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CARDIAC PHARMACOLOGY

Advanced Care Paramedicine

Module: 07

Section: 04

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Cardiac Glycosides

Cardiac Glycosides

- Cardiac Glycosides and Positive Inotropic Agents
  - Digoxin (Lanoxin)
  - Digitoxin (Crystodigin)

Mechanism of Action

- Positive Inotropic (Strength) Effect
  - increases the contractile force of the heart
  - ventricular emptying is more complete
  - increased stroke volume
- Negative Chronotropic (Speed) Effect
  - decreases the heart rate by increasing the refractory period at the AV node

Other effects

- Decreases heart size with cardiomegaly and heart failure
  - increases stroke volume and improves ventricular emptying
  - decreases cardiac workload
- Mild indirect diuretic effect
  - due to increased cardiac output and renal perfusion
- Indirect effect on ECG
  - shorter T wave
  - ST segment dips below the baseline
  - PR interval is prolonged
  - shorter QT interval

Indications

- Treatment of :
  - CHF (Congestive Heart Failure)
  - Dysrhythmias:
    - Atrial Fibrillation
    - Atrial Flutter
    - Supraventricular Tachycardia

Adverse Effects

- N/V AD
- Abdominal pain
- Headache
- Confusion
- Visual changes
  - (flickering lights/snowflakes)
- Skin rash
- Dysrhythmias

Digitalis Toxicity

- History suggesting change in Dig dosage
- History of any other new drugs
- Fatigue, blurred vision, disturbed color perception, N/V, anorexia, diarrhea, abdominal pain, HA, dizziness, confusion, delirium, hallucinations
- Bradycardia
- Occasional tachycardia
- Hypotension in severe cases

Contraindications

- Acute Myocardial Infarction
- Heart Block
- Ventricular Tachycardia
- Bradycardia
- Acute or Chronic Renal Failure

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Antihypertensives

Antihypertensives

- Central Adrenergic Inhibitors
- Alpha-Adrenergic Blockers
- Beta-Adrenergic Blockers
- Calcium Channel Blockers
- Peripheral Adrenergic Inhibitors
- Vasodilators
- Angiotensin-Converting Enzyme

Central Adrenergic Inhibitors

- Drugs:
  - Clonidine (Catapres)
  - Methyldopa (Aldomet)
  - Guanabenz (Wytensin)
  - Guanfacine (Tenex)
- Action:
  - inhibits vasoconstriction by stimulating CV center of the brain, decreasing outflow of SNS impulses

Alpha-adrenergic Blockers

- Drugs:
  - Minipres (Prazosin)
  - Cardura (Doxazosin)
  - Phenoxybenzamine (Dibenzyline)
  - Phentolamine (Regitine)
  - Ergotamine tartrate (Ergomar)
- Action:
  - inhibits action of alpha-receptors in vascular smooth muscle - causing vasodilation

Beta-adrenergic Blockers

- Drugs:
  - Propranolol (Inderal)
  - Metoprolol (Lopressor/Betaloc)
  - Nadolol (Corgard)
  - Timolol (Blocadren)
  - Atenolol (Tenormin)
- Action:
  - competes with epinephrine to occupy beta-adrenergic receptors in the heart, blood vessels, lungs, and CNS

Calcium Channel Blockers

- Drugs:
  - Diltiazem (Cardizem)
  - Nicardipine (Cardene)
  - Nifedipine (Procardia)
  - Verapamil (Calan, Isoptin)
  - Amlodipine besylate (Norvasc)
- Action:
  - blocks the flow of calcium ions through the cell membrane

Peripheral Adrenergic Inhibitors

- Drugs:
  - Guanadrel sulfate (Hylorel)
  - Guanethidine monosulfate (Ismel)
  - Reserpine (Serpasil)
- Action:
  - reduces vascular wall tone through reduction of SNS stimulation of blood vessels

