PHARMACOLOGY

OXYGEN

*** Used for any suspected cardiopulmonary emergency***
Used in all ACLS algorithms

Indications:
- Acute Chest Pain
- Hypoxia
- Cardiopulmonary Arrest
- Pulmonary Edema

Dosage:

Device	Flow Rate	02%
Nasal Cannula	1-6 L/min	22-44
Venturi Mask	4-8 L/min	24-40
Non-rebreather	8-12 L/min	80-95
Bag Value Mask	15 L/min	100

Machanism of Action: Improves tissue oxygenation and hemoglobin saturation when circulation is maintained.

Precautions: Oxygen toxicity > 3-5 Days.
Rare with short-term use – make sure high flow O2 delivered adequately.

Note: Do not withhold oxygen from patients with COPD if signs of hypoxia are present.
Be prepared to intubate and assist ventilation.
O2 adequacy checked by End Tidal CO2 detector & pulse oximeter. Pulse oximetry should be kept > 95%.

EPINEPHRINE

*** Used for all pulse-less rhythms***

Indications: Patients in cardiac arrest or Symptomatic Bradycardia.

Dosages:
a. Standard: 1mg IVP (10ml of 1:10,000 soln.) repeat q 3-5 min.
b. Symptomatic Bradycardia: 2-10 mcg/min (1mg in 500 ml) IV drip. Use after Atropine & Pacing.
c. Endotracheal: 2-2 ½ mg & followed by 12-20 ml NS.

Mechanism of Action: α – adrenergic receptor – stimulating properties.
*Increases coronary perfusion pressures
*Increases myocardial & cerebral blood flow
*Increase in SVR – systemic Vascular Resistance (Vasoconstriction & ↑ Blood Pressure)
*Increases electrical activity in the myocardium
*Increases Automaticity

Precautions: High intravenous-dose may exacerbate post resuscitation myocardial dysfunction.
Increases myocardial oxygen demand.
Continuous infusions should be administered by central venous Access to reduce the risk of extravasation.

Algorithms: Vfib
V tach without pulse
Asystole
PEA
Refractory Bradycardia

VASOPRESSIN (ADH)
(Pitressin)

Naturally occurring antidiuretic hormone

Indications:	Increases coronary perfusion pressure increasing vital organ Flow and return of spontaneous circulation. Effective vasopressor increasing blood pressure. Increases cerebral oxygen delivery.
Dosage:	40 U IVP – One time dose * Note half life is 10-20 minutes*
Mechanism of Action:	In unnaturally high doses it acts as a non-adrenergic peripheral vasoconstrictor.
Note:	Vasopressin is recommended for a one time does and may take 10 minutes to see beneficial results. May be useful for hymodynamic support in vasodilatory shock as a continuous infusion if standard therapy is inadequate.
Algorithms:	V-Fib V-Tach no pulse Asystole PEA

NOREPINEPHRINE
(LEVOPHED)

***Severe hypotension systolic B/P <70**

Indications:	Symptomatic bradycardia (Syst B/P <70mmHG) Last resort for management of ischemic Heart disease and stroke. Cardiogenic Shock Increase Cardiac Output & Blood Pressure
Dosage:	0.5-1.0 mcg/min titrate up to 30 mcg/min (Mix 4 mg in 250ml D5W or D5NS-16mcg/ml)
Mechanisms Of Action:	Dominant Alpha Activity Potent Vasoconstrictor renal & mesenteric.
Precaution:	Increases Oxygen demand May induce arrhythmia's May cause hypotension due to hypovolemia Causes tissue necrosis if exacerbates.

DOPAMINE
(INTROPIN)

***Significant Hypotension B/P 70-110 and S/S of shock**

Indications:
Correct hypotension.
Cardiogenic Pulmonary Edema
Symptomatic Bradycardia with hypotension
Cardiogenic Shock
Renal Failure

Dosage:

1. 5-10 mcg/kg/min Cardiac Dose
   ↑force of myocardial contraction & cardiac output.

