• AIRWAY AND BREATHING
  – Waveform capnography
    • 1. Measures exhaled CO2
    • 2. Recommended for all intubated patients
    • 3. Most reliable way to monitor patients respirations
    • 4. Continue throughout the peri-arrest period
  – Reasons to use waveform capnography
    • 1. Confirm placement of the ET tube
    • 2. Detect ROSC based on CO2 changes
    • 3. Monitor CPR quality

  – Supplemental oxygen (especially high flow)
    • 1. Not needed for POSC patients
      – Without respiratory distress
      – With an SPO2 >94%
    • 2. Titrate to maintain SPO2 > 94% in hypoxic patients
    • 3. Hyper-oxygenation in ROSC patients
      – May reduce cerebral blood flow during resuscitation
      – Long term may create oxygen toxicity
    • Apply oxygen to patients with ACS that:
      – Have an oxygen saturation < 94%
      – Are in cardiac or respiratory failure
• PHARMACOLOGY
  – Atropine
    • 1. Is not recommended for PEA and asystole
    • 2. Has been removed from the algorithms
    • 3. Evidence suggests no therapeutic benefit
  
  – Adenosine
    • 1. May be used in initial diagnosis of stable monomorphic wide complex tachycardia
    • 2. It should not be used if pattern is irregular
    • 3. May be used to diagnose and treat wide complex tachycardia for SVT with aberrant conduction
  
  – Dopamine and epinephrine infusions
    • 1. Recommended as an alternative to pacing for all symptomatic bradycardias
    • 2. Either dopamine or epinephrine infusions may be used
  
  – Morphine
    • 1. Caution in all non-STEMI patients with unstable angina
    • 2. Morphine is indicated for STEMI patients with chest discomfort not relieved by nitrates
DEFIBRILLATION AND CARDIOVERSION

- Ventricular tachycardia
  - 1. Stable monomorph VTach – cardiovert
  - 2. Start at 100J and increase stepwise
  - 3. A biphasic dose has been added
  - 4. Treat polymorphic VTach with unsynchronized shock

- A-fib and A-flutter
  - 1. Recommended biphasic dose A-fib 120 – 200 J
  - 2. Initial dose for monophasic cardioversion is 200J
  - 3. Atrial flutter and SVT (50-100j) either monophasic or biphasic
• CHAIN OF SURVIVAL

- Early recognition of cardiac arrest
  - Early quality CPR
  - Rapid defibrillation
  - Effective advanced life support
  - Integrated post arrest care

MEDICAL RESPONSE TEAM

- Purpose
  - Improve patient outcomes by identifying and treating early clinical deterioration

Team
  - The team is composed of specialized and highly trained professional personnel covering medical and respiratory disciplines
• **GENERAL**
  - If patient is unconscious
    • Use BLS survey for initial assessment
    • Use ACLS survey for advanced assessment
  - If patient is conscious
    • Use ACLS survey for initial assessment

• **BLS SURVEY**
  - Check responsiveness
  - Activate 911 and get the AED
  - Circulation
    • Check for carotid pulse < 10 seconds
    • Start CPR
  - Defibrillation
    • If no pulse assess shock able rhythm / AED
    • Provide shock if indicated
    • Resume CPR following shocks
ACLs Survey

- Airway
  - Airway patent
  - Is an advanced airway indicated
  - Confirm and secure tube

- Breathing
  - Adequate oxygenation and ventilation?
  - Arrest 100% O2 - Non arrest O2 if SPO2 <94%

- Circulation
  - Adequate chest compressions if in arrest
  - Rhythm interpretation / 12 lead
  - Is defibrillation, cardioversion, pacing indicated
  - Has IV/IO been established
  - Administer fluids and medications

- Differential diagnosis
  - Why did patient develop symptoms or arrest
  - Is there a reversible cause that can be treated
• OPENING THE AIRWAY
• No evidence of trauma (Head tilt chin lift)

• Evidence of trauma (Jaw thrust)
• BLS AIRWAY MAINTENANCE

• Oropharyngeal
  – Keeps tongue from blocking the airway
  – Indications
    • Unconscious patient
    • Absence of a gag reflex
  – Sizing
    • Corner of the mouth to the angle of the mandible
  – Insertion
    • Upside down to uvula then rotate to fully insert
    • Sideways to uvula then rotate to fully insert
    • Must be flush with the mouth
• BLS AIRWAY MAINTENANCE
• NASOPHARANGEAL
• Indications
  – Conscious or semi-conscious patient
  – Patient with a gag reflex
• Sizing
  • Nose to tragus of the ear
• Insertion
  – Lubricate well
  – Choose the largest nostril
  – Gently use a spiral motion to insert
  – Check patient ventilation
  – If resistance is encountered remove and try the other nostril

• Caution
  – Do not use on patients with serious head injuries
  – Contraindicated with basilar skull fractures
• BLS AIRWAY MAINTENANCE
• SUCTIONING
• Soft catheters
  – Aspirates thin secretions oro and naso pharynx
  – Performing endotracheal suctioning
  – Suction through an in place airway
• Rigid catheters
  – Suctioning oropharynx, thick particulate matter
• Endotracheal suctioning
  – Use sterile technique
  – Insert catheter into the endotracheal tube
    • Use the largest tube possible
    • Do not insert below the end of the ET tube
    • Be sure opening is not occluded during insertion
    Apply suctioning by occluding the catheter opening during withdrawal
    Do not suction longer than 10 seconds
• ADVANCED AIRWAYS
  
  • SUPRAGLOTIC
    – Combitube
    – King airway
    – LMA (laryngeal mask airway)
    – SALT airway

• NASOTRACHEAL INTUBATION
  – Conscious or semi conscious patients
  – Insert in largest nostril (Lubricate well)
  – Do not use a stylette
  – Glottic opening located by sound and vapor in the tube
  – Most useful in pulmonary edema and patients unable to open the mouth
  – Stop insertion if resistance is encountered
  – Contraindicated in head trauma
• ADVANCED AIRWAYS

• ENDOTRACHEAL INTUBATION
  – Essential for unconscious patients
  – May be used on conscious patients with RSI (Rapid sequence intubation)
  – Performed with
    • Laryngoscope
      – Miller blade - straight
      – Macintosh blade – curved
      – Check scope prior to insertion
    • Endotracheal tube
      – Trial inflate the tube cuff prior to insertion
    • Stylette
    • 10 cc syringe
    • Lubricant
  – Confirm placement
    • Auscultation
    • Capnography
    • Chest x ray
  – Secure the tube
• VENTILATION (BLS)
  • Mouth to mouth and mouth to mask
    – Does not prevent disease transmission
    – Must provide a good seal
    – Deliver enough breath to make the chest rise
    – Your exhaled breath can only supply 16% oxygen
  • Ambu bag
    – Safest method to prevent disease transmission
    – Can supply 100% oxygen
    – Open the airway
    – Completely seal the mask
    – Deliver breath volume enough to make the chest rise
    – Each breath should be 1 second duration
    – Requires 2 rescuers to assure a good mask seal
VENTILATION (ACLS)

Automated pneumatic ventilators
- Provides automatic ventilation to intubated patients
- Sets rate, tidal volume, PEEP pressure, FiO2 and minute volume

CPAP
- Provides PEEP (positive end expiratory pressure)
- Requires a mask and a CPAP machine
- Most useful for conscious pulmonary edema patients
- Expands terminal bronchi and alveolar sacs

BIPAP
- Provides both positive inspiratory and expiratory pressure
- Most useful on asthmatic and COPD, and pneumonia patients that require additional inspiratory pressure support with PEEP.
Why use waveform capnography

- Capnography measures CO2 resulting from breathing
- It is the only accurate way to assess breathing
- AHA requires it on all intubated patients

How waveform capnography works

- CO2 is absorbed in the IR at 4.3 nm
- Exhaled bas passes through an IR adaptor attached to the ET tube
- This provides an electrical signal to the cardiac monitor
- The monitor provides exhaled CO2, respiration rate and a capnographic waveform analysis

Waveform capnography is used to

- Measure CO2 level
- Determine the respiration rate
- Show the capnography waveform
- Indicate a missed tube
- To indicate a missed intubation
• MANUAL MONITOR / DEFIBRILLORS

• General
  – All manual monitor defibrillators provide the same functions
  – You must become familiar with the one that you use

• Modes
  – Basic 3, 4 leads for rhythm interpretation
  – A 12 lead capability
  – A defibrillator mode
    • Cardioversion – synchronized
    • Defibrillation - unsynchronized
  – A pacing mode
    • Sets the rate
    • Increases current to obtain capture
MANUAL MONITOR / DEFIBRILLATORS

- 3, 4, and 5 lead placement

- 3 lead RA (white) LA (black) LL (red)
- 4 lead RA (white) LA (black) LL(red) RL (green)
- 5 lead RA (white) LA (white) LL(red) RL (green) V1 (brown)
• 12 LEAD PLACEMENT LEFT SIDE

• 12 LEAD PLACEMENT RIGHT SIDE
**CARDIOVERSION**

Cardioversion is used to treat rapid heartbeats that are not related to a treatable cause and compromise hemostasis.