Vasodilators

- Drugs:
  - Diazoxide (Hyperstat IV)
  - Hydralazine (Apresoline)
  - Minoxidil (Loniten)
  - Sodium nitroprusside (Nipride, Nitropress)
- Action:
  - relaxation of smooth muscles in the blood vessel walls to cause peripheral vasodilation

Angiotensin Converting Enzyme Inhibitors

- ACE Inhibitors:
  - Captopril (Capoten)
  - Enalapril (Vasotec)
  - Lisinopril (Prinivil, Zestril)
  - Ramipril (Altace)
- Action:
  - reduces blood pressure by blocking conversion of angiotensin I to angiotensin II

Angiotensin II Receptor Blockers

- Angiotensin II Receptor Blockers:
  - Cozaar
  - Atacand
  - Diovan
- Action:
  - reduces blood pressure by blocking angiotensin II stimulation and inhibiting Aldosterone release

Renin Blockers

- Renin Blockers
  - Aliskiren
- Action:
  - reduces blood pressure by blocking renin stimulation of angiotensinogen and inhibiting the RAAS

Anti-Anginals

Antianginals

- DRUGS:
  - Erythrityl tetranitrate (Cardilate)
  - Isosorbide dinitrate (Isordil, Sorbitrate)
  - Nitroglycerin (Nitrostat, Nitrogard, Nitro-Bid, Transderm-Nitro patch, Nitrol)

Nitrates

- Action:
  - vasodilation
  - decreases myocardial demand for oxygen
  - decreases preload by dilating veins, thus indirectly decreasing afterload
- Adverse Effects:
  - orthostatic hypotension, dizziness, weakness, NV, headache, tolerance, cardiovascular collapse

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Antilipemic Agents

Antilipidemics

- Drug:
  - Bile Acid Sequestrant
  - Cholesterol-Lowering Agents
    - Cholestyramine (Questran)
    - Colestipol (Colestid)
- Action:
  - binds bile acids in the small intestines to form an insoluble complex to be excreted in feces

Antilipidemics

- HMG-CoA Reductase Inhibitors (Statins)
  - Lipitor (Atorvastatin)
  - Crestor (Rosuvastatin)
  - Lovastatin (Mevacor)
  - Simvastatin (Zocor)
- Action:
  - inhibit the enzyme HMG-CoA reductase in the cholesterol biosynthesis pathway; increases the clearance of LDL from the plasma

Antilipidemics

- Drug:
  - Triglyceride Lowering Agents
    - Gemfibrozil (Lopid)
    - Clofibrate (Atromid-S)
- Action:
  - decreasing lipoprotein and triglyceride synthesis

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ACLS Medications

Epinephrine

- Class: Sympathomimetic

- Actions:
  - α Vasoconstriction to improve coronary and cerebral blood flow
  - β1 Increased speed (Chronotropic)
    Increased force of contraction (Inotropic)
    Decreases defibrillation threshold
  - β2 Bronchodilation

Epinephrine

- Indications:
  - Cardiac Arrest
  - Bradycardia

- Doses:
  - Cardiac Arrest: IV 1.0 mg (1:10,000) q 3 -5 min
    ET 2.0 – 2.5 mg (1:10,000)
  - Bradycardia: 1.0 mg (1:1,000) in 500 ml NaCl at 2-10 µg/min titrated to effect

Epinephrine

- Side Effects:
  - Increased MVO_2 demand
  - Headache
  - Tremor
  - Angina
  - Ectopic beats
  - Anxiety
  - Nervousness
  - Palpitations
  - Increased BP
- Precautions:
  - Do not give with $NaHCO_3$ as it will cause a precipitate to form

Anti-arrhythmics

Antidysrhythmics

- Vaughn-Williams Classifications
  - Class I
  - Class II
  - Class III
  - Class IV

Antidysrhythmics

TABLE 7–7

Antidysrhythmic Classifications and Examples

General action	Class	Prototype	ECG effects
Sodium channel blockers	IA	Quinidine, procainamide*, disopyramide	Widened QRS, prolonged QT
	IB	Lidocaine*, phenytoin, tocainide, mexiletine	Widened QRS, prolonged QT
	IC	Flecainide*, propafenone	Prolonged PR, widened QRS
	I (Miscellaneous)	Moricizine*	Prolonged PR, widened QRS
Beta blockers	II	Propranolol*, acebutolol, esmolol	Prolonged PR, bradycardias
Potassium channel blockers	III	Bretylium*, amiodarone	Prolonged QT
Calcium channel blockers	IV	Verapamil*, diltiazem	Prolonged PR, bradycardias
Miscellaneous		Adenosine, digoxin	Prolonged PR, bradycardias

*Prototype.

