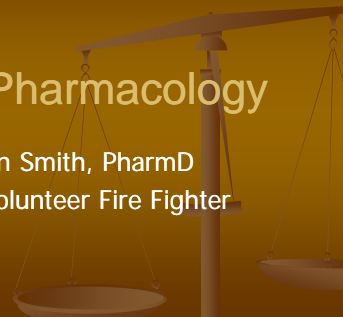


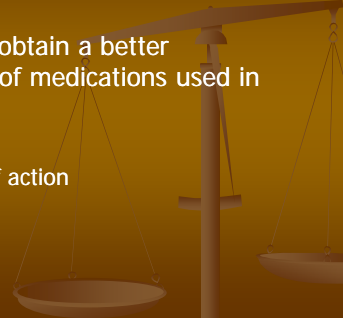
ACLS Pharmacology

Clinton Smith, PharmD
Steese Volunteer Fire Fighter



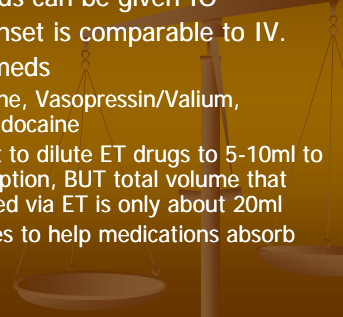
Objectives

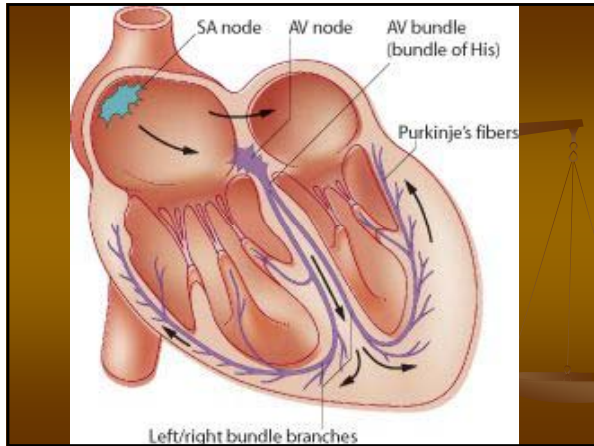
- To review and obtain a better understanding of medications used in ACLS
 - Indications
 - Mechanisms of action
 - Dosing
 - Precautions

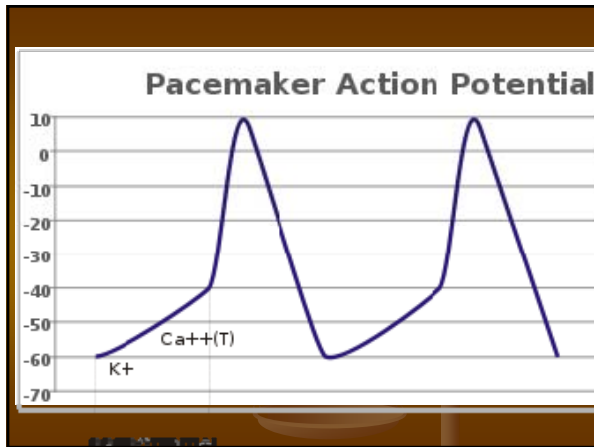


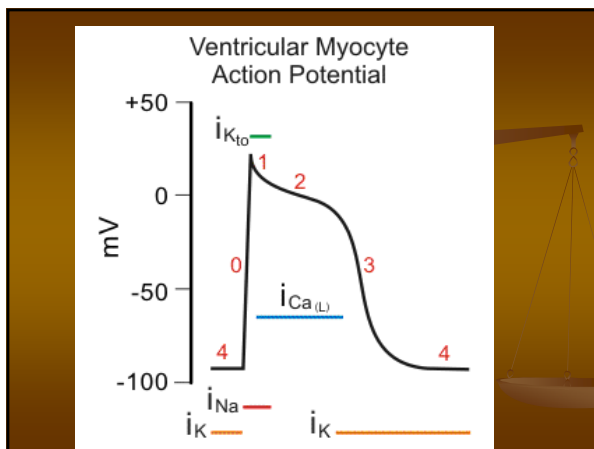
General Drug Info

- All ACLS IV meds can be given IO
- Intraosseous onset is comparable to IV.
- NAVEL for ET meds
 - Narcan, Atropine, Vasopressin/Valium, Epinephrine, Lidocaine
 - Generally want to dilute ET drugs to 5-10ml to facilitate absorption, BUT total volume that can be absorbed via ET is only about 20ml
 - Bag a few times to help medications absorb