- To cardiovert the unit must be in the DEFIB mode.
- Be sure to push the SYNC button before your initial dose and again before each subsequent dose.
- Failure to push the SYNC button will result in defibrillation.
- When the unit is in the sync mode a light will appear over each R wave as shown.
• **CARDIOVERSION**

  • If the patient is conscious consider sedation
    – Valium or versed
  • Charge the unit to the appropriate joule level
  • Be sure that the unit is in the synchronized mode
  • Be sure that everyone is clear or the patient
  • **IM CLEAR YOUR CLEAR WERE ALL CLEAR**
  • Deliver the charge
    – Hold the charge button until the R wave captures
  • If you increase to the next joule level be sure to re synchronize.
**EXTERNAL PACING**

- External pacing is done using multifunction pads
- The anterior posterior position for pad location is most effective
- Sedate the patient if conscious
- Set a heart rate of at least 60 beats per minute
- Adjust the current until both electrical and mechanical capture is attained
- Mechanical cap occurs when a carotid pulse is felt that matches the set rate
- Switch to trans-venous pacing ASAP

**Contraindications**
- Asystole
- Pulseless VTach

**Side effects**
- Skin burns
- Chest muscle contraction
- Chest discomfort
• DEFIBRILLATION

• How defibrillation works
  – An electrical charge is placed across the heart
  – This creates asystole
  – Either the heart will remain in asystole or a new rhythm will occur

• Rhythms that require early defibrillation
  – Ventricular fibrillation
  – Pulseless ventricular tachycardia
  – Multi form ventricular tachycardia (Torsades)
• **DEFIBRILLATION**

• Pad contact
  - Good pad contact is essential for successful defibrillation.
    - Be sure to dry the patient before applying the pads
    - Shave chest hairs in pad application areas
    - Remove any nitro paste or ointments

• Pad placement
  - Pads may be placed in either the anterior–anterior or the anterior–posterior position
  - The anterior posterior position is preferential if pacing is anticipated
• DEFIBRILLATION

• Defibrillator operation
  – Set the unit in the defibrillator mode
  – Charge the defibrillator
  – Clear the patient before administering the shock
    • This includes anything touching the patient
    • IM CLEAR YOUR CLEAR WERE ALL CLEAR
  – Deliver the shock
  – Remember
    • Do CPR while the defibrillator is charging
    • Start CPR immediately after the shock is delivered
• GENERAL
  – The pharmacological approach
    • Works well for non-arrest patients
    • Is slower acting in arrested patients
  – Factors contributing to pharmacological success
    • The quality of CPR
    • The down time before medication administration
    • The condition of the patient’s arteries

• MEDICATION ACCESS ROUTES
  – Intravenous
    • Give medications through large bore IV’S
    • The preferred sites are
      – Antecubital
      – External jugular
    • Try to start IV’S before arrest occurs
• MEDICATION ACCESS ROUTES

• Intra-osseous (IO) access
  – Direct injection through the bone wall into the bone marrow venous plexis
  – Safe and reliable
  – You can administer fluids, colloids, and all medications

• Indications for IO access
  – Inability to achieve IV access
  – Previously required central lines
  – Emergent need for drugs or fluids
  – Cardiac arrest without IV access

• Contraindications to IO
  – Fracture in the extremity
  – Previous insertion attempt in the same bone
  – Infection at the injection site
  – Inability to locate landmarks or excessive tissue
• Intra-osseous devices
  – Jamshidi needle
  – BIG (Bone injection gun)
  – EZIO (Injection drill)

• Intra-osseous injection sites
  – Proximal tibia
  – Distal tibia above the medial malleolus
  – Head of the humerus
• **INTRA-OSSEOUS**

• Confirmation of catheter placement
  - Catheter is firmly seated in the bone
  - Flash of blood or bone marrow
  - Pressurized fluids flow without difficulty
  - Pharmacological effects are noted

• After IO insertion
  - Stabilize IO
  - Remove trocar
  - Aspirate the IO
  - Attach a short connecting tubing with a 3 way stopcock
  - Flush IO to insure patency
    • Pressurized fluids should flow freely
    • There should be no evidence of extravasation
  - For conscious patients consider lidocaine for pain
  - Flush with 10-20 cc N.S. after each medication
• ENDOTRACHEAL ROUTE

- Least effective route of administration
- Meds that can be given ET (NAVEL)
  - Narcan
  - Atropine
  - Vasopressin
  - Epinephrine
  - Lidocaine

- Rules for ET administration
  - Use 2-2.5 times the IV dose (except vasopressin)
  - Stop compressions
  - Use 10 ml total volume (dilute with N.S. or sterile water)
  - Ventilate several times
  - Resume compressions
MEDICATIONS TO STIMULATE THE HEART
EPINEPHERINE

- Indications
  - Cardiac arrest
  - Bradycardia refractory to atropine and TCP

- Actions
  - Increases heart rate, contractility, automaticity and vasoconstriction

- Dose
  - 1-3 mg every 3-5 minutes

- Infusion
  - Mix 8 mg /500ml in D5W or N.S.
  - Infuse at 2-10 mcg/min for bradycardia
  - Infuse at 8-40 mcg / min for hypotension

- Route
  - IV or IO

- Side effects
  - Tachycardia
  - Hypertension
  - PVS’S
  - Increased oxygen demand
• MEDICATIONS TO STIMULATE THE HEART

• VASOPRESSIN
  – Classification
    • Antidiuretic hormone
    • Non-adrenergic vasoconstrictor
  – Indications
    • Cardiac arrest as an alternative to epinephrine
  – Actions
    • Vasoconstriction- stimulates smooth muscle receptors
    • Increases coronary perfusion during CPR
    • Increases vital organ blood flow and cerebral oxygen
  – Dosage – 40 units
  – Route – IV, IO, ET
  – Side effects – Potential vasoconstriction
• ANTI-ARRHYTHMIA MEDICATIONS

• AMIODARONE (CORDARONE)
  – Classification – anti-dysrhythmic
  – Indications
    • VT/VF
    • Rapid atrial arrhythmias
  – Actions
    • Prolongs recovery period of cardiac cells
    • Affects sodium, potassium, and calcium channels
    • Affects alpha and beta
  – Dosage (IV/IO)
    • Cardiac arrest- 300 mg in 10 ml Repeat 150 mg 3-5 min
    • Perfusing patients 150 mg over 10 min. Repeat in 10 min.
  – Infusion (900 mg / 500 ml)
    • 1 mg / min for 6 hours then 0.5 mg /min for 18 hours
  – Side effects
    • HTN, bradycardia, AV blocks, CHF, arrhythmias
  – Contraindications
    • Cardiogenic shock
    • Second or third degree heart blocks
• ANTI-ARRHYTHMIA MEDICATIONS

• LIDOCAINE
  – Classification
    • Anti-dysrhythmic
  – Indications
    • VT, VF, PVC’S
  – Actions
    • Sodium channel blocker
    • Depresses ventricular irritability and automaticity
  – Dosage
    • Cardiac arrest- 1-1.5 mg/kg repeat half dose to 3mg/kg
    • VT /PVC’S 0.5-0.75 mg/kg @ 5-10 min as needed
  – Infusion
    • Maintenance – Mix 2 gm /500ml (4mg/ml)
    • Infuse at 1-4 mg/min (15-60 ml/hr)
  – Route
    • IV,IO,ET
  – Side effects
    • Muscle tremors
    • seizures
• MEDICATIONS TO CONTROL HEART RATE
• ATROPINE
  – Classification
    • Parasympathetic blocker
  – Indications
    • Symptomatic bradycardia
  – Action
    • Increases heart rate and conduction through the AV node
  – Dosage
    • 0.5 mg Repeat every 3-5 minutes
    • Maximum dose 3 mg
  – Route
    • IV, IO, ET
  – Side effects
    • Tachycardia, dilated pupils, angina
    • Small doses may cause bradycardia
MEDICATIONS THAT CONTROL HEART RATE