Antidysrhythmics

- Class I
  - Na Channel Blockers
    - Slow the maximum rate of Phase 0 depolarization
    - Slow conduction velocity
    - Slow rate and force of contraction refractory period effects

- Mechanisms of Action
  - Blocks Na influx through fast Na channels

Antidysrhythmics

- Differential effects:
  - Ia
    - Increase duration of AP, prolonged repolarization, prolonged refractory period, decreased membrane responsiveness
    - Decreased depolarization of SA node thus decreased pacemaker activity
    - Also blocks K+ channels
  - Ib
    - Decreased duration of AP, decreased membrane responsiveness in ventricles
    - Blocks activated and inactivated Na+ channels, depresses damaged or depolarized cells (eg. post MI)
    - Does not block K+ channels
  - Ic
    - No effect or minimal increase in duration of AP & repolarization
    - Decreased membrane responsiveness
    - Decreased conduction velocity in atrial & ventricular cells
    - Also blocks K+ channels

Antidysrhythmics

- Class Ia
  - Quinidine
  - Procainamide
  - Disopyramide
- Class Ib
  - Lidocaine
  - Tocainide (Mexilitine)
  - Phenytoin
- Class Ic
  - Flecainide
  - Propanfenone
  - Moricizine

Antidysrhythmics

- Class II
  - Beta Blockers

- Mechanisms of Action
  - Blockade of ß-receptors
  - Inhibition of norepinephrine release (bretylium)

- Propranolol
- Metoprolol
- Atenolol

Antidysrhythmics

- Class III
  - K Channel blockers
  - Prolong action potential and affiliated refractory period
- Mechanisms of Action
  - Do not alter normal fast Na conductance
  - Do not compete for ß-receptors
- Bretylium
- Amiodarone (Has effects of all classes)
- Sotalol (no longer used – causes Torsades)

Antidysrhythmics

- Class IV
  - Ca Channel Blockers

- Mechanisms of Action
  - Selectively block slow Ca channels
    - Inhibit slow inward Ca current during phase 2
      - Decrease rate of phase 4 depolarization
      - Effect on the “pacemaker in charge”
    - Depress conduction velocity in Purkinje system and AV node
    - Decrease contractility in myocardium
    - Vasodilatation (lower intracellular Ca in arterial muscle)
- Verapamil (Isoptin)
- Diltiazem
- Cardizem
- Nifedipine
- Plendil

Amiodarone (Cordarone)

- Class: Anti-arrhythmic
  (Class III with properties of all IV)

- Actions:
  - α vasodilatation (decreases preload and MVO_2)
  - β adrenergic blocking effects by effecting the Na, K and Ca channels

Amiodarone (Cordarone)

- Indications:
  - VFib/VTach
  - Tachy rhythms
    - Stable Afib/Aflut if < 48 hrs old (convert)
    - Afib/Aflut with ↓LVF rate control
    - WPW convert/control rate
    - Stable wide-complex tach of unknown type

Amiodarone (Cordarone)

- Dose:
  - VFib/Vtach
    - 300 mg in 20-30 ml D_5W
    - Consider second dose of 150 mg if VF/VT returns
  - Anti-arrhythmic
    - 150 mg over 10 min followed by an infusion of 1 mg/min for 6 hours then 0.5 mg/min
  - Max does 2.0 g in a 24 period

- Side Effects:
  - Hypotension
  - Bradycardia

Lidocaine

- Class: Anti-arrhythmic
  (Class I b)

