous lymph node syndrome**
- Autoimmune vasculitis of small and medium blood vessels of unknown cause -- 2-4,000 / yr in US
- 80% are less than 5 YO (peak 1-2 YO)
- Persistent, so-so unresponsive fever (5-25 days, usually 10) with 4 of 5 cardinal signs (ROLLE)
  - **Rash** -- measles like (doesn’t itch)
  - **Oral signs** – red / cracked lips, mouth redness
  - **Limb signs** – firm swelling of the hands and feet with **marginated redness of the palms / soles** with periungual desquamation as a late finding
  - **Lymphadenopathy** (1.5cm or greater of the neck)
  - **Eye signs** – conjunctivitis (also like measles)
Pediatric ACLS (1)

- Defibrillation = 2 J/kg (double dose if unsuccessful)
- Cardioversion = 0.5 J/kg
- ET intubation: Cuffed or uncuffed acceptable
- ET size: \((16 + \text{age})/4 = \text{diameter of } 5\text{th finger}\)
- Air leaks are normal with an uncuffed tube at peak inspiratory pressures
- Surgical cricothyrotomy is not recommended for children younger than 10 yrs
- Narrowest part of airway: cricoid cartilage
- Fluid resuscitation: 20 mL/kg NS boluses
## Apgar Score

**Apgar Scale (evaluate @ 1 and 5 minutes postpartum)**

<table>
<thead>
<tr>
<th>Sign</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Activity (muscle tone)</td>
<td>Active</td>
<td>Arms and legs flexed</td>
<td>Absent</td>
</tr>
<tr>
<td>P - Pulse</td>
<td>&gt;100 bpm</td>
<td>&lt;100 bpm</td>
<td>Absent</td>
</tr>
<tr>
<td>G - Grimace (reflex irritability)</td>
<td>Sneezes, coughs, pulls away</td>
<td>Grimaces</td>
<td>No response</td>
</tr>
<tr>
<td>A - Appearance (skin color)</td>
<td>Normal over entire body</td>
<td>Normal except extremities</td>
<td>Cyanotic or pale all over</td>
</tr>
<tr>
<td>R - Respirations</td>
<td>Good, crying</td>
<td>Slow, irregular</td>
<td>Absent</td>
</tr>
</tbody>
</table>

**Additional Mnemonic: How Ready Is The Child?**

H = heart rate, R = resp. effort, I = irritability, T = tone, C = color
1. Neonates increase respiratory volume almost exclusively by increasing their respiratory rate vs. increasing depth of ventilation (and are obligate nose breathers)

2. Newborn infants, especially premature ones, can have periods of apnea. Spells lasting more than 20 second with bradycardia, cyanosis or a change in muscle tone warrant investigation

3. Bradycardia in neonates is almost always due to hypoxia

4. A respiratory rate over 60 or grunting should always be considered an emergency

5. Fever of 39C (102.2) in the presence of a UTI = pyelonephritis (only 5-10% will have bacteremia) (bacteremia doesn’t change treatment)

6. The incidence of bacteremia/sepsis in febrile children three months of age or less is about 2-3% (ill appearance or significantly abnormal labs [CBC] can have higher rates)

7. Immunized children 3-36 months of age who are well appearing but febrile have bacteremia rates of 0.5-0.7%

8. The incidence of meningitis in febrile infants less than three months of age is about 1%
Pediatric Pearls (2)

9. The safest approach to febrile children less than 30 days of age is sepsis testing, admission and empiric antibiotics

10. The AAP advises testing for a UTI in all febrile girls and in uncircumcised boys less than 2 years of age if there is no apparent focus of infection (one year in circumcised boys)

11. Analgesics (oral or topical if no TM perf) is an important aspect of treating otitis media

12. According to AAP guidelines, high-dose amoxicillin (80-90mg/kg/day) is the first line antibiotic of choice for OM

13. Variation in the pattern of stridor suggests a foreign body (are most common 1-3 yo) / Sudden onset is most reliable finding

14. X-rays can confirm a FB but not exclude one / >75% are radiolucent

15. Look for hemangiomas on the skin in a child with stridor as there may be a hemangioma in the airway causing it

16. In a constipated child a rectal exam that reveals tonic constriction of the anus with an empty rectum suggests Hirschsprung disease

17. Strep throat can cause abdominal pain in kids over 3 – check the throat
18. Although very uncommon, a UTI can co-exist with a viral infection
19. Nitrite testing has less sensitivity for a UTI when caused by Gram + bacteria
20. Migraine headaches in children – rather sudden onset, intensify over 10 minutes, maximum at 1 hour
21. About a third of migraines in children are unilateral
22. Ergotamines should not be used in basilar or hemiplegic migraine (may decrease cerebral perfusion)
23. Most serious causes of headaches will have concomitant neurologic findings
24. In adolescents with altered mental status due to alcohol, concomitant hypoglycemia may also be present – look for it
25. Blunt head trauma in children can be accompanied by diffuse cerebral swelling causing increase CSF pressure and altered mental status
26. Children having concussions should not be allowed to participate in contact sports until cleared by another physician in follow-up
27. Children presenting in metabolic crisis (inborn errors of metabolism), regardless of cause, will have some combination of dehydration, metabolic acidosis, hypoglycemia and encephalopathy – treatment = NPO to stop the metabolic pathway, give bicarb, glucose, fluids

28. Don’t give insulin and glucose to treat hyperkalemia in children – may result in severe hypoglycemia

29. Unless clearly vasovagal, all children with syncope should have an EKG

30. Syncope associated with exertion suggests a structural problem of the heart (aortic stenosis, coarctation of the aorta, hypertrophic cardiomyopathy)