ADENOCARD (ADENOSINE)

Classification
– Anti-dysrhythmic

Indications
– SVT (Specifically atrial tachycardia)
– Wide complex undiagnosed tachycardia

Action
– Abolishes reentry
– Slows AV conduction

Dosage
– 6mg rapid IV push followed by a saline flush
– 12 mg IV rapid push followed by a saline flush

Route
– IV, IO, Rapid push

Side effects
– Brief period of asystole
– Transient reentry dysrhythmias
– Chest pain, palpitations, flushing
• MEDICATIONS THAT CONTROL HEART RATE
• CARDIZEM (DILTIAZEM)
• Classification
   – Anti-dysrhythmic
• Indications
   – SVT (Especially A-fib and A-flutter)
• Action
   – Calcium channel antagonist
   – Slows conduction
   – Smooth muscle dilation
• Dosage
   – Give 0.25 mg/kg over 2 minutes (15-20 mg)
   – May repeat 0.35 mg/kg in 15 minutes
   – Infuse 125 mg/100ml at 5-15 mg/hr
• Route
   – Slow push followed by an infusion
• Side effects
   – Bradycardia
   – Hypotension
• ELECTROLYTES
• SODIUM BICARBONATE
• Classification
  – Alkalizer, buffer
• Indications
  – Metabolic acidosis
  – Tricyclic antidepressant overdose
  – Hyperkalemia
• Action
  – Increases pH reversing acidosis
• Dosage
  – 1 mEq/kg iv push, then 0.5 mEq/kg every 10 minutes
  – May give as an infusion for certain overdoses
• Route
  – IV push or infusion
• Side effects
  – Hypernatremia, hyperosmolality
  – Metabolic alkalosis
• **ELECTROLYTES**
• **CALCIUM CHLORIDE**
• Classification
  – Electrolyte
• Indications
  – Hypocalcemia
  – Hyperkalemia
  – Hypermagnesemia
  – Calcium channel blocker overdose
• Action
  – Increased inotropic force and contractility
• Dosage
  – 2-4 mg/kg of a 10% solution. Repeat in 10 min. if required
  – Usual dose is 500mg to 1 gm
• Route
  – IV, IO
• Side effects
  – Hypercalcemia
  – Ventricular fibrillation
  – Exacerbates digitalis toxicity
• ELECTROLYTES
• MAGNESIUM SULFATE
• Classification
  – Anti-dysrhythmic / electrolyte
• Indications
  – Refractory dysrhythmias
  – Torsades
  – Hypomagnesemia
• Action
  – Stabilizes tissue membranes
  – Raises magnesium levels
  – Smooth muscle relaxant
• Dosage
  – VF / pulseless VT – 1-2 gm over 1-2 minutes
  – VT with pulse – 1-2 gm in 10 ml over 1-2 minutes
  – Hypomagnesemia w/o ectopy 0.5-1 mg/hr infusion
• Route
  – IV or infusion
• Side effects
  – Bradycardia
  – Hypotension
• Caution
  – Patients with little or no urine output
• **VASOPRESSORS**
• **DOPAMINE**
  • Classification
    – Adrenergic stimulator / inotrope
  • Indications
    – Symptomatic hypotension (SBP 70-100 Shock)
    – Refractory bradycardia
  • Action
    – Dopaminergic (1-2 mcg/kg/min) Dilates renal arteries and mesentery
    – Beta- 2-10 mcg/kg/min Increased heart rate and cardiac output
    – Alpha- 10-20 mcg/kg/min Vasoconstriction increased afterload
  • Dosage
    – 2-20 mcg/kg/min (usual start dose -5mcg/kg/min)
    – Estimate start dose as 10% of the patient’s weight
  • Route
    – IV, IO infusion only
  • Side effects
    – Chest pain
    – Tachycardia
    – Hypertension
    – PVC’S
• VASOPRESSORS
• NOREPINEPHERINE (LEVOPHED)

Classification
Vasopressor

Indications
– Hypotension refractory to dopamine
– SBP <70 mmHg and low peripheral resistance

Action
– Primarily alpha

Dosage
– Mix 4 mg/250ml D5W or N.S.
– Infuse at 0.1-0.5 mcg/kg/min

Route
– IV infusion only

Side effects
– Increased myocardial work load and O2 demand
– Severe tissue necrosis if infiltrated
• VASOPRESSORS
• DOBUTAMINE (DOBUTEREX)

• Classification
  – Adrenergic stimulator

• Indications
  – CHF with hypotension
  – Hypotension SBP < 70-100 mmHg with no signs of shock

• Action
  – Primarily beta
  – Increase in stroke volume w/o increase in heart rate

• Dosage
  – Mix 500 mg/ 250ml D5W = 2000 mcg/ml
  – Infuse at 2-20 mcg/ml (average = 4 ml/hr)

• Route
  – IV infusion only

• Side effects
  – Tachycardia
  – Chest pains
  – Palpitations
• **VASODILATORS**

• **NITROGLYCERINE** (Nitrostat, Tridil)

• **Classification**
  – Antihypertensive

• **Indications**
  – Angina, MI, CHF

• **Action**
  – Smooth muscle dilator
  – Reduces preload and afterload
  – Reduces artery spasm

• **Dosage**
  – Tablet / spray 1 SL every 5 minutes
  – 1 inch of nitro paste
  – Infusion – Mix 50 mg in 250 ml.
  – Start at 10 mcg/min (3ml/hr)

• **Route**
  – SL, IV infusion, paste

• **Side effects**
  – Hypotension, headache, tachycardia

• **Caution**
  – Erectile dysfunction drugs
  – Right sided infarct
• **VASODILATORS**
  • **NITROPRUSSIDE (NIPRIDE)**
  • Classification
    – Anti-hypertensive
  • Indications
    – Hypertension
    – CHF with pulmonary edema
  • Action
    – Smooth muscle dilator
    – Decreases preload and afterload
    – Works more in the arteries than the veins
  • Dosage
    – Infusion – Mix 50 mg / 250ml D5W= 200mcg/ml
    – Start at 0.5 – 0.8 mcg/kg/min
  • Route
  • IV infusion only
  • Side effects
    – Hypotension
    – Headache
    – Cyanide toxicity
• **VASODILATORS**

• **ACE INHIBITORS** (Enalapril, Captopril, Lisinopril)

• **Classification**
  – Anti-hypertensive

• **Indication**
  – Hypertension/CHF
  – Post MI

• **Action**
  – Prevents conversion of angiotension I to angiotension II
  – Suppresses renin- angiotension aldosterone system

• **Dosage**
  – Enalapril- 5-40 mg PO
  – 0.625-1.25mg IV over 5 min. every 6 hours
  – Captopril – 12.5-50 mg PO BID/TIB
  – Lisinopril- 10-40 mg PO Q/day

• **Route**
  – IV, PO

• **Side effects**
  – Hypotension
  – Chest pain
  – Tachycardia and dysrhythmias
• **DIEURETICS**

• **FUROSEMIDE (LASIX)**

• **Classification**
  – Loop diuretic

• **Indications**
  – Pulmonary edema

• **Action**
  – Vasodilation – reduced venous pressure
  – Inhibits reabsorption of sodium in the kidneys

• **Dosage**
  – 40 – 80 mg (increase in 20 mg increments)

• **Route**
  – IV slow push

• **Side effects**
  – Dehydration
  – Tinnitus
  – Hypokalemia
• ANALGESICS
• MORPHINE
• Classification
  – Narcotic analgesic
• Indications
  – Chest pain during a STEMI unrelieved by nitroglycerine
  – Pulmonary edema
• Action
  – Potent analgesic
  – Promotes venous pooling – reduces preload
  – Reduces anxiety
• Dosage
  – 2-4 mg in 2 mg increments
• Route
  – Slow IV push
• Side effects
  – Respiratory depression, nausea and hypotension
  – Caution – unstable angina / non ST elevated patients (mortality)
• ANALGESICS
• DILAUDID
• Classification
  – Opioid analgesic
• Indications
  – Chest pain during a STEMI unrelieved by nitroglycerine
  – Pulmonary edema
• Action
  – Potent analgesic much stronger than morphine
  – 3 mg Dilaudid = 20 mg morphine
  – Reduces anxiety
  – Does not alter blood pressure
• Dosage
  – 0.5 – 1 mg slow IV push
• Route
  – Slow IV push
• Side effects
  – Respiratory depression
  – Caution with elderly patients
  – Rapid push in doses above 1 mg may be a problem
• **BETA BLOCKERS**