- Actions:
  - Reduces velocity of electrical impulses by blocking the Na channels of the heart cells
  - Thus reduces automaticity of the conduction system

Lidocaine

- Indications:
  - VFib/VTach
  - Stable VTach with a pulse
  - Wide-complex tachycardia of unknown origin

Lidocaine

- Dose:
  - VFib/Vtach
    - 1st dose: 1.0 mg/kg
    - 2nd dose: 0.5 mg/kg q 10 mins (Max 3.0 mg/kg)
  - Post Arrest
    - Only give if runs of VT
  - VT with pulse
    - 1st dose: 1.0 mg/kg
    - 2nd dose: 0.5 mg/kg q 10 mins (Max 3.0 mg/kg)
    - Infusion of 1 – 4 mg/min
      - 2.0 mg/min, 30 cc/hr or 30 gtts/min
    - (consider ½ dose for pt > 70 y/o or compromised liver function or CHF)

Lidocaine

- Side Effects:
  - Seizures
  - CNS Depression
  - Drowsiness
  - Dizziness
  - Hypotension
  - Bradycardia
  - Tremors
  - Numbness
- Precautions:
  - Should not be given with 3° Heart block or bradycardia related PVC's or idioventricular rhythms

Procainamide

- Class: Anti-arrhythmic
  (Class I A)

- Actions:
  - Slows conduction through the myocardium at the Bundle of HIS and Purkinje fibers
  - Prolongs the refractory period of the atrium than that of the ventricles

Procainamide

- Indications:
  - VFib/VTach
  - Wide-complex tachycardia
  - PSVT (Afib/Aflut)

Procainamide

- Dose:
  - VFib/VTach — 30 – 50 mg/min slow IVP
  - VTach with a pulse — 20 mg/min slow IVP
  - Maintenance Drip — 1 – 4 mg/min
  - Max dose — 17 mg/kg
  - Endpoints
    - Max dose
    - QRS widens 50%
    - Arrhythmia is suppressed

Procainamide

- Side Effects:
  - Dizziness
  - Hypotension
  - V-Fib
  - Reflex Tachycardia
  - CNS Depression
  - Seizures
  - Systole
  - Hallucinations
  - Confusion
  - Bradycardia
  - AV Blocks
  - Widen QRS
  - N/V
  - Fever

Procainamide

- Precautions:
  - Torsades de Pointes
  - QT Prolonged
  - Reduce maintenance dose with Renal Failure

Magnesium Sulfate

- Class: Anti-convulsant
  Electrolyte replenisher

- Actions:
  - Hypomagnesium may impair replacement of intracellular K at the Na-K pump which may precipitate refractory VFib
  - Should be corrected by administration

Magnesium Sulfate

- Indications:
  - Hypomagnesium
  - Torsades de Pointes
  - Severe Refractory or Recurrent VFib

- Dose:
  - VFib/VTach 1 – 2 g in 100 ml of D_5W
  - Hypomagnesia 1 – 2 g in 100 ml over 1 – 2 min
  - Torsades 1 – 2 g in 100 ml over 1 – 2 min

Magnesium Sulfate

- Side Effects:
  - Respiratory depression
  - Bradycardia
  - Hypothermia
  - Diarrhea
  - Diaphoresis
  - Drowsiness
- Contraindications:
  - Heart Blocks
  - Pt with MI Damage
- Precautions
  - Rapid admin may cause hypotension or asystole or respiratory arrest

Adenosine

- Class: Anti-arrhythmic

- Actions:
  - Depresses SA and AV conduction
  - The “Chemical Defibrillator”

Adenosine

- Indications:
  - PSVT
- Dose:
  - Initial 6.0 mg rapid IVP with 20 ml flush
  - Second 12.0 mg
  - Third 12.0 mg

Adenosine

- Side Effects:
  - Asystole
  - Bradycardia
  - Ventricular Ectopics
  - Dizziness
  - Facial Flushing
  - Chest Pain
  - N/V
  - SOB
  - Headache