&

2. 10-20 mcg/kg/min VASOPRESSOR DOSE

Mechanism of Action:
Alpha dominant - ↑SVR Preload & HR

3. Above 20 mcg/kg/min effects similar to LEVOPHED

Precautions:
<u>Should not be used in:</u>
Hypotension due to hypovolemia
Uncorrected tachy-arrhythmia
Excessive vasoconstriction
Do not mix with Sodium Bicarb
Or Alkaline Solutions
Not to confuse with Dobutamine

Algorithms:
Refractory Bradycardia with hypotension
Hypotension & Shock

DOBUTAMINE
(Dobutrex)

***Used for "pump" problems with Systolic B/P 90-100**

Indications:	Used for heart pump problems (CHF, Pulmonary Congestion * Cardiogenic Pulmonary Edema)
Dosage:	5-20 meg/kg/min IV Infusion Titrate so heart does not increase greater than 10% from baseline.
Mechanisms Of Action:	Has less cardiac effects than Dopamine Strong Beta 1 Stimulant ↑myocaridal contractility – ↑Blood Pressure & ↑Renal Perfusion Slight Beta 2 (Some vasodilation ↓ ventricular afterload & ↑HR)
Precautions:	<u>Should not be used in:</u> Uncorrected Tachycardia Systolic B/P <90 Doses > 40 mcg/kg may be toxic Signs of myocardial ischemia Hypovolemia Not to confuse with Dopemine
Algorithms:	Acute Pulmonary Edema, Hypotension & Shock

ATROPINE

Indications:	Symptomatic Bradycardia Bradycardia with PVC's Asystole PEA with rate < 60 after Epinephrine May be useful in AV Blocks › 1st Degree AVB › 2nd Degree type I (Wenchbach) * Watch carefully for slowing
Dosage:	0.5 – 1.0 mg IV q 3-5 min for Bradycardia 1.0 mg for Asystoke & PEA (Total 3-4 mg)
Mechanisms Of Action:	Accelerates the HR by blocking parasympathetic nervous system. Enhances sinus node automaticity & AV conduction. Effects of Atropine on the heart is almost entirely to its electrical activity.
Precautions:	Increases myocardial ischemia & hypoxia Use caution in the AMI Decreases the body's vagal reflexes Increases myocardial oxygen demand Avoid in ypothermia due to increase ischemia
Algorithms:	Asystole Bradycardia with Hypotension PEA (rate < 60)

AMIODARONE
(CORDARONE)

Indications:	Antiarrhythmic VF and VT no pulse.
Dosage:	VT/VF – 300mg rapid in 20-30ml NS or D5W Atrial & Ventricular Arrhythmia's – Adults initially 150mg over 10 min. followed by 1mg/min for 6 hours then 0.5mg/min
Mechanism Of Action:	α & β-adrenergic blocking properties. Prolongs action potential duration Decrease AV conduction & sinus node function
Precautions:	Hypotension 2^{nd} & 3^{rd} degree AV block Bradycardia induced syncope Severe hepatic disease Caution in thyroid disease
Note:	If HR ↓ 60 or B/P ↓ 90 mmHg withhold drug and call physician. Inform family against photosensitivity to sunlight Bluish skin color will disappear when dug is discontinued. Do not use OTC nasal decongestants without physician approval.
Algorithm:	VT/VF PSVT Atrial Tachycardia

LIDOCAINE

Indications:	Ventricular Ectopy Hemodynamically compromising PVC's Cardiac Arrest VF – Pulseless VT Stable VT wide complex tachycardia of uncertain type. *Stable V-tach meds first*
Dosage:	Hemodynamically Stable Initial Treatment 1.0 – 1.5 mg/kg/IVP Max 3mg/kg Followed by Maintenance Infusion: 1 – 4 mg/min May be administered endotracheally 2-2 ½ x dose
Mechanisms Of Action:	Shortens the refractory period (QT Interval) and suppresses automaticity. ↓ irritability.
Precautions	Prophylactic use in AMI <u>not recommended</u> 3rd Degree AV Block Bradycardia related to PVC's * Idioventricular rhythm Lidocaine toxicity (can cause VT)
Algorithms:	Vfib/Vtach no pulse Wide Complex Tachycardia Stable→Unstable Vtach with pulse

PROCAINAMIDE
(Pronestyl)