Epinephrine

- For VF, pulseless VT, asystole, pulseless electrical activity
- Alpha and beta agonist properties
 - increases cerebral and coronary blood flow –beta (through vasoconstriction-alpha 1)
 - Increases HR, force of contraction, conduction velocity – B1
 - Bronchodilator – Beta2
 - Higher doses did not improve mortality
 - Flush and elevate extremity after dose
- Dose: 1mg IV/IO, repeat every 3 to 5 minutes
- May give via endotracheal route – Double the dose: 2mg dilute to 10ml in NS
- Also IV infusion 2-10mcg/min for profound bradycardia, hypotension

Epinephrine

- **Additional Indications:**
 - Pediatric bradycardia unresponsive to ventilation and oxygen therapy.
 - Anaphylaxis, severe allergic reactions (BP < 90 systolic and/or respiratory distress)
 - Severe asthma attacks
- **NO Contraindications:**
- **Cautions:**
 - CAD: increases myocardial oxygen demand (MI)
 - Hypertension, CV disease, hyperthyroidism, diabetes, elderly patients
 - Contraindicated for cardiogenic pulmonary edema.
- **Pregnancy Category:** C
- **Drug interactions:**
 - Sympathomimetics, TCA, antihistamines add to the effects of epinephrine.
 - Beta-blockers and epinephrine counteract each other.
 - Epi unstable in alkaline solutions – Don't add to sodium bicarbonate.
- **Onset and Duration:**
 - SQ/IM: Onset: 5-10 minutes. Peak: 20 minutes. Duration: 1-4 hours
 - IV/IO: Onset: immediate. Peak: within 1 minute. Duration: several minutes
- **Adverse reactions:**
 - Agitation, anxiety, palpitations, nausea, vomiting, headache, tremor
 - Hypertension, tachycardia, dysrhythmias, angina MI
- **Notes:**
 - Protect epinephrine from light. Do not use epinephrine that has turned brown.

Lidocaine

- For cardiac arrest from VT/VF, stable VT, wide-complex tachycardia, ectopy
- Depresses cell excitability, ventricular irritability, raises vfib threshold due to sodium channel blockade
- Dose:
 - 1-1.5mg/kg IV/IO, then 0.5-0.75mg/kg, max 3mg/kg or 3 doses.
 - Maintenance IV infusion 2-4mg/min
- ET double dose (2-3mg/kg)
- Lidocaine toxicity: paresthesias, dizziness, slurred speech, drowsiness, decreased level of consciousness, seizures

Lidocaine

Contraindications:

- Second- or third-degree heart block
- Stokes-Adams syndrome (occasional transient slowing or cessation of pulse due to heart block, causing dizziness, fainting or convulsions)
- Wolff-Parkinson-White syndrome (presence of an auxiliary conduction pathway between the atria and the ventricles)

Cautions:

- Hypoxia is a frequent cause of PVCs (give oxygen)
- CHF, SA node dysfunction, prolonged PRI and QRS complexes.

Pregnancy Category: B

Dose Adjustments:

- Conscious patients over age 70 and patients with known liver disease, CHF or signs of shock, repeat doses are 1/4 of the initial dose.

Maintenance Infusion Drip Rates for Lidocaine Premixed at 4 mg/ml

Desired Infusion	Required Volume	Rate – 60 gtt set	Rate – 20 gtt set
1 mg/min	0.25 cc/min	15 gtt/min	5 gtt/min
2 mg/min	0.5 cc/min	30 gtt/min	10 gtt/min
3 mg/min	0.75 cc/min	45 gtt/min	15 gtt/min
4 mg/min	1 cc/min	60 gtt/min	20 gtt/min