Note: Most resolve in 1 - 2 minutes

Adenosine

- Precautions:
  - Should not be used for:
    - 2° Type II or 3° HB
    - Sick Sinus Syndrome
  - Use with caution with Asthma patients
  - Remember short half-life of drug
  - Should be administered in IV port closest to patient

Beta Blockers

- Class: Anti-arrhythmic
  (Class II)

- Actions:
  - β_1 and β_2 blocker
  - Decreases HR and contractility
  - May reduce incidence of VF in post MI pt's

Beta Blockers

- Indications:
  - SVT
  - AMI
  - Unstable Angina

- Dosing:
  - Atenolol — 5 – 10 mg IV over 5 min
  - Metoprolol — 5 – 10 mg Slow IVP (Max 15 mg)
  - Esmolol — 0.5 mg/kg over 1 min then 50 µg/min
  - Propranolol — 0.1 mg/kg slow IVP divided into 3 doses
    Should not exceed 1 mg/min
  - Sotalol — 1 – 1.5 mg/kg at 10 mg/min

Beta Blockers

- Side Effects:
  - Bronchospasms
  - CHF
  - Bradycardia
  - Hypotension
  - AV Conduction delays
  - Side-effects are also Contraindications

Ca Channel Blockers

- Class: Anti-arrhythmic
  (Class IV)

- Actions:
  - Ca channel blocker
  - Delays conduction through AV
  - Decrease ventricular response rate
  - May decease MVO_2

Ca Channel Blockers

- Indications:
  - Narrow complex PSVT
  - Terminate reentrant arrhythmias
  - Rate control for AFib/AFlut

- Dosing:
  - Verapamil (Isoptin) — 2.5 – 5.0 mg over 2 min; 5 – 10 mg repeated 15 – 30 min (Max 20 mg)
  - Diltiazem (Cardizem) — 0.25 mg/kg followed by 0.35 mg/kg

Ca Channel Blockers

- Side Effects:
  - Bradycardia
  - Hypotension
  - Decrease myocardial contractility
  - May exacerbate CHF
- Precautions
  - Pt's on β-Blockers

Atropine

- Class: Anticholinergic

- Actions:
  - Parasympathetic blocker (muscarinic receptors)
  - Decreases parasympathetic tone which increases HR (Allows for SA and AV node automaticity)

Atropine

- Indications:
  - Asystole, PEA (HR < 60)
  - Symptomatic Bradycardia
  - 2º or 3º block w/ narrow QRS and SBP < 90 (QRS < 0.8 sec)
  - Organophosphate poisonings

- Dose:
  - Asystole/PEA — 1.0 mg IVP q 3 – 5 min
  - 2º or 3º block or Bradycardia — 0.5 mg IVP
  - Organophosphate poisonings — 1 mg q 3-5 min PRN
    - Min dose — 0.5 mg
    - Max dose — 0.04 mg/kg (3.0 mg)

Atropine

- Side Effects:
  - Palpitations
  - Tachycardia
  - Headache
  - Dizziness
  - Anxiety
  - Dry Mouth
  - Decreased urination

- OD Effects
  - Hot as a hare
  - Blind as a bat
  - Dry as a bone
  - Red as a beet
  - Mad as a hatter

Atropine

- Precautions
  - Use carefully in pt's with 2° Type II or 3° HB
  - May worsen AV Blocks
  - May increase Myocardial O2 demand
  - May exacerbate ischemia

Vasopressin

- Class: Antidiuretic

- Actions:
  - Naturally occurring ADH
  - Increases re-absorption of H_2O in renal tubules
  - Powerful peripheral vasoconstriction at high doses
  - Does not have negative effect on heart

Vasopressin

- Indications:
  - VFib
- Dosing:
  - 40 U IV
    - If no response within 10 min return to Epi regimen