Indications:	Recurrent VT not controlled by Lidocain Refractory PSVT Refractory VT/Pulse-less VT Stable wide-complex tachycardia of unknown origin Afib with rapid rate such as WPW
Dosage:	IV infusion 100mg over 5 minutes (20mg/min) Maintenance Infusion 1-4 mg/min To prepare infustion: Mix 1 gram/250ml (4mg/ml) *End points for stopping IV bolus arrhythmia suppression hypotension QRS widens > 50%
Mechanism of Action:	Reduces the automaticity of all pacemakers Slows intra-ventricular conduction Suppresses Ventricular ectopy
Precautions:	Patient with cardiac or renal dysfunction Hypotension with bolus administration <u>Should not be used in:</u> Complete AV Block Digitalis toxicity Prolonged QT interval Torsades de Points.
Algorithms:	VF/VT no pulse VT with pulse stable & unstable Wide complex Tach stable & unstable Afib – A flutter stable PEA

ADENOSINE

(Adenocard)

***Primary effect is to slow AV conduction**

Indications:	Paroxysmal supraventricular tachycardia PSVT/SVT Narrow Complex Wide complex tachycardia of uncertain type Chemical Cardioversion (c/o of CP, N&V, SOB, Flush) Can cause temporary asystole
Dosage:	6mg IV slam (1-3 sec) After 1-2 minutes if cardioversion doesn't occur 12 mg IVP May give second 12 mg IVP
Mechanisms Of Action:	Interrupts reentry pathways in the AV node Slows the conduction time through the AV node restoring NSR. Half-line less than 5 seconds.
Precautions:	2^{nd} or 3^{rd} Degree Block – SSS (unless artificial pacer Working) Asthmatic may experience bronchospasms. Can cause hypotension Chest pain Prolonged effects in denervated heart transplants
Drug-Drug Interaction:	Tegretol may increase heart block Dipridamole potentates effects of Adenosine Theophylline or caffeine may lower adenosine effects. Nicotine may increase tachycardia rise
Algorithms:	V-Tach with a pulse Narrow complex paroxysmal SVT

DIGOXIN

Indications:	Parozysmal Atrial Tachycardia – Stable Atrial Fibrillation/Atrial Flutter Chronic Treatment of CHF
Dosage:	Loading: 0.5 – 1.0 mg IV or PO in divided Doses/24h Maint. 0.125 – 0.5 mg IV or PO daily Consider body size & renal function
Therapeutic Range:	0.5 – 2.0 mg/ml A patient can be dig toxic even with levels below normal Range due to amount of digitalis glycoside in the myocardium not the circulating blood levels. › Digibind can treat serious toxicity
Mechanisms Of Action:	↓ conduction through the AV vode + inotropic effect ↓ ventricular response in Afib, Aflutter, & PSVT ↑ Cardiac Output
Precautions:	Monitor for toxicity more frequent in electrolyte imbalances. Calcium used simultaneously with calcium may precipitate dysrhythmias. Simultaneous use of verapamil, propranolol, & procainamide may cause additive cardiac effects.
Signs & Symptoms of Toxicity:	Excessive slowing of heart rate Dysrhythmias & changes in mental status N&V, diarrhea, & visual disturbances
Algorithm:	Afib and Aflutter Stable Narrow SVT

MAGNESIUM

Dosage:	<u>In recurrent or refractory VF/VT</u> 1-2 grams diluted in 100ml D5W IVP over 1-2 min. <u>In documented hypomagnesiums:</u> 1-2 grams diluted in 50-100 ml of D5W over 60 min.
Indications:	Torsades de Pointes – Drug Induced Suspected hypomagnesium Severe recurrent or refractory Vfib
Mechanisms Of Action:	Plays important role in neurotransmission and muscular excitability.
Precautions:	Bradycardia Hypotension Dysrhythmias Paralysis Cardiac Arrest <u>Should not be used in:</u> Heart Block Caution in renal insufficiency
Algorithm:	Vfib & Pulse-less Vtach