• Common beta blockers
  – Metoprolol (Lopressor)
  – Sotalol (Betapace)
  – Esmolol (brevi block)

• **Indications**
  – During MI to decrease oxygen consumption
  – SVT refractory to other therapies

• **Action**
  – Decreases
    • Heart rate
    • Stroke volume
    • Automaticity and conductivity

• **Dosage**
  – Metoprolol- 5 mg dose @ 5 minutes (15 mg max)
  – Sotalol – 100 mg over 5 minutes for VTach
  – Esmolol – 500 mg/kg over 1 min. Then 50 mcg/kg for 4 minutes

• **Route**
  – Oral, IV

• **Contraindications**
  – CHF, hypotension, bradycardia, heart blocks
• **ANTIPLATELETS**

• **ASPIRIN**

• **Classification**
  – Anti-platelet

• **Indications**
  – Cardiac chest pain
  – Unstable angina

• **Action**
  – Blocks thromboxane
  – Prevents platelet aggregation
  – Keeps platelets from occluding arteries

• **Route**
  – Oral

• **Dosage**
  – 162-325 mg (chewable)
• **ANTIPLATELETS**
• **CLOPIDOGREL (PLAVIX)**

• **Indications**
  – STEMI
  – High risk ST depression or T wave inversion
  – Patients with planned PCI
  – Patients that cannot take aspirin

• **Action**
  – Inhibits glycoprotein

• **Dosage**
  – 300 mg PO followed by 75 mg PO

• **Considerations**
  – History of bleeding
  – Patients with impaired liver function
  – Planned surgery in the near future
• **ANTIPLATELETS**

• **INTEGRILLIN**

• Classification
  – Glycoprotein IIb /IIIa inhibitor

• Indications
  – Chest pain ST depression or elevation
  – Unstable angina
  – Non-Q wave MI

• Action
  – Blocks enzyme essential to platelet aggregation

• Dosage
  – 180 mg /kg over 1-2 minutes
  – Infuse @ 2 mcg/kg/min.
  – Decrease to 0.5 mcg/kg/min pre catheterization

• Side effects
  – Bleeding (increased with heparin running)
  – Nausea, vomiting,
  – Hypotension and bradycardia

• Contraindications
  – Active internal bleeding
  – Platelets < 100000
  – Systolic BP >180
• **ANTICOAGULANTS**

• **HEPARIN**

• Classification
  – Anticoagulant

• Indications
  – Patients undergoing angioplasty
  – Selected patients receiving fibrinolytic therapy
  – MI, pulmonary embolism, DVT

• Action
  – Prevents conversion of prothrombin to thrombin

• Dosage
  – Bolus dose of 600 units/kg
  – Infusion of 12 units/kg/hr

• Side effects
  – Hemorrhage
  – Thrombocytopenia

• Contraindications
  – Active bleeding, peptic ulcers, hepatic disease
  – Hemophilia
• FIBRINOLYTICS

• Indications
  – Active MI less than 12 hours
  – 12 lead with ST elevation in 2 contiguous leads
  – New branch bundle block
  – Acute ischemic stroke < 3 hours

• Action
  – Lysis of fibrin holding together thrombi blocking the artery
  – Allows blood flow to distal arteries blocked by the clot

• Dosage
  – TNK – Single bolus 30-50 mg IV push over 5 min.
  – Reteplase- 10 units followed by 10 unit bolus 30 min apart
  – Alteplase-15 mg bolus, then 0.75 mg/kg over 30 minutes

• Side effects
  – Bleeding
  – Allergic reactions
  – Reperfusion arrhythmias
• FIBRINOLYTICS

• Contraindications
  – Active bleeding
  – Hemorrhagic stroke
  – Intracranial neoplasm
  – Aortic dissection
  – Head trauma or prior stroke x 3 months
  – Subarachnoid hemorrhage
  – Uncontrolled BP >185 systolic or 110 diastolic
  – Platelet count < 100000/mm or INR >1.7
  – CT demonstrates multiple infarctions
• **TYPES OF STROKES**

• **Ischemic**
  – Caused by an occlusion of an artery in the brain
  – Accounts for 87% of all strokes
  – Likely candidates
    • Diabetics
    • History of atherosclerotic disease
    • History of clotting abnormalities
    • History of phlebitis
    • History of atrial fibrillation

• **Hemorrhagic**
  – Caused by a rupture of a blood vessel in the brain
  – Accounts for 13% of all strokes
  – TPA is contraindicated
  – A non contrast CT is required
  – Likely candidates
    • History of hypertension
    • African Americans
    • History of AV malformations
    • History of aneurysms
    • History of PCP or cocaine use
• STROKE FOCUS

• PRE-HOSPITAL
  – Rapid stroke identification
  – Rapid transport

• IN HOSPITAL
  – Rapid determination of fibrinolytic eligibility
    • Non contrast CT scan
    • Exclusion criteria
    • Time from stroke onset
  – Administration of a fibrinolytic agent
  – Initiation of the stroke pathway
  – Admission to a stroke unit
• **STROKE SIGNS AND SYMPTOMS**

  • **Initial assessment (Cincinnati scale)**
    - Always check blood glucose
    - Facial droop / non symmetrical smile
    - Arm drift – affected arm drifts downward
    - Abnormal speech
      - Slurred words
      - Wrong words
      - Inability to speak

  • **Secondary neurological assessment**
    - Numbness in the extremities
    - Pupillary response, size, and eye movement
    - Vision trouble (one or both eyes)
    - Bilaterally equal grip strength
    - Equal extension and pronation of both feet
    - Level of consciousness
    - Sudden confusion
    - Periods of aphasia
    - Trouble walking, gait disturbances
    - Dizziness, loss of balance
    - Severe head ache (worst headache I ever had)
• ISCHEMIC STROKE

• Pathology
  – Occurs when a cerebral artery becomes occluded
  – This causes an area of the brain to infarct
  – The infarcted area is surrounded by a larger ischemic area called the penumbra
  – The goal of stroke management is to prevent the penumbra from infarcting, worsening the stroke.

• Protection of the penumbra
  – The best way to save the penumbra is to open the occluded vessel with TPA.
  – TPA must be given within 3 hours of the onset of stroke symptoms
  – Beyond 3 hours the risk of giving TPA does not outweigh the benefits
  – Before giving TPA all patients must be given a non contrast CT scan.
• **ISCHEMIC STROKE**

• **Inclusion criteria**
  – An ischemic stroke causing measurable neurologic damage
  – Onset of symptoms < 3 hours before beginning treatment
  – Age > 18 years

• **Exclusion criteria**
  – Head trauma or stroke in the previous 3 months
  – Symptoms of a subarachnoid hemorrhage
  – History of a previous intra-cranial hemorrhage
  – Uncontrolled BP >185 systolic or 110 diastolic
  – Platelet count < 100000 / mm or INR >1.7
  – CT demonstrates multi-lobal infarction
• ISCHEMIC STROKE

• Post TPA management
  – Monitor patient for bleeding
  – Monitor EKG
  – Control BP to maximize perfusion.
  – Avoid excessive blood pressures
  – Conduct frequent neurological checks
    • Every 15 minutes for the first hour
    • Every 30 minutes for the next hour
    • Then every 2 hours
  – Monitor coagulation factors
  – Admit patient to a stroke center
• HEMORRHAGIC STROKE

• Pathology
  – Occurs when a blood vessel in the brain ruptures
  – The ruptured vessel
  – Leaking blood is inflammatory
  – This creates an increase in cerebral spinal fluid
  – This increases intracranial pressure

• Management
  – A rapid non contrast head CT is essential
  – Intubate the patient as soon as possible
  – Attach the patient to a ventilator
  – Keep the CO2 level to 25-30 to hyper oxygenate
  – Hyper oxygenation constricts the cerebral arteries
  – This helps control bleeding
  – Control blood pressure to lowest level that will maintain adequate organ perfusion
  – Consider mannitol as an osmotic diuretic
  – Transport rapidly to a neurosurgical operating facility
Adult Suspected Stroke

1. Identify signs and symptoms of possible stroke
   Activate Emergency Response

2. Critical EMS assessments and actions
   - Support ABCs, give oxygen if needed
   - Perform prehospital stroke assessment
   - Establish time of symptom onset (last normal)
   - Triage to stroke center
   - Alert hospital
   - Check glucose if possible

3. Immediate general assessment and stabilization
   - Assess ABCs, vital signs
   - Provide oxygen if hypoxemic
   - Obtain IV access and perform laboratory assessments
   - Check glucose; treat if indicated
   - Perform neurologic assessment
   - Activate stroke team
   - Order emergent CT scan or MRI of brain
   - Obtain 12-lead ECG

4. Immediate neurologic assessment by stroke team or designee
   - Review patient history
   - Establish time of symptom onset or last known normal
   - Perform neurologic examination (NIH Stroke Scale or Canadian Neurologic Scale)

5. Does CT scan show hemorrhage?
   - No Hemorrhage
   - Hemorrhage

6. Probable acute ischemic stroke; consider fibrinolytic therapy
   - Check for fibrinolytic exclusions
   - Repeat neurologic exam: are deficits rapidly improving to normal?