31. Other risk factors for serious causes of syncope – family history of sudden death, recurrent episodes (suggests arrhythmia), recumbent episodes (suggests arrhythmia), prolonged spells (hypotension with hypoperfusion of the brain), chest pain, palpitations, medications that alter conduction

32. Loss of consciousness occurs simultaneously with shaking movements with seizures but after loss of consciousness with syncope

33. Benzos should be considered second line drugs in the treatment of psychiatric disorders in children due to the potential to cause disinhibition
Dermatomes of the Head
### Characteristics of Vertigo

<table>
<thead>
<tr>
<th></th>
<th><strong>Peripheral</strong></th>
<th><strong>Central</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Onset</strong></td>
<td>Sudden</td>
<td>Slow</td>
</tr>
<tr>
<td><strong>Severity</strong></td>
<td>Intense spinning</td>
<td>Less intense, ill-defined</td>
</tr>
<tr>
<td><strong>Pattern</strong></td>
<td>Intermittent</td>
<td>Constant</td>
</tr>
<tr>
<td><strong>Worse on movement</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Nausea / sweating</strong></td>
<td>Frequent</td>
<td>Infrequent</td>
</tr>
<tr>
<td><strong>Nystagmus</strong></td>
<td>Horizontal, Rotatory-vertical</td>
<td>Vertical</td>
</tr>
<tr>
<td><strong>Fatigues</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Hearing loss / tinnitus</strong></td>
<td>May occur</td>
<td>No</td>
</tr>
<tr>
<td><strong>Abnormal TM</strong></td>
<td>May occur</td>
<td>No</td>
</tr>
<tr>
<td><strong>CNS Symptoms</strong></td>
<td>Absent</td>
<td>Usually present</td>
</tr>
</tbody>
</table>
Le Fort I
The nose is not mobile.
The upper dental arch is mobile.

Le Fort II
The zygoma is not mobile.
The upper dental arch and the nose are mobile.

Le Fort III
The entire face is mobile.
(upper dental arch, nose and zygomas)
<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Definition</th>
<th>Presentation</th>
<th>Complications</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversible pulpitis</td>
<td>Pulpal inflammation</td>
<td>Pain with hot, cold, or sweet stimuli</td>
<td>Periapical abscess, cellulitis</td>
<td>Filling</td>
</tr>
<tr>
<td>Irreversible pulpitis</td>
<td>Pulpal inflammation</td>
<td>Spontaneous, poorly localized pain</td>
<td>Periapical abscess, cellulitis</td>
<td>Root canal Extraction</td>
</tr>
<tr>
<td>Periodontal abscess</td>
<td>Gum abscess</td>
<td>Pain, local gum mass</td>
<td>Cellulitis</td>
<td>I/D, penicillin +/- metronidazole or clindamycin</td>
</tr>
<tr>
<td>Periapical abscess</td>
<td>Infection / necrosis of the tooth apex</td>
<td>Toothache Most commonly due to a dead tooth</td>
<td>Rupture through alveolar bone (= parulis)</td>
<td>Root canal &amp; Antibiotics Extraction</td>
</tr>
<tr>
<td>Pericoronitis</td>
<td>Inflamed gum over partially erupted molar due to food impaction</td>
<td>Pain, erythema local swelling</td>
<td>Cellulitis</td>
<td>Irrigation Antibiotics if cellulitis noted</td>
</tr>
<tr>
<td>Tooth fracture with bleeding or pulp exposed</td>
<td>Broken tooth into the viable area</td>
<td>Bleeding from center of tooth or reddish central blush noted</td>
<td>Pulpitis Tooth death</td>
<td>Fillings with or without root canal</td>
</tr>
<tr>
<td>Tooth fracture with only enamel involved</td>
<td>No viable part of tooth involved</td>
<td>No bleeding or reddish blush</td>
<td>Cosmesis Rough edges</td>
<td>Cosmesis</td>
</tr>
<tr>
<td>Tooth loose</td>
<td>Traumatic</td>
<td>Loose / bleeding</td>
<td>Pulpitis, aspiration</td>
<td>Splint, root canal?</td>
</tr>
<tr>
<td>Tooth avulsed</td>
<td>Traumatic</td>
<td>Absent tooth</td>
<td>Anklyosis, resorption</td>
<td>Reimplant / splint</td>
</tr>
</tbody>
</table>
Salter Fractures (2)

- S = Slipped
- A = Above
- L = Below
- T = Through
- eR = Ram
Distribution of the Sensory Nerves of the Hand

- Radial nerve
- Median nerve
- Ulnar nerve
## The Nerves of the Hand

<table>
<thead>
<tr>
<th></th>
<th>Sensory</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radial Nerve</strong></td>
<td>Dorsal web space between thumb and index finger</td>
<td>Extension of fingers and wrist</td>
</tr>
<tr>
<td><strong>Median Nerve</strong></td>
<td>Thumb, index, long and ½ of ring finger</td>
<td>Thumb opposition and flexion of index and middle fingers</td>
</tr>
<tr>
<td><strong>Ulnar Nerve</strong></td>
<td>½ of ring and little finger</td>
<td>Finger adduction and abduction; flexion of ring and little fingers</td>
</tr>
</tbody>
</table>
Amputation Care (1)

- In a plastic bag in ice water (not directly in water)
- Thumb has better outcome proximal to IP joint
- Distal third of fingertip doesn't need graft in small children

**General indications for replantation**
- Multiple digits
- Thumb
- Single digit between PIP & DIP (distal to the superficialis insertion)
- Metacarpal (palm)
- Wrist, forearm
- Almost any part in child
Boutonniere Deformity

Disruption of the central extensor mechanism allows the PIP joint to protrude through the extensor hood.