CALCIUM CHLORIDE

Indications:	Acute Hyperkalemia Acute Hypocalcemia Overdose of a calcium channel blocker Multiple infusions of processed blood
Dosage:	2-4 mg/kg (10% solution) slow IV push May be repeated at ten minute intervals * High doses may be detrimental
Mechanisms Of Action:	Increases myocardial contractility and maintains cell membrane & capillary permeability
Precautions:	Bradycardia with rapid infusion
	<u>Should not be used in:</u> Patients with renal calculi Patients receiving digitalis causes toxicity Precipitates with bicarb

NITROPRUSSIDE
(Nipride)

Indications:	Hypertension Emergencies CHF Cardiogenic Shock AMI if Nitroglycerin not effective
Dosage:	0.1 – 5.0 mcg/kg/min IV Infusion Prepared: 50 – 100mg in 250 ml of D5W Deteriorates when exposed to light.
Mechanism Of Action:	Potent rapid acting peripheral vasodilator Reduces peripheral arterial pressure (preload & afterload)
Precautions:	Decreases cerebral perfusion Causes hypotension especially with hypovolemia Caution in renal & hepatic disease May cause cyanide toxicity – confusion – convulsions (takes 7 days to get levels back)
Note:	Compatible with NS but best to give in D5W due to sodium Retention and ↑ B/P. Easier to treat high sugars than sodium.

NITROGLYCERIN

Indication:	Ischemic Chest Pain AMI CHF Hypertension Emergencies
Dosage:	<u>With Chest Pain:</u> 0.3 – 0.5 mg/SL or Spray may repeat every 3-5 min. total of 1.2 mg <u>In Congestive Heart Failure:</u> 10-20 mcg/min IV Infusion Prepared: 50-100 mg in 250ml in D5W
Mechanisms: Of Action	Smooth muscle relaxant Reduces cardiac workload (preload) Dilates coronary arteries Dilates systemic arteries (May reduce BP and relieve pain in AMI)
Precautions:	<u>Should not be used in:</u> Cerebral hemorrhage Hypotension Suspected tamponade or pericarditis Avoid with Bradycardia Avoid with extreme Tachycardias.
Note:	May cause throbbing headaches Reprefusion dysrhythmias Palpitations
Algorithms:	Acute Coronary Syndrome

MORPHINE

Indications:	Pulmonary Edema due to CHF Pain associated with AMI (if NTG not working) Dilate blood vessels Emergency treatment of Cardiogenic Pulm. Edema
Dosage:	2-4 mg IVP as often as q 5 minutes
Mechanism Of Action:	Causes Vasodilation which reduces myocardial Oxygen consumption Analgesia Sedation
Precautions:	Respiratory Depression Hypotension especially with hypovolemia Bradycardia Pupil constriction Seizures (caution in head injury)

DIURETICS

Indications:	<u>Circulatory Overload:</u> Acute pulmonary edema Congestive Heart Failure Hypertensive Crisis Cerebral edema after cardiac arrest Cardiogenic Pulmonary Edema	
Mechanism of Action:	Increase the excretion of water/sodium and other electrolytes via the kidneys. Antihypertensive effect thought to be due to reducing plasma volume or ↓ PVR.	
Subclassifications:	Thiazides:	Diuril Zaroxolyn
	Potassium Sparing:	Aldactone
	Loop:	Bumex Edecrin Lasix
	Osmotic:	Glycerin Mannitol

SODIUM BICARBONATE

Indications:	Refractory Cardiac Arrest *Known pre-existing hyperkalemia *Known pre-existing metabolic acidosis *Overdoes with tricyclic antidepressants
Dosage:	1 mEq/kg IVP Dose should be calculated by base deficit.
Mechanisms Of Action:	Reverses acidosis
Precautions:	Lowers serum potassium CHF Renal insufficiency
Algorithm:	Asystole Vfib Vtach no pulse PEA

Contraindications of Bicarbonate use by clinical data:

›Does not improve the ability to defibrillate

›Can compromise coronary perfusion pressure

›May cause adverse effects due to extracellular alkalosis

- ♦ Including inhibiting the release of oxygen

›May induce hyperosmolarity and hypernatremia

›Produces carbon dioxide contributing to intracellular acidosis

›Exacerbates central venous acidosis

›May inactivate simultaneously administered catecholamines.