Atropine

- 1st line symptomatic sinus bradycardia
- 2nd line bradycardic PEA, asystole
- Symptomatic bradycardia due to AV nodal block (Mobitz Type I block).
- Contraindicated for Mobitz type II (infranodal block), and third degree heart block
- Anticholinergic
- Dose:
 - 1mg IV/IO every 3-5min up to 3 doses (0.04mg/kg max) for asystole/PEA
 - 0.5mg IV every 3-5min for symptomatic bradycardia with pulses
- ET –double dose (2mg for asystole)
- Precaution –increases myocardial oxygen demand
- Doses < 0.5mg may cause paradoxical slowing of HR
- Side effects: delirium, decreased secretions, blurred vision, flushed/hot skin

Atropine

- Cautions:
 - Do not treat bradycardia during acute MI unless there are signs of poor perfusion (low blood pressure, mental confusion).
 - Avoid for hypothermic bradycardia.
- Pregnancy Category: C
- Organophosphate Poisoning (Insecticide/Nerve Gas exposures)
- Contact Poison Control for dosage
- Typical adult starting dose is 2-6 mg IV depending on severity of symptoms. Subsequent doses 1-2 mg IV q 10-20 min PRN. Titrate to clear lung sounds.
- Onset and duration:
 - Onset: immediate. Peak 2-4 minutes. Duration 2-6 hours
- Adverse reactions:
 - Bradycardia, lachrymation, palpitations, tremor
 - Dilated pupils, blurred vision, dry mouth, dry hot skin
 - Anaphylaxis
- Notes:
 - Treat the patient, not the arrhythmia. People do well with chronic 2nd and 3rd degree heart blocks, symptoms occur mainly with acute changes.
 - "Blind as a bat, mad as a hatter, red as a beet, hot as a hare, dry as a bone, the bowel and bladder lose their tone, and the heart runs alone"
 - "Can't See, Spit, Sh...Piss"

Adenosine (Adenocard®)

- 1st line for stable narrow-complex SVT (rate >150)
 - consider for unstable while setting up for cardioversion
 - Also for wide-complex regular tachycardia (reentry SVT) not resolved by lidocaine
- Mechanism:
 - Degradation product of adenosine triphosphate (ATP)
 - Produces transient AV block, which breaks reentry pathway
 - Slows cardiac conduction, terminating paroxysmal supraventricular tachycardia
- Half-life less than 10 seconds –FAST IVP

Adenosine

- Dose: 6mg over 2 seconds, flush with 10-20ml saline (have ready), then elevate extremity.
 - Repeat 12 mg in 1-2 minutes, and again as needed
 - Will cause short asystole, bradycardia, and incidence of a-fib up to 12%.
 - Facial flushing common (40%, due to vasodilation)
- Less effective if taking theophylline, caffeine (methylxanthines competitive antagonist at adenosine receptor) –might need larger doses

Adenosine

Contraindications:

- Poison/drug-induced tachycardia
- Sick sinus syndrome or 2nd or 3rd degree heart block, unless functional pacemaker is in place

Cautions:

- atrial fibrillation, atrial flutter or ventricular tachycardia.
- deterioration/hypotension with wide-complex tachycardia.
- bronchoconstriction in asthma and COPD patients.
- V-fib taking digoxin and verapamil (rare).
- Wolff-Parkinson-White Syndrome, adenosine may convert A-fib to ventricular fibrillation

Pregnancy Category: C

Drug interactions:

- Caffeine and theophyllines (given for asthma) antagonize adenosine. Larger doses of adenosine may be required.
- Dipyridamole (Persantine), an anti-platelet drug, and carbamazepine (Tegretol), an antiseizure drug, potentiate adenosine (only get 3mg).

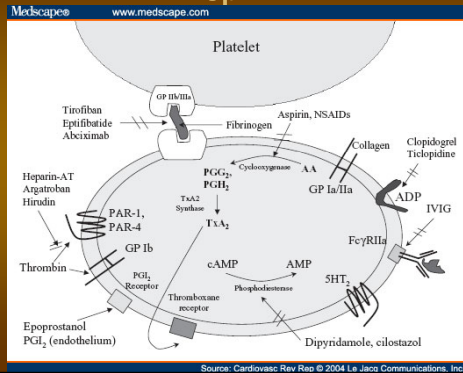
Pediatric:

- Initial dose: 0.1 mg/kg (max 6 mg) rapid IV push; follow with >5 ml saline flush.
- Second dose: 0.2 mg/kg (max 12 mg) rapid IV push, follow with >5 ml saline flush.