Displaced intact lateral components of the extensor mechanism hold the DIP joint in extension while flexing the PIP joint.
Gamekeeper’s (Skier’s) Thumb

- Ulnar collateral ligament (UCL) MCP joint
- UCL critical for pincher function
- Forced radial abduction
- Associated avulsion common
- Treatment
  - Partial tear: thumb spica splint
  - Complete tear: surgery
- Complication: chronic instability
- Bull rider’s thumb = RCL injury
Mallet Finger (3)

- Tear of extensor tendon
- Avulsion fracture of dorsal base of distal phalanx
- Deformity resulting from inadequate treatment
Metacarpal Fractures (Shaft)

- Angulation is unacceptable for 2\textsuperscript{nd} and 3\textsuperscript{rd} metacarpals
- Angulation amounts that are acceptable:
  - Index 10°
  - Long 20°
  - Ring 30°
  - Small 40°
- All rotational deformities must be corrected
- Operative fixation is usually required for 2\textsuperscript{nd} and 3\textsuperscript{rd} metacarpals
- Ulnar gutter splints usually fail to maintain any significant correction of angulation
- Short-arm casting with “outriggers” do work

Boxer’s Fracture
Metacarpal Fractures

*Bennett’s Fracture*

- Axial load with hand closed
- Ulnar aspect of base of thumb at metacarpal joint
- Intraarticular with dislocation or subluxation at the CMC joint
- Anatomical reduction required, ORIF

*Rolando Fracture*

- Comminuted intraarticular, requires ORIF
- No subluxation dislocation of CMC joint
- **Worse prognosis**

Thumb spica + emergent ortho referral
Flexor Tenosynovitis (1)

• Secondary to puncture wound of volar surface: especially cat bites

• Kanavel’s signs (do NOT include erythema)
  • Diffuse fusiform swelling,
  • Pain on palpation proximal sheath
  • Severe pain on extension
  • Held in slightly flexed position

• Treatment: surgical I&D
Colles’ Fracture (1)

- **Most common fracture in adults >50**
- Distal radius at the metaphysis
- Dorsal displacement
- “Dinner fork” deformity
- Ulnar styloid fracture is common
- Treatment: closed reduction

Complication: median nerve injury
Colles’ Fracture (3)

**Smith’s Fracture**

“Reverse Colles”
Volar displacement of distal radius
Associated median nerve and flexor tendon injury
Perilunate Dislocation (2)

Scaphoid

Lunate

Capitate
Lunate Dislocation
Galeazzi Fracture (1)

- **Distal** radial fracture, usually displaced
- Disrupted **distal** radio-ulnar joint
- Pain and swelling of wrist
- Complication: ulnar nerve injury
- Treatment: ORIF
Galeazzi Fracture (2)
Monteggia Fracture (2)

Galeazzi
Radial fx
Ulnar fx
Monteggia
Elbow Radiographic Abnormalities

- Fat pad sign
  - Posterior fat pad is never normal
  - Intraarticular hemorrhage
  - Intracapsular hemorrhage
  - Occult radial head fracture
  - Also seen with gout, villonodular synovitis, and some infections

- Anterior fat pad
  - Small fat pad may be normal
  - Large fat pad (sail sign) is abnormal
Anterior Shoulder Dislocation (1)

- **Mechanism:** indirect forced abduction, extension and external rotation
- **Arm held in slight abduction and external rotation**
- **Subcoracoid is the most common type**
- **Hill-Sachs lesion:** notch on posterior humeral head (impression fracture)
- **Bankart's lesion:** labral tear +/- erosion or anterior glenoid rim fracture
  - Leads to joint laxity
  - Younger patients, initial injury
- **X-ray:** need scapular “Y” and AP views

Complications: axillary nerve injury, rotator cuff injury, avascular necrosis, adhesive capsulitis
Ottawa Ankle Rules

• Simple guidelines to identify patients with ankle or midfoot injury who do not need X-ray
• Validated by numerous clinical studies
• Ankle X-rays are indicated if any of the following are present
  • Inability to bear weight (both immediately and in the emergency department),
  • Bone tenderness along the posterior edge of the distal 6 cm of either the lateral or medial malleolus
  • Point tenderness over the proximal base of the 5th metatarsal
  • Point tenderness over the navicular bone
Fifth Metatarsal Fracture (1)

- Dancer’s
  - *Avulsion fracture* base of 5th metatarsal
  - At attachment of peroneus brevis
  - Inversion injury
  - Cast shoe only

- Jones'
  - *Transverse fracture*
  - Proximal diaphysis
  - Common in athletes
    - Running or jumping sports
  - Increased incidence nonunion
  - ORIF or cast
Bone and Joint Infections