MIDAZOLAM
(Versed)

Indications:	Concsious sedation for cardioversion Relieve anxiety and produce amnesia
Dosage:	Conscious sedation Initially up to 2.5 mg IVP in small increments Total dose rarely >5mg Elderly up to 1.5 for total of 3.5 mg
Mechanism Of Action:	Depressant action at all levels of CNS
Precautions:	Severe fluid & electrolyte imbalance Impaired renal function CHF Shock Acute alcohol intoxication May cause respiratory depression May cause hypotension May increase ventricle irritability in hypoxic patients
Note:	Reverse with Romazicon (max dose of 1 mg)

IBUTILIDE
(Corvert)

Indications:	Short acting antiarrhythmic Treatment for recent onset Atrial Fibrillation & Atrial Flutter – 3 hours to 90 days
Dosage:	Adults > 60kg – 1 mg over 10 minutes Adults < 60kg – 0.01 ml/kg over 10 minutes Second dose may be given in 24 hours
NOTE:	STOP INFUSION AS SOON AS RHYTHM CONVERTS TO SINUS!
Mechanism Of Action:	Decrease the heart rate and AV conduction by activating a slow inward NA Current.
Precautions:	May cause Vtach, headache, tachycardia, and hypotension. Patient needs to be hemodynamically stable. Electrolytes in normal ranges (esp. K+ & Mg+) EKG with QT interval <440 msec.
NOTE:	Patients are placed on monitoring equipment with emergency equipment close. CHS requires ACLS personnel at bedside.
Drug Interaction:	Anti-arrhythmics such as: Quinidine, procainamide, norpace, betapace, cordarone prolong refractoriness. Other drugs that prolong QT interval: Phenothiazine, tricyclic antidepressants, antihistamines seldane & Hismanal.
Algorithm:	Afib – A – Flutter sudden onset

BETABLOCKERS

Indications:	Effective antiarrhythmic ↓incidence of VF in post MI patients May ↓rate of nonfatal re-infarction Slows HR & treat rhythm problems ↓ myocardial ischemia by ↓ 02 requirements ↓ Blood pressure	
Mechanism Of Action:	α – adrenergic receptor blockade Anti-dysrhythmic	
Precautions:	<u>Should be avoided in:</u> Bradycardia Second or third-degree AV block Hypotension Overt CHF Lung disease associated with bronchospasm Can depress pumping function of the heart Increase airway resistance.	
Drug & Dosage:	Atenolol:	5-10 mg IV over 5 min slow
	Esmolol:	500 µg/kg over 1min. followed by infusion 50 µg/kg/min over 4 minutes
	Metroprolol:	5-10 mg slow IVP at 5 min. intervals a total of 15mg.
	Propranolol:	Total dose of 0.1 mg/kg slow IVP divided into 3 equal doses.
Algorithms:	Acute Coronary Syndrome Polymorphic VT Stable A-Fib-A-Flutter Junctiional Tachycardia SVT & MAT	

ACE INHIBITORS

Angiotensin Converting Enzyme

Indications: HTN & CHF

Mechanism Of Action: Prevents conversion of angiotension I to II, a potent vasoconstrictor.

Precaution: Renal Impairment
Hypovolemia
Coronary or Cerebral Insufficiency
Watch for Hypotension

- Lotensin
- Capoten
- Inhibase
- Vasotec
- Monopril
- Prinivil
- Univase
- Aceon
- Acupril
- Altace
- Renor max

Algorithm: Acute Coronary Syndrome in 6 hours or when stable

CALCIUM CHANNEL BLOCKERS

Indications:	Treatment for essential hypertension Prophylaxis of angina pectoris Prevent/control SVT & Sinus Tachycardia Prevent neurologic damage due to subarachniod hemorrhage.	
Mechanism Of Action:	Inhibit the flow of Ca+ across the cell membrane Relax arterial smooth muscle Slow rate of SA node & AV node conduction Prevents reentry arrhythmia's Slow HR & decrease myocardial O2 demand	
Precautions:	Renal or hepatic dysfunction Heart Block Hypotension Extreme bradycardia/SSS Aortic Stenosis Discontinuation should be gradual	
Drugs	Cardizem:	20-25 mg IV bolus; 5-15 mg/hr IV Infusion
	Cardene:	60-120 mg/day PO
	Procardia:	30-60 mg/day PO/SL
	Nimotop:	60 mg q4h x 3 weeks PO/SL
	Verapamil:	5-10 mg IV max
Algorithms:	Atrial Tachycardias	