Dopamine

- Class: Sympathomimetic

- Actions:
  - Rate dependent
  - ↑Cardiac contractility
  - Causes peripheral vasoconstriction
  - ↑ Chronotropic and inotropic effects
  - Dilatation of mesenteric and renal arteries
    - Low dose action (<10 µg/kg/min)
      - Beta Effects predominate
    - High dose action (> 10 µg/kg/min)
      - Alpha Effects predominate

Dopamine

- Indications:
  - Cardiogenic shock with BP < 70 mmHg
  - Shock states with hypotension (without hypovolemia)

- Dosing:
  - < 5 µg/kg/min renal rate
  - 5 – 10 µg/kg/min ↑HR and contractility
  - 10 – 20 µg/kg/min peripheral vasoconstriction

Dopamine

- Side Effects:
  - Headache
  - Tremor
  - Tachycardia
  - Palpitations
  - N/V
  - Angina
  - Dyspnea
  - Ectopic beats
- Precautions
  - Hypovolemia
  - VFib or Tachycardias
  - Pheochromocytoma
  - Do not mix with $NaHCO_3$

Dobutamine

- Class: Sympathomimetic

- Actions:
  - Direct inotropic stimulation of the β1-receptors
  - Produces less chronotropic and vasodialation effects
  - Increases cardiac output (BP)

Dobutamine

- Indications:
  - Decreased heart function due to cardiac contractility
- Dosing:
  - 5 – 20 µg/kg/min
- Side Effects:
  - May increase myocardial ischemia

Levophed (Norepinephrine)

- Class: Sympathomimetic
- Actions:
  - Inotropic
  - Potent Vasoconstrictor
  - Renal, mesenteric and Vas deferens constrictor
- Indications:
  - Hypotension
  - Low PVR
- Dosing:
  - Mix 4 mg in 250 ml NaCl (16 µg/ml)
  - Initial dose 0.5 – 1.0 µg/min (Titrate to effect)
- Side Effects:
  - May increase myocardial ischemia

Nitroglycerine

- Class: Nitrate

- Actions:
  - Vasodilatation decreasing preload
  - Decreases workload of the heart
  - Decreases MVO_2

- Indications:
  - Ischemic Chest Pain
  - CHF
  - Hypertensive emergencies

Nitroglycerine

- Dosing:
  - Angina/CP — 0.4 mg SL q 3 – 5 min
    Note: Pressure >100/50
  - HTN — Mix 50 mg in 250 ml NaCl
    10 – 20 µg/min titrated to effect

- Side Effects:
  - Hypotension
  - Dizziness
  - Headache

Morphine

- Class: Opiate, Narcotic analgesic

- Actions:
  - CNS depressant, providing both analgesia and sedation
  - ↑ peripheral venous capacitance and ↓ venous return
  - ↓ myocardial oxygen demand

- Indications:
  - Pain relief
  - CHF
  - AMI

Morphine

- CI:
  - Hypersensitivity
  - Hypovolemia
  - Hypotension (BP < 100 systolic)
  - Head injury
- Precautions:
  - Use with caution in elderly, asthma, and those who may already have or be susceptible to CNS depression

Morphine

- Side Effects:
  - Respiratory depression
  - Hypotension
  - Palpitations
  - Dry mouth
  - Bradycardia
  - Tachycardia
  - Constricted pupils
  - Altered mental status
  - Headache
  - Nausea/Vomiting

Morphine

- Dosage:
  - Adult:
    - 2-10 mg IV q 10 min prn
    - 5-15 mg IM q 10 min prn
  - Pediatric:
    - 0.1 mg/kg at 1 mg/min

Isoproterenol (Isuprel)

- Class: Sympathetic agonist
- Action:
  - Is a synthetic catecholamine
  - Acts primarily on β-adrenergic receptors
  - No significant α-receptor stimulating capabilities
  - Primarily acts on the heart and lungs
  - In cardiac emergencies, may be used to increase heart rate in bradycardias that are refractory to atropine
  - With the advent of transcutaneous pacing, seldom used by paramedics

Isoproterenol (Isuprel)