- Neonates: Group B Streptococcus
- IVDA: Pseudomonas osteomyelitis
- Sickle cell: Gram negative osteomyelitis, Salmonella
- Foot puncture wounds: Pseudomonas
- Cat bites: Pasteurella multocida
- Fresh water wounds: Aeromonas
- Diabetic foot: polymicrobial
- Human bites: Eikenella corrodens, Staph, Strep, anaerobes
- Reptile bites: Salmonella
<table>
<thead>
<tr>
<th>ROOT</th>
<th>REFLEX DECREASED</th>
<th>SENSORY LOSS</th>
<th>MOTOR WEAKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5</td>
<td>Biceps</td>
<td>Deltoid area</td>
<td>Deltoid (abduction)</td>
</tr>
<tr>
<td></td>
<td>Brachioradialis</td>
<td></td>
<td>Biceps (elbow flexion)</td>
</tr>
<tr>
<td>C6</td>
<td>Biceps</td>
<td>Thumb and index</td>
<td>Biceps (elbow flexion)</td>
</tr>
<tr>
<td></td>
<td>Brachioradialis</td>
<td></td>
<td>Wrist extensors</td>
</tr>
<tr>
<td>C7</td>
<td>Triceps</td>
<td>Long finger</td>
<td>Triceps (elbow extension)</td>
</tr>
<tr>
<td>C8</td>
<td></td>
<td>Little finger</td>
<td>Finger adduction</td>
</tr>
<tr>
<td>T1</td>
<td></td>
<td>Medial arm</td>
<td>Finger abduction</td>
</tr>
</tbody>
</table>
# Nerve Roots in Leg

<table>
<thead>
<tr>
<th>ROOT</th>
<th>REFLEX DECREASED</th>
<th>SENSORY LOSS</th>
<th>MOTOR WEAKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L4</td>
<td>Knee jerk</td>
<td>Knee, medial leg</td>
<td>Knee extension</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L5</td>
<td></td>
<td>Dorsum foot, big toe</td>
<td>Foot dorsiflexion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>Ankle jerk</td>
<td>Lateral foot, sole</td>
<td>Foot plantar flexion</td>
</tr>
</tbody>
</table>
Unstable Cervical Fractures

“Jefferson Bit Off A Hangman’s Thumb”

• J - Jefferson Fracture (burst of C1)
• B - Bifacet dislocation +/- fracture
• O - Odontoid types II and III
• A - Any fracture/dislocation
• H - Hangman’s fracture (posterior element C2)
• T - Teardrop fractures
Spinal Cord Syndromes

- Posterior columns
  - (vibration / proprioception)
- Lateral corticospinal tract
  - (Upper motor neuron)
- Anterior horn cells
  - (lower motor neuron)
- Spinothalamic tract (pain / temperature)
Anterior Cord Syndrome

- Compression of the cord
- Retropulsion of bony fragments
- Disc herniation
- Injury to anterior spinal arteries
- Flexion injury
  - Complete motor paralysis below injury
  - Vibration and proprioception preserved
- Loss of pain and temperature sensation (hypalgesia) below injury
- Needs surgical intervention
Brown-Sequard Syndrome

- Unilateral cord injury (usually in penetrating injury)
- **Crossed findings below level**
- Ipsilateral weakness, loss of position/vibration sense
- Contralateral loss of pain and temperature sensation
Central Cord Syndrome

• Hyperextension injury
• Older patients with DJD
• Weakness, **arms > legs**
• Also some loss of bladder control and some decreased sensation (distal pain and temperature)
• Sacral sparing
  (rectal tone present)
Transverse Cord Syndrome

- Trauma, tumors, transverse myelitis
- **Complete loss of all sensory and motor** pathways below a certain level
- No sacral sparing

Posterior Cord Syndrome

- Trauma (extension), B12 deficiency, tertiary syphilis
- Loss of position and vibration sensation only
Ortho Trivia (2)

- Pediatric hip problems
  - Legg-Calve-Perthes 4-8 years old
  - Toxic synovitis 4-10 years old
  - SCFE 10-16 years old
  - Septic arthritis any age
- Torus fracture: cortex buckled but intact
- Greenstick fracture: cortex disrupted on one side and intact on the other
- Lumbar disc syndromes
  - L4: Absent knee jerk
  - L5: Absent dorsiflexion of great toe
  - S1: Absent ankle jerk, numbness of lateral foot
UV Keratitis
Acute Angle Closure Glaucoma (3)

- Treatment goal: **Decrease IOP**
- Decrease aqueous humor production
  - Topical beta-blocker (timolol)
  - Alpha-agonists (apraclonidine)
  - Acetazolamide IV
- Mannitol IV: 1 gm per kg
  - Osmotically decompresses the eye
- Topical miotic (pilocarpine)
  - Facilitates drainage of aqueous humor
  - Elevated IOP may cause a pressure-induced ischemic paralysis of the iris and pilocarpine may not be effective. If used, it should be used **AFTER** the IOP is decreased
- Emergent ophthalmology consult (call before you give the pilocarpine)
Pupillary Syndromes (1)

- **Pupil control**
  - Parasympathetic innervation of the eye runs with the oculomotor (CN III) nerve and constricts the pupil
  - Sympathetic chain dilates the pupil

- **Normal pupillary light reflex**
  - Tests cranial nerves II & III
  - Light enters one eye – both pupils constrict
  - Retina sends fibers into both optic tracts
  - Compression of CN III causes ipsilateral fixed dilated pupil

- **Argyll-Robertson pupil**
  - Small irregular pupil
  - Accommodates (convergence of the eyes on near objects is accompanied by bilateral pupillary constriction) but does not react to light shined into the affected eye
  - Seen in **neurosyphilis**


Afferent Pupillary Defect
Marcus-Gunn Pupil
# Ocular Dysfunction Syndromes

<table>
<thead>
<tr>
<th></th>
<th>Horner’s</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Nerve</th>
<th>6&lt;sup&gt;th&lt;/sup&gt; Nerve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ptosis</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Mydriasis</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Miosis</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anhydrosis</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye deviation</td>
<td></td>
<td>Lateral</td>
<td>Medial</td>
</tr>
</tbody>
</table>
Visual Field Deficits

The vision is preserved on the side where the lesion is (look to that side)
Central Retinal Artery Occlusion (1)

- Sudden, painless monocular visual loss
- May be transient ("amarosis fugax") or permanent
- + Afferent pupillary defect
- Pale retina, fixed, dilated pupil
- Cherry-red spot in the macula (different blood supply)
- "Box-car" look to retinal artery, due to sluggish flow
- Mostly embolic. Ophtho consult + stroke work-up (neurologist or PMD).