Aspirin

- For ACS, new chest pain suggestive of MI or angina
- Blocks formation thromboxane A₂, which causes platelet aggregation
- Reduces mortality in acute MI, nonfatal stroke, and reinfarction
- Dose: (4) 81mg –chewed for faster onset, suppository also option

Aspirin



Aspirin

Contraindications:

- Bleeding disorders (e.g. hemophilia)
- Active GI bleeding or ulcers

Cautions:

- Aspirin or NSAID-induced asthma
- Anticoagulant use
- Recent trauma or surgery

Pregnancy Category: D

Drug interactions:

- Anticoagulants (example) warfarin (Coumadin), heparin, thrombolytics

Onset and duration:

- Antiplatelet effects last 4-7 days

Overdose:

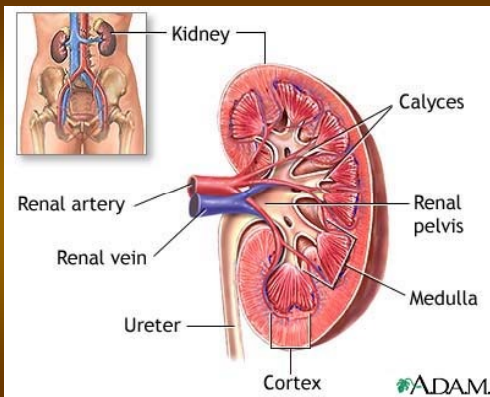
- metabolic acidosis, respiratory alkalosis

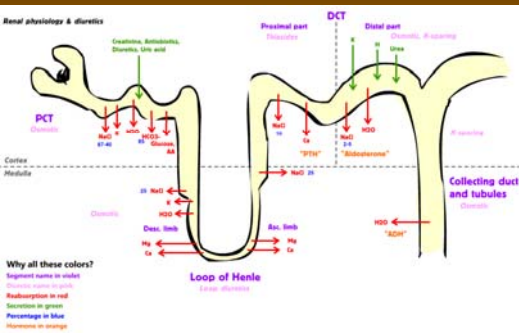
Notes:

- Already taken daily aspirin – not much effect by giving more?

Furosemide (Lasix[®])

- Adjuvant for pulmonary edema, hypertensive emergencies, CHF, increased ICP
- Loop diuretic –
 - inhibits reabsorption of Na⁺, K⁺, Cl⁻ ions, and water follows
 - Reduces vascular volume and preload
- Dose: 40mg slow IVP (may match patients usual dose up to 80mg)





Furosemide

- **Contraindications:**
 - BP < 90 systolic
 - Unable to urinate
 - Hypersensitivity sulfonamides (sulfa drugs)
 - Severe electrolyte depletion
 - Lasix is not given to children.
- **Cautions:**
 - Physician consult required before giving to pregnant patients
 - May precipitate hepatic coma in patients with severe liver disease.
- **Pregnancy Category: C**
- **Drug interactions:**
 - May potentiate lithium toxicity
 - May potentiate digitalis toxicity
 - IV incompatible with diltiazem (Cardizem), dopamine (Intropin), midazolam (Versed)
- **Onset and Duration:**
 - Onset: 5 minutes. Peak action: 20-60 minutes. Duration: 2 hours
- **Adverse reactions:**
 - Dizziness, hypotension
 - Hypochloremia, hypokalemia, hyponatremia, ECG changes
 - May cause fetal abnormalities
- **Notes:**
 - Protect from light.