7. Consult neurologist or neurosurgeon; consider transfer if not available

8. Patient remains candidate for fibrinolytic therapy?
   - Candidate
   - Not a Candidate

9. Review risks/benefits with patient and family. If acceptable:
   - Give rtPA
   - No anticoagulants or antiplatelet treatment for 24 hours

10. Begin post-rtPA stroke pathway
    - Aggressively monitor:
      - BP per protocol
      - For neurologic deterioration
      - Emergency admission to stroke unit or intensive care unit

11. Begin stroke or hemorrhage pathway
    - Admit to stroke unit or intensive care unit
STROKE ALGORITHM
QUICK VIEW

ONSET TIME – O2 IF REQUIRED

BP – EKG - SPO2

HISTORY – PHYSICAL EXAM

IV – BGL - LABS

ISCHEMIC

NON CONTRAST CT

HEMORRHAGIC

FIBRINOLYTICS IF LESS THAN 3 HOURS FROM ONSET

SYMPTOMS IMPROVING (TIA)

FREQUENT NEURO EVALUATIONS

FREQUENT NEURO EVALUATIONS

NEUROSURGERY
• Pathophysiology
  – An acute coronary syndrome occurs when a coronary artery becomes partially or totally blocked.
  – The syndromes include
    • Unstable angina
    • STEMI and non STEMI attacks
    • Sudden cardiac death
• Initial evaluation
  – Symptoms suggestive of ischemia or an MI
  – LOC, 12 lead EKG, vital signs SPO2, oxygen
  – Physical exam, history, (thrombolytic candidate)
  – IV access, electrolytes, cardiac markers, coagulation
  – Chest x-ray

• Initial treatment
  – Oxygen (if SPO2 < 94%)
  – Aspirin 160-325 mg
  – Nitroglycerine – SL or spray
  – Morphine IV if pain is not relieved by 3 nitroglycerine

• 12 lead interpretation
  – ST elevation or new left branch bundle block
    • STEMI – high risk
  – ST depression or T wave inversion
    • Indicates ischemia high risk unstable angina
  – Normal or non diagnostic changes (ST or T wave)
    • Lower risk requires monitoring
• STEMI < 12 HOURS
  – High risk
  – ST elevation in 2 or more related leads
  – New left branch bundle block
  – Treatment
    • IV nitroglycerine
    • Antiplatelet / anticoagulants
      – Heparin
      – Integrilin
      – Lovenox
      – Plavix
    • Prepare for PCI/STENT /CABG
      – < 90 minutes door to table
    • Fibrinolytics if PCI is delayed
      – < 30 minutes EMS to drug time
    • ACE inhibitors after 6 hours
    • Beta blockers when stable
• NON STEMI HIGH RISK ACS
  – ST depression
  – T wave inversion
  – Unstable angina

• Treatment
  – IV nitroglycerine if blood pressure uncontrolled
  – Control clotting
    • Anti platelets
      – Plavix
      – Integrilin
    • Anti coagulants
      – Heparin
      – Lovenox
  – ACE inhibitors (after 6 hours)
  – Beta blockers when stabilized
  – Cardiac catheterization
  – PCI or CABG if indicated
ACUTE CORONARY SYNDROMES

• ACS ALGORITHM

Acute Coronary Syndromes

1. Symptoms suggestive of ischemia or infarction

2. EMS assessment and care and hospital preparation:
   - Monitor, support ABGs. Be prepared to provide CPR and defibrillation
   - Administer aspirin and consider oxygen, nitrroglycerin, and morphine if needed
   - Obtain 12-lead ECG if ST elevation:
     - Notify receiving hospital with transmission or interpretation; note time of onset and first medical contact
     - Notify hospital should mobilize hospital resources to respond to STEMI
   - If considering prehospital fibrinolysis, use fibrinolytic checklist

3. Concurrent ED assessment (<10 minutes):
   - Check vital signs; evaluate oxygen saturation
   - Establish IV access
   - Perform brief, targeted history, physical exam
   - Review/complete fibrinolytic checklist: check contraindications
   - Obtain initial cardiac marker levels, initial electrolyte and coagulation studies
   - Obtain portable chest x-ray (<30 minutes)

4. Immediate ED general treatment:
   - If O2 sat <90%, start oxygen at 4 L/min, titrate
   - Aspirin 150 to 325 mg (if not given by EMS)
   - Nitrroglycerin sublingual or spray
   - Morphine IV if discomfort not relieved by nitrroglycerin

5. ST elevation or new or presumably new LBBB; strongly suspicious for injury ST-elevation MI (STEMI)

6. Start adjunctive therapies as indicated
   - Do not delay reperfusion

7. Time from onset of symptoms <12 hours?

8. Reperfusion goals:
   - Therapy defined by patient and center criteria
   - Door-to-balloon inflation (PCI) goal of 90 minutes
   - Door-to-needle (fibrinolysis) goal of 30 minutes

9. ST depression or dynamic T-wave inversion; strongly suspicious for ischemia:
   - High-risk unstable angina
   - Non-ST-elevation MI (UA/NSTEMI)

10. Troponin elevated or high-risk patient
    - Consider early invasive strategy if:
      - Refractory ischemic chest discomfort
      - Recurrent/persistent ST deviation
      - Ventricular tachyarrhythmia
      - Hemodynamic instability
      - Signs of heart failure

11. Start adjunctive treatments as indicated
    - Nitroglycerin
    - Heparin (UFH or LMWH)
    - Consider PO β-blockers
    - Consider: Diltiazem
    - Consider: Glycoprotein IIb/IIIa inhibitor

12. Admit to monitored bed
    - Assess risk status
    - Continue ASA, heparin, and other therapies as indicated
    - ACE inhibitor/ARB
    - HMG CoA reductase inhibitor
    - Statin therapy
    - Not at high risk: cardiology to risk stratify

13. Normal or nondiagnostic changes in ST segment or T wave
    - Low-intermediate-risk ACS

14. Consider admission to ED chest pain unit or to appropriate bed and follow:
    - Serial cardiac markers (including troponin)
    - Repeat ECG/continuos ST segment monitoring
    - Consider invasive diagnostic test

15. Develops 1 or more:
    - Clinical high-risk features
    - Dynamic ECG changes consistent with ischemia
    - Troponin elevated

16. Abnormal diagnostic continuous imaging or physiologic testing?
    - Yes
    - No

17. If no evidence of ischemia or infarction by testing, can discharge with follow-up
PULMONARY EDEMA
QUICK VIEW

FOWLER'S POSITION/O₂

BP, EKG, SPO₂

PHYSICAL EXAM / HISTORY / LABS

BIPAP / CPAP IF CONSCIOUS
INTUBATE IF UNCONSCIOUS

CHF WITH HYPO TENSION

CHF SYSTOLIC BP >100

DOPAMINE -2.5-20 mcg/kg/min
DOBUTAMINE 2-20MCG/KG/MIN

NITROGLYCERINE IF BP>100
MORPHINE 2-4 mg SLOW IV PUSH
LASIX 0.5-1 mg/kg if bp>100

NITROGLYCERIN 10-20 mcg/min
NITROPRUSSIDE 0.5-8 mcg/kg/min
Symptomatic with systolic BP < 90 mmHg

1. Administer oxygen
2. EKG SPO2 Monitor IV Labs
3. Physical Exam / History
4. Fluid bolus 1-2 L if lungs clear

- SBP < 70 signs of shock
- Reassess BP
  - SBP > 70
    - Epinephrine 2-10 mcg/min
  - Dopamine drip 5-20 mcg/kg/min
- Nor epinephrine
• SYMPTOMATIC BRADYCARDIAS
  – Sinus
  – Junctional
  – First degree heart block
  – Mobitz 1 (Wenckebach)
  – Mobitz 2 (second degree type 2 heart block)
  – Complete heart block (3rd degree)

• SYMPTOMS
  – Many bradycardias are normal especially for athletes and patients taking beta blockers
  – Symptomatic bradycardias involve perfusion inadequacies.
  – Some signs include
    • Decreased level of consciousness
    • Hypotension
    • Dyspnea
    • Pale color
    • Diaphoresis
    • Generalized weakness
BRADYCARDIA ALGORITHM

Adult Bradycardia (With Pulse)

1. Assess appropriateness for clinical condition. Heart rate typically <50/min if bradyarrhythmia.

2. Identify and treat underlying cause
   - Maintain patent airway; assist breathing as necessary
   - Oxygen (if hypoxic)
   - Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
   - IV access
   - 12-Lead ECG if available; don’t delay therapy

3. Persistent bradyarrhythmia causing:
   - Hypotension?
   - Acutely altered mental status?
   - Signs of shock?
   - Ischemic chest discomfort?
   - Acute heart failure?