90 minute time window to restore vision
Central Retinal Vein Occlusion

More gradual onset of vision loss than with arterial occlusion which is sudden
Retinal hemorrhages / cotton wool spots /
macular edema
No acute treatment - urgent ophtho consult, consider ASA

“Blood and thunder”
Optic Neuritis

Inflammation of optic nerve
Sudden non-specific vision loss with painful eye movements
+ Afferent pupillary defect in affected eye
Unilateral optic disc swelling (papillitis)
Loss of color vision
MS until proven otherwise
### Chemical Injuries to the Eye

<table>
<thead>
<tr>
<th></th>
<th>Alkali</th>
<th>Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of injury</strong></td>
<td>Liquefaction necrosis</td>
<td>Coagulation necrosis</td>
</tr>
<tr>
<td><strong>Depth of penetration</strong></td>
<td>Deep</td>
<td>Not deep</td>
</tr>
</tbody>
</table>

Alkali WORSE than acid

Irrigate the eye until pH returns to normal (pH 7.4 – normal)
## Ulcerative Lesions

<table>
<thead>
<tr>
<th>STD</th>
<th>Ulcer</th>
<th>Adenopathy</th>
<th>Systemic Symptoms</th>
<th>Preferred Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis (primary)</td>
<td>Single <em>Painless</em> Start as papule</td>
<td>Minimal</td>
<td>None</td>
<td>Penicillin</td>
</tr>
<tr>
<td>Syphilis (secondary)</td>
<td>None</td>
<td>Generalized Nontender Nonfluctuant</td>
<td>Generalized rash Mucous patches Condyloma lata</td>
<td>Penicillin</td>
</tr>
<tr>
<td>Herpes</td>
<td>Multiple Shallow <em>Painful</em> Start as vesicle</td>
<td>Shotty Bilateral Minimally tender</td>
<td>Flu-like Precedes lesions</td>
<td>Any of the “-virs” (antivitals)</td>
</tr>
<tr>
<td>Chancroid</td>
<td>Single or multiple <em>Painful</em> Purulent base</td>
<td>Unilateral Fluctuant</td>
<td>None</td>
<td>Ceftriaxone</td>
</tr>
<tr>
<td>LGV</td>
<td>Evanescent Multiple <em>Painless</em> Start as vesicle</td>
<td>Groove sign</td>
<td>Sometimes</td>
<td>Doxycycline (or erythromycin)</td>
</tr>
</tbody>
</table>
Contraindicated Drugs in Pregnancy

- ASA
- NSAIDs (3rd trimester)
- Tetracycline
- ACE inhibitors
- Aminoglycosides
- Warfarin (Coumadin)
- Isotretinoin (Accutane)
- Live vaccines (MMR)

- Ergot alkaloids
- Anticonvulsants (Neuro/OB GYN consult)
Umbilical Cord Prolapse

• High perinatal mortality
• Knee-to-chest position
• Immediate C-section

Impede delivery and elevate presenting part
Muscle Stretch Reflexes

- Biceps C5-C6
- Supinator (brachioradialis) C6
- Triceps C7
- Knee L4
- Ankle S1

Cutaneous reflexes

- Abdominal – upper umbilicus T8-T10
- Abdominal – below umbilicus T10-T12
- Cremasteric L1-L2
- Anal S2-S5
Dermatomes (Nerve Roots)

- C4: clavicle  
  “C” is for “clavicle”

- C6: thumb & index  
  Left hand “OK” sign makes a “6” with thumb and index

- C7: middle finger

- C8: little finger

- T4: nipple line  
  “T” is for “thorax”

- T10: umbilicus  
  Bellybut "TEN"

- L1: inguinal ligament  
  IL-L1

- L4: knee  
  “Down on all fours” – Down on L4
Altered Mental Status

• ABCs
• Glucose check
• Consider thiamine, naloxone but not flumazenil

A - Alcohol  T - Trauma, temperature
E - Epilepsy   I - Infection
I - Insulin  P - Poisonings
O - Opioids   P - Psychiatric
U - Uremia  S - Stroke, shock
Bacterial Meningitis (1)

• Early diagnosis and treatment is critical
• Headache, fever, nuchal rigidity, photophobia, altered mental status, rash, focal neuro exam
• Infants: Irritability, poor feeding, bulging fontanelle, neck stiffness often absent

**Brudzinski’s sign:** Flexion of the hips caused by passive flexion of the neck

**Kernig’s sign:** Pain in hamstrings causes inability to straighten leg when hip is flexed to 90°
# CSF Findings in Meningitis