FIBROLYTIC AGENTS

Indications:

Lysis of thrombi obstructing coronary arteries in acute MI.
Ideally within the first 6 hours of onset of symptoms.
Re-establish blood flow to infarct related artery.
Goal door to drug <30 min.
Acute Ischemic Stroke within 3 hours of onset of symptoms

Mechanism Of Action:

Activate both soluble plasminogen and surface bound plasminogen to plasmin where generated close to fibrin clot digest fibrin and dissolves the clot.

Precautions:

Absolute contraindications
Activate bleeding disorder (past 3 weeks)
Suspected aortic aneurysm or acute pericarditis
Recent Trauma or surgery (2 weeks)
Intracranial neoplasm
Prolonged CPR > 10 minutes.
History of recent CVA or TIA (6 months)
Pregnancy
Previous Allergic reaction
Diabetic hemorrhagic retinopathy
Excessive hypertension

Agents:

Thrombolytic agents currently available tin the US
APSAC, Streptokinase, t-PA, Urokinase, Alteplase, Reteplase (all lyse existing clots)

Antiplatelets:
ReoPro, Aspirin, Persantine, & Ticlid
(Primarily ↓ risk arterial thromboembolism)

Anticoagulants:
Fragmin, Lovenox, Heparin, & Coumadin
(Primarily ↓ risk of venous thromboembolism)

FIBRINOLYTIC THERAPY

- Alteplase
- Tenecteplase
- TPA
- Reteplase
- Streptokinase
- APSAC

Mechanism of Action: Thrombolytic Enzymes – Binds to fibrin, converts Plasminogen to plasmin initiating local fibrinolysis.

Indications: Lysis of thrombi obstructing coronary arteries in
Acute MI
Acute Ischemic Stroke
Pulmonary Embolism

- Heparin

Mechanism of Action: Anticoagulant – Acccelerates formation of Antithrombin III- thrombin complex & deactivates thrombin preventing concersion of fibrinogen to fibrin

Indications: DVT
MI
Pulmonary Embolism

- ASA

Mechanism of Action: Impedes clotting by blocking prostaglandin synthesis preventing thromboxane A2.

Indications: MI

- Aggrastat
- ReoPro

Mechanism of Action: Binds to glycoprotein IIb/IIIa receptor inhibiting platelet aggregation.

Indications: Acute Coronary Syndrome

MISCELLANEOUS

Not approved by FDA for IV use

♦ Solotol (Betapace)

Indication:	Ventricular & Supraventricular arrhythmia's
Mechanism Of Action:	Non selective beta blocker that depresses sinus heart rate, slows AV conduction, decreases cardiac output & lowers systolic and diastolic Blood Pressure.
Dosage:	1-1.5 mg/kg at a rate of 10mg/min (slow)
Precautions:	bradycardia, hypotension and torsades de pointes

♦ Flecainide (tambocor)

♦ Propafenone (Rhythmol)

Indication:	Ventricular & Supraventricular arrhythmia's (Wolfe-Parkinson White Syndrome)
Mechanism Of Action:	Potent sodium channel blocker with significant conduction-slowing effects.
Dosage:	2mg/kg at 10mg/min (slow)
Precautions:	bradycardia, hypotension, neurological symptoms and avoid in patients with LV dysfunction.

♦ Isoproterenol (Isuprel)

Indications:	Temporary measure before pacing for torsades de pointes Refractory Symptomatic Bradycardia Low dose chronotropic effect
Mechanism Of Action:	Pure β-adrenergic agonist with potent inotropic and chronotropic effects.
Dosage:	2 to 10 mcg/min add 1mg to 500ml of D5W
Precautions:	Higher doses will increase myocardial oxygen consumption, increase infarct size and exacerbate ischemia & arrhythmias.

♦ Phenytoin (Dilantin)

Indications:	Stable Ventricular Tachycardia with wide baseline QT