4. Monitor and observe

5. Yes
   - Atropine
     If atropine ineffective:
     - Transcutaneous pacing OR
     - Dopamine infusion OR
     - Epinephrine infusion

6. Consider:
   - Expert consultation
   - Transvenous pacing

Doses/Details
Atropine IV Dose:
First dose: 0.5 mg bolus
Repeat every 3-5 minutes
Maximum: 3 mg

Dopamine IV Infusion:
2-10 mcg/kg per minute

Epinephrine IV Infusion:
2-10 mcg per minute
EVALUATE RHYTHM

- Wide complex 2nd or 3rd degree HB
  - MAY TRY ATROPINE
    - TCP @ 60-70 BPM
      - Dopamine / epinephrine Infusion HR>60
        - Prepare for TVP

- NO
  - ATROPINE 0.5 mg 3mg max
    - TCP @ 60-70 BPM
      - Dopamine / epinephrine Infusion HR>60
        - Prepare for TVP
• Tachycardias include
  – Sinus tachycardia
  – Supraventricular tachycardia
  – Atrial fibrillation / flutter
  – Ventricular tachycardia with a pulse

• Asymptomatic tachycardias
  – BP, HR, SPO2 stable with good perfusion
  – Patient conscious and fully alert

• Symptomatic tachycardias
  – Altered level of consciousness
  – Inadequate perfusion
  – Chest pain
  – Dyspnea

• Sinus tachycardias
  – Occur from a reversible cause
    • Fever, anxiety, shock, stress, stimulants, exertion
  – Are < 150 beats per minute
  – Treat the cause treat the tachycardia
TACHYCARDIAS

• SVT ALGORITHM

**Adult Tachycardia**
(With Pulse)

1. Assess appropriateness for clinical condition.
   Heart rate typically ≥150/min if tachyarrhythmia.

2. Identify and treat underlying cause
   - Maintain patent airway; assist breathing as necessary
   - Oxygen (if hypoxemic)
   - Cardiac monitor to identify rhythm; monitor blood pressure and oximetry

3. Persistent tachyarrhythmia causing:
   - Hypotension?
   - Acutely altered mental status?
   - Signs of shock?
   - Ischemic chest discomfort?
   - Acute heart failure?
   - Yes → Synchronized cardioversion
   - No → Wide QRS? ≥0.12 second

4. Synchronized cardioversion
   - Consider sedation
   - If regular narrow complex, consider adenosine

5. Wide QRS? ≥0.12 second
   - Yes → IV access and 12-lead ECG if available
     - Consider adenosine only if regular and monomorphic
     - Consider antiarrhythmic infusion
     - Consider expert consultation
   - No → IV access and 12-lead ECG if available
     - Vagal maneuvers
     - Adenosine (if regular)
     - β-Blocker or calcium channel blocker
     - Consider expert consultation

**Doses/Details**

- **Synchronized Cardioversion**
  Initial recommended doses:
  - Narrow regular: 50-100 J
  - Narrow irregular: 120-200 J bипhasic or 200 J monophasic
  - Wide regular: 100 J
  - Wide irregular: defibrillation dose (NOT synchronized)

- **Adenosine IV Dose:**
  First dose: 6 mg rapid IV push; follow with NS flush.
  Second dose: 12 mg if required.

- **Antiarrhythmic Infusions for Stable Wide-QRS Tachycardia**
  - **Procainamide IV Dose:** 20-50 mg/min until arrhythmia suppressed, hypotension ensues, QRS duration increases >50%, or maximum dose 17 mg/kg given.
    Maintenance infusion: 1-4 mg/min.
    Avoid if prolonged QT or CHF.
  - **Amiodarone IV Dose:**
    First dose: 150 mg over 10 minutes.
    Repeat as needed if VT recurs.
    Follow by maintenance infusion of 1 mg/min for first 6 hours.
  - **Sotalol IV Dose:**
    100 mg (1.5 mg/kg) over 5 minutes.
    Avoid if prolonged QT.
Hemodynamically stable, absence of chest pain

LOC, EKG, VS, SPO2, O2 if needed
Physical exam and history / RO non cardiac causes
IV access, labs, cardiac markers CXR

↓

Vagal maneuvers

↓

Adenosine 6mg rapid push / flush
Adenosine 12 mg rapid push / flush

↓

Cardizem 0.25mg/kg then 0.35mg/kg in 15 min
OR
Verapamil 2.5-5mg /repeat 5-10mg 15-30 min

↓

Metoprolol 5mg over 5 min /repeat 5min x2
OR
Atenolol 5mg over 5 min may repeat in 10 minutes

↓

Cardiovert- 50-100 J biphasic initial dose increase in increments
Hemodynamically unstable ALOC or unconscious

↓

LOC. EKG, VS, SPO2, O2 if required

Brief history/ exam / RO non cardiac causes

↓

IV / IO access do not delay cardioversion

Sedation if conscious and BP allows

↓

Synchronized cardioversion

50-100J initial dose biphasic / increase in increments

↓

If unsuccessful combine with pharmacological treatment used for stable SVT
• ATRIAL FIBRILLATION / FLUTTER
• Stable with RVR < 48 hours
• Hemodynamically stable no chest pain
  – INITIAL
  – LOC, EKG, VS, SPO2 oxygen if required
  – Physical exam and history / RO non cardiac causes
  – IV, labs, cardiac markers, chest x-ray

TREATMENT
– Control rate – Calcium channel blocker (choose 1)
  • Cardizem 0.25 mg/kg then 0.35 mg/kg in15 min. if required
  • Verapamil- 2.5-5 mg repeat 5-10 mg 15-30 min if required
  • Beta blocker (choose one)
  • Metoprolol 5 md over 5 min. repeat 5 mg x 2
  • Other beta blockers – labetalol, atenolol, sotalol, esmolol
– Cardiovert if drug therapy is unsuccessful
  • 50-100 joules biphasic initial dose. Increase in increments

– Consider anticoagulant therapy

– NOTE A-fib /A flutter should be < 110 beats / min to be considered controlled.
• A-FIB / A FLUTTER > 48 HOURS
• Stable with RVR no chest pain
• INITIAL
  – LOC, EKG, SPO2 oxygen if required
  – Physical exam and history / RO non cardiac causes
  – IV, labs, cardiac markers, chest X-ray

TREATMENT
– Delay cardioversion unless unstable
  • Unstable – Poor perfusion, CP, ALOC
– Control rate with
  • Calcium channel blockers
  • Beta blockers
– Patient needs to be current with anticoagulant therapy
– RO emboli for 4 weeks before cardioversion
• A-FIB / A- FLUTTER UNSTABLE WITH RVR
• Hemodynamic instability, chest pain altered level of consciousness, unresponsive
• Initial
  – LOC, EKG, SPO2, oxygen if required
  – Brief history
  – IV IO access. DO not delay cardioversion
• Treatment
  – Cardiovert
  – Atrial flutter 50-100 j biphasic initial dose
  – Increase in increments
  – Atrial fibrillation – 120-200 j biphasic initial dose
  – Increase in increments

  – Pharmacology (if cardioversion is unsuccessful)
  – Amiodarone – 150 mg over 10 minutes
  – Digoxin – 10-15 mg/kg (0.5-1.0 mg