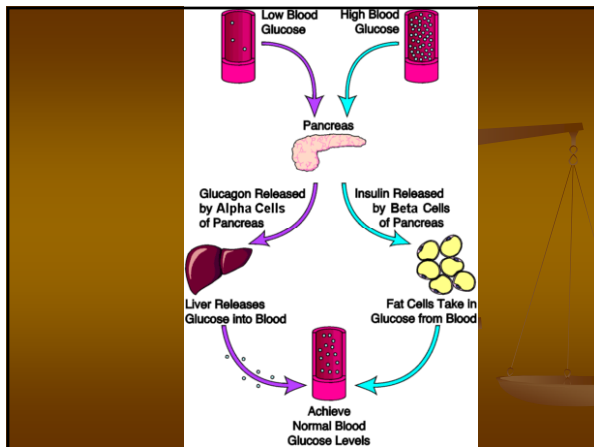
Glucagon

To increase blood glucose levels in hypoglycemic patients (<60mg/dl) when IV access for dextrose administration is unavailable

Convert glycogen stored in the liver to dump glucose to the blood stream (pancreatic hormone)

Dose: 1mg prefilled syringe (mix gently to dissolve glucagon)

Adults and children >20 kg (44 pounds): 1 mg IM
Children <20 kg (44 pounds): 0.5 mg IM



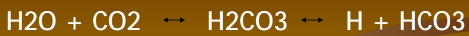
Glucagon

- **Cautions:**
 - Insulinoma (an insulin-producing tumor of the pancreas). Glucagon may help initially, then cause the tumor to release insulin, producing hypoglycemia. If this occurs, give oral or IV dextrose.
 - Pheochromocytoma (a tumor of the adrenal gland). Glucagon may cause the tumor to release catecholamines resulting in sharp increase in blood pressure.
- **Pregnancy Category: B**
- **Onset and Duration:**
 - Onset: 4-10 minutes
 - Full recovery usually occurs within 12-32 minutes
- **Adverse reactions:**
 - Hyperglycemia
 - Nausea and vomiting
 - Tachycardia, hypertension, dizziness, headache
- **Notes:**
 - Glucagon works only if there are sufficient glycogen stores in the liver, and may not work for malnourished patients or for chronic hypoglycemia.

Sodium Bicarbonate

- **Indications:**
 - Prolonged resuscitation with effective ventilation upon return of spontaneous circulation after long arrest interval
 - Known preexisting hyperkalemia
 - Known preexisting bicarbonate-responsive acidosis (DKA, TCA or ASA OD, cocaine, diphenhydramine)
 - Crush injuries
- Neutralizes hydrogen ions to act as a buffer and raise pH (use ABG to guide therapy)
- **Dose: 50-100 mEq (1mEq/kg IV bolus)**
 - Repeat 50 mEq q 10minutes FLUSH IV lines before and after use due to multiple compatibility issues

Acid Base



Nitroglycerin

- **Dose:**
 - 0.4mg SL tablets or spray, repeat every 3-5minutes
- **Side effects:** hypotension, severe headache
- **Contraindicated:**
 - SBP less than 100
 - RV MIContraindicated with Viagra, Revatio, Cialis, Levitra
- **Watch for** HA, BP drop, syncope, tachycardia

Nitroglycerin

- **Indications**
 - CP of cardiac origin
 - Unstable angina
 - CHF, left ventricular failure
 - Hypertensive crisis
- **Decreases:**
 - Pain of ischemia
 - Venous blood return to heart
 - Preload and cardiac O2 consumption
- **Increases:**
 - Venous dilation
 - Cardiac collateral flow
 - Dilation of coronary arteries (may improve flow to ischemic areas)

Nitroglycerin

- **Cautions:**
 - Check blood pressure before and after each dose. If hypotension develops, raise the patient's feet, give fluids.
- **Pregnancy Category:** C
- **Drug interactions:**
 - Alcohol, antihypertensives, beta-blockers and calcium channel blockers add to hypotensive effects of nitroglycerin.
- **Dose Adjustments:**
 - Hypertensive Crisis:
 - 1.2 mg SL q 3-5 minutes PRN
- **Onset and Duration:**
 - Onset: 1-2 minutes
 - Duration: up to 30 minutes
- **Notes:**
 - Nitroglycerin tablets lose potency easily. They should be stored in dark glass bottle with a tight-fitting lid and not exposed to heat or light.