<table>
<thead>
<tr>
<th>NORMAL</th>
<th>BACTERIAL</th>
<th>VIRAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure (mm H$_2$O)</td>
<td>Elevated, usually &gt;200</td>
<td>Normal to slight</td>
</tr>
<tr>
<td>100-150</td>
<td>&gt;150</td>
<td></td>
</tr>
<tr>
<td>Protein (mg/dL)</td>
<td>&lt;0.4 (low CSF glucose)</td>
<td>&gt;100</td>
</tr>
<tr>
<td>30-45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSF/serum glucose ratio</td>
<td></td>
<td>0.6</td>
</tr>
<tr>
<td>0.6 (infants 0.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell Count (cells/mm$^3$)</td>
<td>&gt;500 (PMNs predominate)</td>
<td>&lt;100 (Monos predominate)</td>
</tr>
<tr>
<td>&lt;3 (mononuclear)</td>
<td>Positive</td>
<td>No organisms</td>
</tr>
<tr>
<td>Gram’s stain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No organisms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td></td>
<td>Opalescent</td>
</tr>
<tr>
<td>Clear</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: CSF = Cerebrospinal Fluid, PMNs = Polymorphonuclear Leukocytes.*
## Meningitis Empiric Treatment

<table>
<thead>
<tr>
<th>AGE</th>
<th>Bacterial Agent</th>
<th>Antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 months</td>
<td>Group B Strep, E.coli, Listeria</td>
<td>Amp + 3(^{rd}) ceph (or gentamycin)</td>
</tr>
<tr>
<td>1 – 3 months</td>
<td>Pneumococci, Meningococci, H. flu (no HIB vac)</td>
<td>3(^{rd}) ceph + vanco</td>
</tr>
<tr>
<td>3 mos. – 50 years</td>
<td>Pneumococci, Meningococci, H. flu (no HIB vac)</td>
<td>3(^{rd}) ceph + vanco</td>
</tr>
<tr>
<td>&gt;50 years, Alcoholism, AIDS, debilitating disease</td>
<td>Pneumococci, Listeria, Gram negs</td>
<td>Amp + 3(^{rd}) ceph + vanco</td>
</tr>
</tbody>
</table>
# Meningitis Empiric Treatment

## Special Situations

<table>
<thead>
<tr>
<th>Patient Category</th>
<th>Bacterial Agent</th>
<th>Antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immune compromised</td>
<td>Pneumococci, Meningococci, Listeria, Gram negs</td>
<td>Vanco + 3&lt;sup&gt;rd&lt;/sup&gt; ceph + Amp</td>
</tr>
<tr>
<td>Trauma (CSF leak), neurosurgery</td>
<td>Pneumococci, Staph, Gram negs</td>
<td>Vanco + 3&lt;sup&gt;rd&lt;/sup&gt; ceph</td>
</tr>
<tr>
<td>V-P shunt</td>
<td>Staph. epi</td>
<td>Vanco + 3&lt;sup&gt;rd&lt;/sup&gt; ceph + shunt removal</td>
</tr>
<tr>
<td>LP positive for cells but negative Gram’s stain</td>
<td>HSV encephalitis (viral)</td>
<td>Acyclovir</td>
</tr>
</tbody>
</table>
Botulism (2)

• Characteristics
  • Nausea, vomiting and diarrhea (foodborne)
  • **Bulbar symptoms – diplopia** (the most common early finding), ptosis, dysphagia, dysphonia, dysarthria
  • **Descending flaccid paralysis**
  • **Anticholinergic symptoms** (dry mouth, urinary retention, dilated pupils, ileus, decreased tears)
  • Sensory exam and mental status are normal

• Infants
  • **Floppy baby, constipation,** feeble cry
Neurology Trivia (1)

• Uncal herniation: Ipsilateral fixed, dilated pupil, contralateral hemiparesis
• Cushing reflex: BP up, HR down (late sign of elevated ICP, sign of impending herniation)
• Intracerebral stroke: Gaze toward side of lesion
• Seizure disorder: Gaze away from seizure focus
• Ophthalmoplegic migraine: Cranial nerve palsy (III, IV, VI), mydriasis, diplopia, strabismus
• Headache upon awakening: Hypoxia (COPD), mass, glaucoma, cluster headache, pseudotumor cerebri (idiopathic intracranial hypertension)
Functional Disorder vs. Organic Disorder

- Functional
  - Age 15-40 years
  - Gradual onset
  - Clear sensorium
  - Auditory hallucinations
  - Oriented
  - Flat affect
  - Normal PE

- Organic
  - Onset <12 or >50
  - Acute onset, fluctuating course
  - Disoriented
  - Visual and tactile hallucinations
  - Abnormal vital signs
  - Pupil size, nystagmus
  - History of substance abuse
### Acute Renal Failure (14)

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>PRE-RENAL</th>
<th>RENAL (ATN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fractional Excretion of Na+ (FENa)</td>
<td>&lt; 1%</td>
<td>&gt; 1%</td>
</tr>
<tr>
<td>Urine Na+ mEq/L</td>
<td>LOW (&lt; 20)</td>
<td>HIGH (&gt; 40)</td>
</tr>
<tr>
<td>BUN / Creatinine Ratio</td>
<td>HIGH (&gt; 20)</td>
<td>LOW (&lt; 20)</td>
</tr>
</tbody>
</table>
### Acute Renal Failure (15) – U/A

<table>
<thead>
<tr>
<th>FORMED ELEMENT</th>
<th>LOCATION OF PATHOLOGY</th>
<th>SPECIFIC ENTITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBC Casts (or dysmorphic RBCs)</td>
<td>Glomerular Disease</td>
<td>Nephritic Syndrome (Rapidly progressive GN)</td>
</tr>
<tr>
<td>WBC Casts</td>
<td>Interstitium</td>
<td>Pyelonephritis AIN</td>
</tr>
<tr>
<td>Eosinophils</td>
<td>Interstitium</td>
<td>Acute Interstitial Nephritis (AIN)</td>
</tr>
<tr>
<td>Granular Casts (Cell debris)</td>
<td>Tubule</td>
<td>Acute Tubular Necrosis (ATN)</td>
</tr>
<tr>
<td>Hyaline Casts (Acellular)</td>
<td>Pre- or post-renal</td>
<td>Pre- or post-renal acute renal failure</td>
</tr>
</tbody>
</table>
Peritoneal Dialysis