  – Rapid anticoagulation
• **STABLE V TACH WITH A PULSE**
  • Wide complex > 150 b/min
    – no P waves no atrial fibrillation
• **INITIAL**
  – LOC, EKG, SPO2, O2 if required
  – Patient exam and history
  – IV, labs, cardiac markers, chest x-ray
  – Consider adenosine
• **TREATMENT**
  – Anti-dysrhythmic
    • Amiodarone – 150 mg over 10 minutes May repeat
    • Lidocaine -0.5-105 mg/kg repeat at half dose to 3 mg
    • Procainamide – 20-50 mg/min infusion
    • Magnesium 1-2 gm
    • Sotalol – 100 mg over 5 minutes
  – Cardiovert (If pharmacology is unsuccessful)
    • 100,200,300,360 joules monophasic
    • 120-200 Joules biphasic
TACHYCARDIAS

• **UNSTABLE VTACH WITH A PULSE**

  • Rate >150
    – Decreased LOC
    – Hypotension with chest pain
    – Possible pulmonary edema

• **INITIAL**
  – LOC,EKG,VS,SPO2, O2 if required
  – IV/IO access
  – Brief history if possible
  – Do not delay cardioversion

• **TREATMENT**
  – Cardioversion
    • Sedation if responsive
    • 120-200 joules biphasic
    • 100-360 joules monophasic
  – Pharmacology
    • Use the same as for stable VTach if cardioversion is unsuccessful
CARDIAC ARREST
ASYSTOLE / PEA
Begin CPR
Attach monitor /defibrillator
Continue CPR in 2 minute cycles
Intubate
IV /IO access
↓
Administer vasopressor
Epinephrine 1 mg
Vasopressin 40 units
↓
Continue CPR
↓
Look for reversible causes (5 H’s and T’s)

5H
HYPOXIA
HYPOVOLEMIA
HYDROGEN ION (ACIDOSIS)
HYPERKALEMIA
HYPOKALEMIA
HYPOTHERMIA

5T
TOXINS
THROMBUS
PULMONARY
THROMBUS
CORONARY
THROMBUS
CARDIAC
TENSION
PNEUMOTHORAX
TAMPERONADE
Adult Cardiac Arrest

Start CPR
- Give oxygen
- Attach monitor/defibrillator

2. Yes
- VF/VT

3. Yes
- Shock

4. CPR 2 min
- IV/IO access
- Epinephrine every 3-5 min
- Consider advanced airway, capnography

5. Yes
- Shock

6. CPR 2 min
- Amiodarone
- Treat reversible causes

7. Yes
- Shock

8. CPR 2 min
- IV/IO access
- Epinephrine every 3-5 min
- Consider advanced airway, capnography

9. No
- Asystole/PEA

10. CPR 2 min
- IV/IO access
- Epinephrine every 3-5 min
- Consider advanced airway, capnography

11. CPR 2 min
- Treat reversible causes

12. CPR Quality
- Push hard (≥2 inches [≥5 cm]) and fast (≥100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 30:2 compression-ventilation ratio
- Quantitative waveform capnography
- If P<sub>ETCO</sub> < 10 mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
- If relaxation phase (diastolic) pressure ≤20 mm Hg, attempt to improve CPR quality

Return of Spontaneous Circulation (ROSC)
- Pulse and blood pressure
- Abrupt sustained increase in P<sub>ETCO</sub> (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Shock Energy
- Biphasic: Manufacturer recommendation (eg, initial dose of 120-200 J; if unknown, use maximum available).
- Second and subsequent doses should be equivalent, and higher doses may be considered.
- Monophasic: 360 J

Drug Therapy
- Epinephrine IV/O Dose: 1 mg every 3-5 minutes
- Vasopressin IV/O Dose: 40 units can replace first or second dose of epinephrine
- Amiodarone IV/O Dose: First dose: 300 mg bolus. Second dose: 150 mg.

Advanced Airway
- Supraglottic advanced airway or endotracheal intubation
- Waveform capnography to confirm and monitor ET tube placement
- 8-10 breaths per minute with continuous chest compressions

Reversible Causes
- Hypovolemia
- Hypoxia
- Hyperkalemia
- Hypo-Hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tumor, cardiac
VENTRICULAR FIBRILLATION
PULSELESS VTACH
QUICK VIEW

Begin CPR
SHOCK (200J biphasic / 360J monophasic)
Continue CPR throughout entire code
Secure airway and start IV/IO with NS or LR

↓
Drug Vasopressor 40 U
Epinephrine 1mg every 3-5 minutes during code

↓
SHOCK (max. dose) {200 j biphasic / 360 j monophasic}

↓
Drug Anti-arrhythmic
Amiodarone 300mg
Lidocaine 1.5 mg/kg

↓
SHOCK (max dose) {200 j biphasic / 360 j monophasic}

↓
Repeat drug shock sequence
Amiodarone = 150mg
Lidocaine – 1.5mg/kg to 3mg max

↓
Look for reversible causes 5 H’s and 5 T’s
CONSIDERATIONS BEFORE ARREST

The non arrested patient

- Recognize a critical patient
  - It is easier to prevent an arrest than to resuscitate
- Obtain the following as early as possible
  - 12 lead EKG
  - Vital signs including SPO2 and temperature
- Obtain a complete history before an arrest occurs
- Draw labs, CT scans x-rays, blood type if needed
- Maintain hemodynamic and respiratory stability
- Consider 5 H’s and T’s before arrest
- Hypoxia
- Hypovolemia
- Hydrogen ion (acidosis)
- Hyper/hypokalemia
- Hypothermia
- Toxins
- Thrombosis (pulmonary)
- Thrombosis (coronary)
- Tamponade
- Tension pneumothorax
ARREST CONSIDERATIONS

• What causes PEA
  – Pulmonary emboli
  – Acidosis
  – Acute myocardial infarction
  – Hyperkalemia
  – Drug overdose
  – Trauma
    • Pneumothorax
    • Tamponade
    • Hypovolemia
    • Hypoxia

• What causes asystole
  – Hypoxia
  – Hypothermia
  – Hypo/hyperkalemia
  – Acidosis
  – Hypoglycemia
  – Drug overdose
  – Trauma
    • Pneumothorax
    • Tamponade
    • Hypovolemia
    • Hypoxia
Basic arrest management trauma
- Start and continue CPR
- Maintain high quality CPR throughout
- Attach monitor and defibrillate ASAP if indicated
- Control the airway (advanced airway)
- Large bore IV or IO
- Give drugs per the appropriate algorithm

Treat hypoxia
- Intubate (cricothyrotomy or tracheotomy)
- Pneumothorax
  - Chest decompression
  - Chest tube
- Tamponade
  - Pericardial centesis

Treat hypovolemia
- Control bleeding
- 2 Large bore IV’s or IO’s with a crystalloïd
- Rapid blood type and transfusion
- In an emergency type O negative blood can be used

Always consider the 5H’s and T’s
- Electrolyte unbalance
- Renal dialysis
  - Acidosis
  - Hyperkalemia
  - Hypoglycemia
- Diabetics
  - Acidosis
  - Hypoglycemia
  - Hyperkalemia
  - Hypokalemia
- Alcoholics
  - Hypokalemia
  - Hypoglycemia
  - Hypomagnesemia
  - Consider a brain bleed from a fall
- Prolonged vomiting
  - Dehydration
  - Acidosis
  - Hypokalemia
- Prolonged diarrhea
  - Dehydration
  - Acidosis
  - Hypokalemia
  - Hypomagnesemia
• Treatment of electrolyte unbalances
  • Hyperkalemia
    – Perform standard ALS and BLS
    – Calcium chloride – 500mg-1 gm to stabilize cells
    – Sodium bicarbonate – 50 mEq to shift potassium into cells
    – Mix 25 gm glucose and 10 units insulin infuse over 15 minutes
  • Hypomagnesemia
    – Perform standard BLS and ALS
    – Mostly found in alcoholics, dehydration and malnourished patients
    – Usually presents as polymorphic VTach (Torsades)
    – Give 1-2 gm magnesium IV bolus
  • Metabolic acidosis
    – Extended period of arrest and overdoses
    – Treat per appropriate BLS and ALS protocols
    – First attempt to correct with CPR and intubation
    – Use 1 mEq /kg dose of sodium bicarbonate
    – Repeat at half dose if required
• PREGNANCY ARRESTS
  – Basic BLS and ALS per algorithms
  – For suspected embolus – fibrinolytics
  – For magnesium overdose 1 gm calcium chloride
  – May also use calcium gluconate