Morphine

- For chest pain due to ischemia (unresponsive to nitrates)
 - Decreases pain of ischemia and anxiety
 - Decreases systemic vascular resistance (SVR)
 - Reduces myocardial oxygen demands
- Dose: 2-4 mg (or higher – max 10mg) IV over 1-5 minutes every 5-30 minutes
- Side effects: respiratory depression, hypotension, itching

Morphine

Contraindications:

- Hypersensitivity
- BP < 100 systolic
- Major blood loss
- Head injury, increased intracranial pressure
- Acute or severe asthma
- GI obstruction
- Severe liver or kidney impairment
- Severe respiratory depression

Pregnancy Category: C

Drug interactions:

- Alcohol, CNS depressants, MAOI'S

Dose Adjustments:

- Pediatric:
 - Severe pain: Age 6 mo-12 years: 0.1-0.2 mg/kg SQ/IM/IV q 2-4 hours, max 10 mg

Naloxone (Narcan®)

- Indication: Respiratory and neurologic depression due to opiate intoxication unresponsive to O₂ and ventilation support
- Dose: 0.4-2mg IV/IO/ET –titrate to adequate respiratory effort
 - higher doses will prompt return of severe pain in opioid tolerant patients
- May cause opiate withdrawal, avoid use in meperidine-induced seizures

Narcan

- **Cautions:**
 - Check blood sugar
 - too rapidly may induce nausea, vomiting, increased blood pressure and tachycardia= withdrawal (RESTRAIN).
 - Repeat doses may be required.
- **Pregnancy Category: B**
- **Onset and Duration:**
 - Onset: 1-2 min IV; 2-5 min SQ/IM. Duration: 20-60 minutes
- **Notes:**
 - Narcotic drugs include morphine, meperidine (Demerol), heroin, hydromorphone (Dilaudid), oxycodone (OxyContin, Percodan, Percoset), codeine, propoxyphene (Darvon), pentazocine

Flumazenil (Romazicon®)

- Reverse respiratory and sedative effects of benzodiazepines (lorazepam, diazepam, etc)
 - Do not use in TCA OD, seizure-prone patients, poly drug OD if drugs known to cause/reduce seizure threshold
- Dose: 0.2mg IVP, may repeat every 1 minute to 3 mg
 - May need to repeat later for long acting benzodiazepines (i.e. diazepam, flurazepam)

Flumazenil

- **Contraindications:**
 - Patients using benzodiazepines to control life-threatening conditions such as status epilepticus or increased ICP
 - Anticholinergic signs such as pinpoint pupils, dry mucosa
 - Arrhythmias, cardiovascular collapse
- **Cautions:**
 - Caution in alcoholics, patients with head injury, liver disease, drug dependence
 - Watch for re sedation as flumazenil wears off.
- **Pregnancy Category: C**

Magnesium sulfate

- During cardiac arrest for recurrent/persistent VT/VF if associated with torsades de pointes, or hypomagnesemia suspected
- Other uses:
 - malnutrition, wide-complex tachycardia associated with hx ETOH abuse, eclampsia
 - Digitalis toxicity, TCA OD
- Dose: 1-2gm IV/IO over 5 to 20 minutes, if pulse present may give over 60 minutes

Magnesium Sulfate

Contraindications:

- Renal failure
- Myocardial damage
- Heart block

Cautions:

- Give slowly to avoid inducing hypermagnesemia or drop in blood pressure.
- Intravenous use in eclampsia should be reserved for immediate control of life-threatening convulsions.
- Use in patients with renal insufficiency may lead to magnesium intoxication.

Pregnancy Category: A

Drug interactions:

- Calcium may neutralize effects of magnesium sulfate
- Adds to effects of CNS depressants
- May cause changes in cardiac conduction or heart block with digoxin

Dose Adjustments:

- **Seizure associated with pregnancy:**
- Initial dose: 4 gm (8 ml of 50% solution, diluted to 20-40 ml with D5W or NS) IV over 3-4 minutes
- Maintenance infusion: 1-2 gm/hr IV
- **Pediatric:**
- 25-50 mg/kg (max 2 gm) IV/IO over 10-20 minutes, faster for torsades
- **Adverse reactions:**
- Metastasis, neuromuscular blockade, respiratory arrest, heart block, hypotension, hypothermia

Oxygen

- It's oxygen ! ? ! ? !
- We always use it
- No contraindications
- SPO2 >90%
- It's cool !
- Oxygen Bar Anyone?