- Indications:
  - Bradycardias refractory to atropine
  - When transcutaneous pacing is unavailable
  - In denervated hearts (transplants)
  - In beta blocker overdoses
  - In high degree heart blocks when transcutaneous pacing is unavailable
  - Severe status asthmaticus
  - Occasionally for refractory torsades de pointes

- Contraindications:
  - Not used to increase blood pressure in cardiogenic shock
  - Other sympathomimetics, such as dopamine and norepinephrine, should be used

Isoproterenol (Isuprel)

- Side Effects:
  - Nervousness
  - Headache
  - Tremor
  - Dysrhythmias
  - Hypertension
  - Angina
  - Nausea and vomiting
- Dose:
  - 1 mg diluted in 500 mL of D_5W (2 µg/mL)
  - Titrate until the desired heart rate is attained or until signs of ventricular irritability
  - Recommended infusion rate is 2 to 10 µg/min

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Diuretics

Diuretics

- Loop diuretics
  - Furosemide
  - Inhibit the body's ability to reabsorb sodium at the ascending loop in the nephron which leads to an excretion of water in the urine whereas water normally follows sodium back into the extracellular fluid
- Thiazides
  - Hydrochlorothiazide
  - Act on the distal convoluted tubule and inhibit the sodium-chloride symporter leading to a retention of water in the urine,
- Carbonic anhydrase inhibitors
  - Acetazolamide and Methazolamide.
  - Inhibit the enzyme carbonic anhydrase which is found in the proximal convoluted tubule
  - This results in several effects including bicarbonate retention in the urine, potassium retention in urine and decreased sodium absorption.

Diuretics

- Potassium-sparing diuretics
  - Do not promote the secretion of potassium into the urine
  - Aldosterone antagonists: spironolactone, which is a competitive antagonist of aldosterone.
  - Epithelial sodium channel blockers: amiloride and triamterene.
- Calcium-sparing diuretics
  - Result in a relatively low rate of excretion of calcium.
  - The thiazides and potassium-sparing diuretics are considered to be calcium-sparing diuretics
- Osmotic diuretics
  - Mannitol, Glucose
  - Their presence leads to an increase in the osmolarity of the filtrate

Furosemide (Lasix)

- Class: Diuretic

- Actions:
  - Blocks reabsorption of Na at the Loop of Henle
  - May have some venous dilatory effects

- Indications:
  - Circulatory Overload
    - Acute pulmonary edema
    - CHF
    - Hypertensive emergency

Furosemide (Lasix)

- Dosing:
  - 0.5 – 1.0 mg/kg IVP (Typically 20 – 80 mg)
  - Max of 2.0 mg/kg
  - EHS: 40 mg if on other Diuretic, or Dbl home dose
- Side Effects:
  - Dysrhythmias
  - Metabolite disturbances
  - N/V
- Contraindications:
  - Hypotension/Hypovolemia (SBP < 100 mmHg)
  - Do not use in pts that are hypokalemic

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Anticoagulant and Fibrinolytic Therapy

Anticoagulant Therapy

- Heparin
  - Inhibits growth of thrombus
  - Inhibits formation of new thrombus
- Warfarin (Coumadin)
  - Inhibit Vitamin K use thus inhibiting coagulation
- Novasen (ECASA)
  - Inhibit the Thromboxane A-2 thus inhibiting aggregation
- Integrilin, Clopidogrel (Plavix) and Ticlid
  - Antithrombotic agent that reversibly inhibits platelet aggregation by preventing binding of fibrinogen to the GP IIb-IIIa receptor.