- Requires no heparin and occurs slowly (fewer acute complications)

**Peritoneal infection is the most serious problem**

**Symptoms:** Abdominal discomfort, Fever, Pain during inflow

**Diagnosis:** Peritoneal fluid analysis

- >100 WBCs/mm$^3$, >50% PMNs
- *S. epidermidis* (#1)
- *S. aureus, Strep.* and gram negatives

**Treatment:** Intraperitoneal antibiotics and lavage
- IV antibiotics if systemically ill
<table>
<thead>
<tr>
<th></th>
<th>PHIMOSIS</th>
<th>PARAPHIMOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>Unable to retract foreskin</td>
<td>Emergency foreskin</td>
</tr>
<tr>
<td><strong>Complication</strong></td>
<td>Urinary retention (Rare)</td>
<td>Necrosis of glans</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Dilation of preputial ostium <em>(if retention only)</em></td>
<td>Compression &amp; dorsal incision</td>
</tr>
<tr>
<td>STONE TYPE (INCIDENCE)</td>
<td>CAUSES</td>
<td>NOTES</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Calcium oxalate (75%)</td>
<td>Most related to diet IBD (UC and Crohn’s)</td>
<td>Male predominance Warm &amp; dry climates</td>
</tr>
<tr>
<td></td>
<td>Hyperparathyroidism</td>
<td></td>
</tr>
<tr>
<td>Struvite (Mg-NH₄-PO₄) (15%)</td>
<td>Chronic Infection (Proteus, pseudomonas)</td>
<td>Staghorn formation High pH (&gt;7)</td>
</tr>
<tr>
<td>Uric acid (10%)</td>
<td>Gout Congenital</td>
<td>Radiolucent Low pH (&lt;6)</td>
</tr>
<tr>
<td>Cysteine (1%)</td>
<td>In-born error</td>
<td>Staghorn formation Renal failure</td>
</tr>
<tr>
<td>Indinivir (&lt;1%)</td>
<td>Indinivir therapy (protease inhibitor)</td>
<td>HIV or post-exposure prophylaxis patients</td>
</tr>
</tbody>
</table>

NOTES:

CAUSES

STONE TYPE (INCIDENCE)

HIV or post-exposure prophylaxis patients

Indinivir therapy (protease inhibitor)

Staghorn formation

Male predominance

Warm & dry climates

Chronic Infection (Proteus, pseudomonas)

Low pH (<6)

Radiolucent

IBD (UC and Crohn’s)

Hyperparathyroidism

Most related to diet
Hepatitis B

- **Viral Type B (HBV)**
  - Percutaneous, parenteral or sexual exposure
  - Incubation period is 1-6 months
  - Complications: cirrhosis, liver cancer, carrier state (10%)

- **Markers**
  - **HBsAg**: positive early, active infection
  - **HBsAb**: positive after clearance of HBsAg
  - best marker for immunity to HBV
  - **HBeAg**: implies high infectivity
  - **HBcAb**: Appears after HBsAg, persists for life. Best indicator of history of HBV infection
Pancreatitis

• Ranson’s criteria (prognostic)
  • On admission (ED)
    • Age > 55
    • Glucose > 200 mg/dL
    • WBC > 16,000
    • SGOT(AST) > 250
    • LDH > 350
  • At 48 hours (ICU)
    • Decrease in HCT >10%
    • Increase in BUN over 5 mg/dL
    • Ca++ below 8 mg/dL
    • PaO₂ < 60 mm Hg
    • Base deficit > 4 mEq/L
    • Rapid fluid sequestration (over 6L)

3 positives: severe disease
(Poor predictive value in acute settings)
Sigmoid Volvulus

Typically **elderly**, debilitated, chronic motility disorder, insidious onset; high fiber diet

Sigmoidoscopy decompression & detorsion
Cecal Volvulus

Young (20-40), acute onset
Congenital freely-mobile cecum

Requires surgery

Cecal volvulus: common cause of bowel obstruction in pregnancy
# HUS / TTP / DIC

<table>
<thead>
<tr>
<th></th>
<th>HUS</th>
<th>TTP</th>
<th>DIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Children</td>
<td>Adults</td>
<td>Adults</td>
</tr>
<tr>
<td><strong>CBC</strong></td>
<td>Anemia</td>
<td>Anemia and thrombocytopenia</td>
<td>Anemia and thrombocytopenia</td>
</tr>
<tr>
<td><strong>Peripheral smear</strong></td>
<td>MAHA*</td>
<td>MAHA</td>
<td>MAHA</td>
</tr>
<tr>
<td><strong>Clinical manifestation</strong></td>
<td>Predominantly renal</td>
<td>Predominantly CNS</td>
<td>Reflects the underlying illness</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Supportive</td>
<td>Plasmapheresis, steroids</td>
<td>Heparin and blood components</td>
</tr>
<tr>
<td><strong>Prognosis</strong></td>
<td>Good</td>
<td>Poor</td>
<td>Generally poor</td>
</tr>
</tbody>
</table>

*MAHA = microangiopathic hemolytic anemia
Diving Injuries

• Disorders of *ascent*
  • Pulmonary over pressurization syndrome
  • Air embolism - sudden
  • Decompression illness - gradual

• Disorders of *descent*
  • Squeeze syndromes
  • Nitrogen narcosis (at depth)
EKG Consistent With Hypothermia