• INTUBATED PATIENTS

• DOPE ALGORITHM
  – Dislodged tube
  – Obstructed ET tube
  – Pneumothorax
  – Equipment failure
• TREATMENTS DONE TO PREVENT ARRESTS
  – It is always better to treat to prevent an arrest than to deal with an arrest situation

• Anaphylaxis peri-arrests
  – Large bore IV, EKG, VS, SPO2, oxygen if required
  – Treat rhythm disturbances per appropriate algorithm
  – Administer 50 mg diphenhydramine IV
  – Administer 1 mg epinephrine or 40 units vasopressin
  – Administer up to 4-8 l crystalloid 1 liter at a time
  – Consider 125 mg Solu-Medrol IV

• Asthma peri-arrests
  – Large bore IV, EKG, VS, SPO2 high flow oxygen
  – Treat rhythm disturbances per appropriate algorithm
  – Mix 2.5mg albuterol and 0.5mg Atrovent nebulized
  – May continue albuterol nebulized treatment
  – Administer 1 mg epinephrine SQ
  – Intubate if severe and put patient on a ventilator
  – Consider Solu-Medrol 125 mg

• Pulmonary edema peri-arrests
  – Large bore IV, EKG, VS, SPO2, oxygen if required
  – Treat rhythm disturbances per appropriate algorithm
  – If patient is conscious use CPAP or BIPAP ASAP
  – If patient is unconscious intubate and suction
  – Control blood pressure with NTG or nitroprusside
  – Instal a Foley catheter
  – Administer 40-80 mg Lasix IV
PERI-ARREST SITUATIONS

- **Overdoses**
- **Cocaine**
  - Large bore IV, EKG, VS, SPO2, temperature oxygen
  - Treat rhythm disturbances per appropriate algorithm
  - Administer a benzo diazepam
  - Pressure ventilated oxygen for pulmonary edema
  - Control blood pressure
    - Nitroglycerine / Nipride
    - Phentolamine (alpha blocker)
  - Anti-dysrhythmic as required
- **Tri-cyclic antidepressants**
  - **Symptoms**
    - Convulsions
    - Coma
    - Cardiac arrhythmias
    - Acidosis
    - Hypotension
  - **Treatment**
    - Large bore IV, EKG, VS, SPO2, OXYGEN IF REQUIRED
    - Treat rhythm disturbances per appropriate algorithm
    - Non-arrest-activated charcoal (< 1 hour)
    - Benzo diazepam for seizures
    - Sodium bicarbonate for acidosis
    - Fluid bolus NACL for hypotension
    - Arrest-administer 1 mEq /kg sodium bicarbonate
• **OVERDOSES**
  
  • **Calcium channel blockers**
    - IV, EKG, VS, SPO2, check BGL, oxygen if required
    - Fluids for hypotension NS 500-1000 ml
    - Activated charcoal < hour of ingestion
    - Insulin for improved energy
    - Epinephrine infusion 2-10 mg /min
    - Calcium chloride 0.2 mEq/kg or calcium gluconate 0.3 mEq /kg
    - Pacing for bradycardias
  
  • **Beta blockers**
    - Same treatment as calcium channel blockers except give 3-10 mg glucagon IM or IV

  • **Narcotics**
    - IV, EKG, VS, SPO2, oxygen if required
    - Administer 2-4 mg Narcan /may have to repeat

  • **Benzo diazepams**
    - IV,EKG, VS, SPO2. oxygen if required
    - Romazicon- only if a known benzo diazepam overdose
    - If uncertain allow patient to naturally process

• **HYPOTHERMIA**
  
  - CPR
  - Hold defibrillation until core temperature is >33 degrees C
  - Warm with blankets, warm IV’s or peritoneal lavage
  - When warm treat per appropriate algorithm
  - They are not dead until they are warm and dead
• Reasons to terminate resuscitation
  – Return of effective spontaneous circulation
  – Criteria for irreversible death
  – Exhaustion of the health care provider
  – A valid DNR
  – Authorization by a physician
  – Transfer to a higher level of care
  – If patient remains in arrest after repeated attempts with high quality CPR and ACLS
• Hemodynamic stability
  – Basic
    • 12 lead cardiac monitor
    • Anti-arrhythmic drip as required
    • Oxygen to keep SPO2 >94%
  – Rate control
    • Control rate per ACLS protocols
  – Blood pressure control
    • Fluids are the first line
    • Vasopressors are the second choice unless fluids are contraindicated by the patient’s condition.
• Hemodynamic and ventilation optimization
  – Use 100% oxygen in the initial resuscitation
  – Titrate inspired oxygen to maintain SPO2 > 94%
  – Avoid excessive ventilation to reduce intrathoracic pressure
  – Recommended ventilation rates 10-12 BPM
    • PETCO – 35-40
    • PaCO2 -40-45
  – Administer fluids and vasoactive drugs to
    • Optimize blood pressure
    • Improve cardiac output
    • Optimize systemic perfusion

• Mild hypothermia
  – Used on all patients unresponsive after ROSC.
  – Prevents brain deterioration due to global ischemia
  – Temperature goal is 32-34 degrees C
  – Time at hypothermia 12-24 hours
  – Treat hypotension with fluids (1-2 liters )
  – Vasopressors may be used if fluids do not work
  – Target glycemic control to 144-180 mg/ml
Immediate coronary reperfusion with a PCI
Adult Immediate Post–Cardiac Arrest Care

1. Return of Spontaneous Circulation (ROSC)

2. Optimize ventilation and oxygenation
   - Maintain oxygen saturation ≥94%
   - Consider advanced airway and waveform capnography
   - Do not hyperventilate

3. Treat hypotension (SBP <90 mm Hg)
   - IV/IO bolus
   - Vasopressor infusion
   - Consider treatable causes
   - 12-Lead ECG

4. Follow commands?
   - No
   - Yes

5. Consider induced hypothermia

6. STEMI or high suspicion of AMI
   - Yes
   - No

7. Coronary reperfusion

8. Advanced critical care

Doses/Details
Ventilation/Oxygenation
Avoid excessive ventilation. Start at 10-12 breaths/min and titrate to target PETCO₂ of 35-40 mm Hg. When feasible, titrate FiO₂ to minimum necessary to achieve SpO₂ ≥94%.

IV Bolus
1-2 L normal saline or lactated Ringer's. If inducing hypothermia, may use 4°C fluid.

Epinephrine IV Infusion:
0.1-0.5 mcg/kg per minute (in 70-kg adult: 7-35 mcg per minute)

Dopamine IV Infusion:
5-10 mcg/kg per minute

Norepinephrine IV Infusion:
0.1-0.5 mcg/kg per minute (in 70-kg adult: 7-35 mcg per minute)

Reversible Causes
- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/Hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

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POST ARREST ALGORITHM
QUICK VIEW

OPTIMIZE VENTILATION AND OXYGENATION

INTUBATE
RATE 10 BPM
OXYGEN SAT 94-99
CO2 35-40 mmHg

OPTIMIZE CARDIAC FUNCTION

RATE > 60
RHYTHM – INFUSION
BLOOD PRESSURE
FLUIDS
VASOPRESSORS

ADVANCED CRITICAL CARE

12 LEAD PCI

INAPPROPRIATE NEUROLOGICAL MILD HYPOTHERMIA
• Role of the team leader
  – Organizes the group
  – Monitors performance of team members
  – Backs up team members
  – Models excellent team behavior
  – Trains and coaches
  – Facilitates understanding
  – Focuses on comprehensive patient care

• Role of team members
  – Clear about role assignments
  – Prepared to fill their role assignments
  – Well practiced in resuscitation skills
  – Knowledgeable about the algorithms
  – Committed to success
  – Team member assignments
    • Compressor CPR
    • Airway management
    • IV / IO medications
    • Monitor / defibrillator
    • Observer / recorder / time keeper
TEAM CONCEPT

TYPICAL CODE LAYOUT

Airway
Compressor
Observer/Recorder
TEAM LEADER
IV/IO/Meds
Monitor/Defibrillator
• Knowledge sharing
  – Team members should be free to share knowledge and ideas that may be helpful to the resuscitation efforts

• Constructive intervention
  – If an incorrect procedure or drug dose is noticed by a team member they should be free to offer an intervention. Example – will you repeat the dose?

• Reevaluating and summarizing
  – Periodic reevaluating and summarizing keeps everyone in touch with the arrests proceeding and assures protocols are followed

• Mutual respect
  – Always treat both the team leader as well as the team members with respect and remain calm