Anticoagulant Therapy

- Fragmin (LMWH)
  - Only small chains of polysaccharides
  - Works the same as heparin
- Lovenox (Enoxaparin) (LMWH)
- Fondaparinux (Arixtra)
  - a synthetic pentasaccharide
  - Inhibits thrombin formation

Fibrinolytic Therapy

- Streptokinase
  - acts with plasminogen to form a “activator complex” that converts residual plasminogen into plasmin
- Tissue Plasminogen Activator (t-Pa)
  - converts the proenzyme plasminogen to plasmin See each individual drug for specifics:
  - Alteplase (Natural form), Reteplase and Urokinase (rTPA)
- Tenecteplase (TNK)
  - rTPA

Tenecteplase (TNKase)

- Class: Fibrinolytic
- MOI: Converts thrombus-bound plasminogen to plasmin, which degrades the fibrin matrix of the thrombus
- Ind: STEMI
- CI: See exclusion criteria

Tenecteplase (TNKase)

- Dosage:

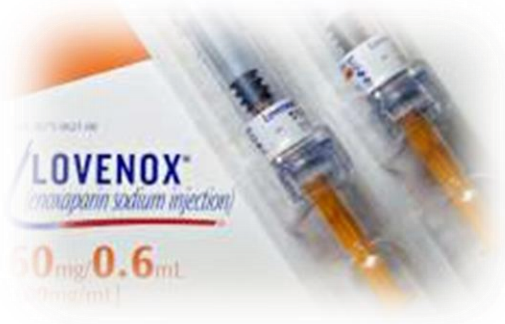
Weight (kg)	TNK (mg)	Reconstituted TNK (ml)
< 60	30	6
60 to 70	35	7
70 to 80	40	8
80 to 90	45	9
>90	50	10

- Note: Rapid injection with 10 ml flush
  - If bleeding occurs, d/c tx, supportive care and contact OLMC ASAP

Lovenox (Enoxaparin)

- Class: Anticoagulant/LMWH
- MOI: Potentiates Antithrombin III (which inhibits coagulation) and decreases the formation of thrombin
- Ind: STEMI
- CI: Do NOT give IM

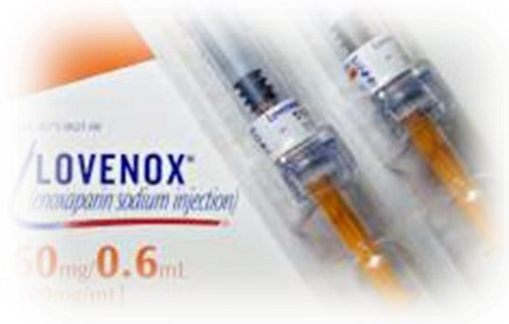
  See Exclusion criteria



Lovenox (Enoxaparin)

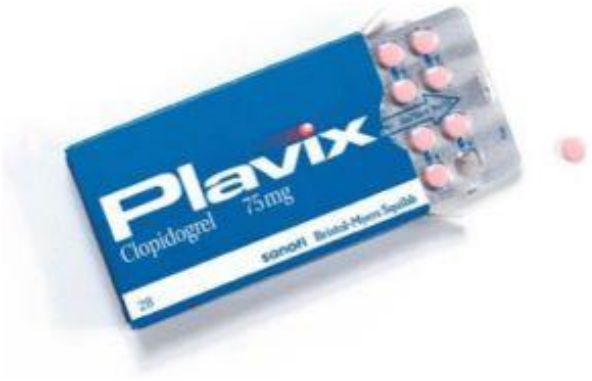
- < 75 y/o
  - 1.0 mg/kg (max 100 mg) SQ (lateral abdomen)
  - 30 mg IV
- >= 75 y/o
  - 0.75 mg/kg (max 75 mg) SQ (lateral abdomen)
  - NO IV DOSE

Weight (kg)	SC Dose (mg) for < 75 y/o	SC Dose (mg) for >= 75 y/o
50	50	38
60	60	45
70	70	53
80	80	60
90	90	68
>= 100	100	75



Plavix (Clopidogrel)

- Class: Antiplatelet agent
- MOI: Inhibits the $P2Y_{12}$ of ADP receptor on the platelet which inhibits platelet aggregation by blocking activation of the glycoprotein IIb/IIIa pathway.
- Ind: STEMI
- CI: See exclusion criteria



Plavix (Clopidogrel)

- Dose:
  - < 75 y/o 300 mg PO
  - >= 75 y/o 75 mg PO