- Bradycardia with an idioventricular or junctional escape rhythm
- Prominent J waves in the anterior leads
# Heat Illness Spectrum

<table>
<thead>
<tr>
<th>Severity</th>
<th>Name</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor (normal core temp)</td>
<td>Heat cramps</td>
<td>Na⁺ losses (local)</td>
</tr>
<tr>
<td></td>
<td>Heat edema</td>
<td>Elevation (not diuretics)</td>
</tr>
<tr>
<td></td>
<td>Heat syncope</td>
<td>Vasodilation</td>
</tr>
<tr>
<td></td>
<td>Prickly heat</td>
<td>Blocked sweat gland</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate (slight core temp elevation)</td>
<td>Heat exhaustion</td>
<td>N / V / D, water depletion, salt depletion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe (core &gt; 40°C)</td>
<td>Heat stroke</td>
<td>CNS changes, liver “meltdown”</td>
</tr>
</tbody>
</table>
BSA & Resuscitation Formulas

• Rule of palms
  • 1 Palm (of patient) = 1% BSA

• Rule of nines for adults

• Lund-Browder chart for pediatrics

• Parkland, Consensus, or Brooke resuscitation formula (other exist)
  • 4 mL x wgt (kg) x % BSA per day of LR
  • 1/2 of volume over 1st 8 hours
  • More if pulmonary or electrical components
  • Some advocate other formulas and using normal saline for children

• Follow urine output (>1 mL/kg/hr)
Rule of Nines / Adult and Child

Adult:
- Head: 9% (front and back)
- Back: 18%
- Chest: 18%
- Right arm: 9%
- Left arm: 9%
- Perineum: 1%
- Right leg: 18%
- Left leg: 18%

Child:
- Head: 18% (front and back)
- Back: 18%
- Chest: 18%
- Right arm: 9%
- Left arm: 9%
- Perineum: 1%
- Right leg: 13.5%
- Left leg: 13.5%
Radiation Exposure (2)

- Tissues with high cell division are most affected
- GI & heme systems are the most vulnerable
- Suspect radiation illness
  - Unexplained burns, GI sx & pancytopenia
- Skin dosimetry and lab dosimetry (more accurate)
  - Epilation ~ 3 Gy
  - Erythema ~ 6 Gy
  - Dry desquamation ~ 10 Gy

**48 hour absolute lymphocyte count** (cells most affected)
- > 1200 (very good)
- 300-1200 (possibly lethal)
- < 300 (lethal)
Thyroid Storm Treatment

• **Five step ORDERED approach**
  1. **General supportive care:** IV fluids, correct electrolyte imbalance, **corticosteroids** (decrease peripheral conversion of $T_4$ to $T_3$), no ASA (displaces thyroid hormone from thyroglobulin)
  
  2. **Block peripheral thyroid hormone effects:** **Propranolol** 1 mg to 10 mg titrated to symptoms

  3. **Block thyroid hormone synthesis:** **PTU** (also inhibits peripheral conversion of $T_4$ to $T_3$) or **Methimazole**

  4. **Block thyroid hormone release:** **iodine** given one hour after PTU

  5. **Identification and treatment of precipitating events**
Hypercalcemia

• Causes

P: Parathyroid: hyperparathyroidism (most common)
A: Addison's disease
M: Multiple myeloma
P: Paget’s disease (during immobilization)
S: Sarcoidosis
C: Cancer
H: Hyperthyroidism
M: Milk-alkali syndrome
I: Immobilization
D: vitamin D
T: Thiazide diuretic
Anion Gap (1)

- Anions = negatively charged ions
- Calculates unmeasured anions
- Electroneutrality: Plasma has no net charge
- Measured cation: Na$^+$
- Measured anions: Cl$^-$ and HCO$_3^-$
- Unmeasured cations: Ca$^{++}$, Mg$^{++}$
- Unmeasured anions: Organic acids, proteins, phosphates and sulfates

Calculation: $\text{Na}^+ - (\text{Cl}^- + \text{HCO}_3^-) \leq 12$
Anion Gap (3)

- Increased anion gap metabolic acidosis: "MUDPILES"

  - Methanol
  - Uremia
  - DKA, AKA, starvation ketosis
  - Phenformin or paraldehyde
  - Iron or INH
  - Lactic acidosis
  - Ethylene glycol
  - Salicylates
Non-gap Acidosis

• Normal anion gap metabolic acidosis
• Loss of bicarbonate and Na⁺
  • Therefore the equation is balanced on both sides with no increase in the anion gap
• Non-gap metabolic acidosis: "HARD UP"
  Hypoaldosteronism
  Acetazolamide
  Renal tubular acidosis
  Diarrhea
  Ureterosigmoidostomy
  Pancreatic fistula
Osmolality

- Determined by the concentration of low molecular weight solutes
- Primarily determinants: Sodium, chloride, glucose and BUN
- A difference between the measured and calculated osmolality of >10 is an osmolal gap
- An osmolal gap indicates the presence of other, unmeasured, low molecular weight solutes (ethanol, ethylene glycol, methanol, isopropyl alcohol, mannitol or glycerol)

Formula to calculate serum osmolality:

\[ 2 \text{Na} + \frac{\text{Glu}}{18} + \frac{\text{BUN}}{2.8} = 280-295 \text{ (normal)} \]
Pemphigus Vulgaris

- Fragile, smaller blisters
- Painful
- Can be **lethal**
- **Positive Nikolsky’s**

Bullous Pemphigoid

- Tense, larger blisters
- Chronic
- **Benign**
- **Negative Nikolsky’s**