Emergency Medical Consultants

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Medical CE Provider

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ADVANCED CARDIAC LIFE SUPPORT

PARTICIPANT PREPARATION PACKET 2021

This information is derived from the 2020 ECC Guidelines

This packet contains prep information for the ACLS Course as well as EKG and BLS reviews.
We strongly recommend completing the EKG practice exam prior to the course.

-MANDATORY REQUIREMENTS-

→AHA requires participants have the current textbook with them during class.
→Complete the Online Mandatory Self -Assessment exam. Min score 70%. Directions on pg. 2 textbook
→Complete mandatory 3 hour pre-course videos with quizzes. Directions on pg. 2 of textbook.
Participants **must bring both certificates of completion to class**

★If you are attending the BLS section following ACLS, refer to page 59 for additional instructions.
(There is a mandatory pretest if you are choosing to do BLS)

COURSE DATE / TIME: _____ **LOCATION:** _____

NAME: _____

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This copyrighted prep packet is a supplement for those students taking an ACLS program with EMC.

Welcome to Emergency Medical Consultants' **Stress Free ACLS** Course. We are pleased that you have chosen us to provide you with this outstanding course and are sure that this will be a worthwhile learning experience for you as a medical professional. **Please remember you will need to be able to perform the AHA CPR skills and must be familiar with basic dysrhythmia recognition and pharmacology before the course.**

In order to keep our program "stress free" and to assure that all participants meet the AHA requirements for ACLS proficiency, preparation is required prior to the actual class. We will be using the latest Emergency Cardiac Care Standards for BLS and ACLS.

The American Heart Association mandates that each participant have a textbook to review prior to the course. Currently there is a Textbook and a Resource Text available. The resource text provides a more in depth and detailed prospective of the AHA guidelines. The Text can be purchased through an AHA vendor or borrowed from your hospital or departments' Education Center if your facility provides a library.

Enclosed you will find information to help you prepare for the required skills stations and ACLS didactic evaluation. Please take the time to look through this information, begin to learn drug uses and doses, review the algorithm and EKG sections, and take the EKG practice exam-the answer key is included. **This will ensure a stress free day**! It is important to prepare for the day by reviewing information prior to class for optimal success.

For more EKG practice, log onto www.Skillstat.com

Refer to pg. 2 of your ACLS textbook to access the MANDATORY AHA Online Pre-Course Work AND Self-Assessment located at (eLearning.heart.org). This contains information regarding pharmacology, EKG and relevant information to prepare for the exam.
******TWO CERTIFICATES will be provided upon completion: (1) Pre-course video quiz cert AND (1) for self-assessment test in AHA text. 70% must be obtained. You may retake if needed******

We strive to make our program realistic and relevant, thus, the scenarios that you will be required to manage will relate to the work that you do.

All information is based on the American Heart Association ACLS standards at the time of printing and thought to be correct. Providers are encouraged to review the ACLS textbook and their specific policies prior to implementing any procedures or administering any medication based on this study packet.

We look forward to meeting you at the course and will be happy to answer any questions you may have - just call our office at 772-878-3085.

Sincerely,
Shaun Fix and the ACLS Staff
Emergency Medical Consultants, Inc.

Table of Contents

ACLS COURSE AGENDA
2-DAY TRAINING PROGRAM

(You will be advised of class start times when you enroll))

DAY ONE

Introduction to ACLS, Overview of the ACLS Program

Resuscitation Concepts and Teams

Break

Pharmacology I and II

Lunch

Small group interactive teaching stations:

- Airway Management, AED, and BLS
- Perfusing Patient Algorithms (includes post arrest)
- Non-Perfusing Patient Algorithms

DAY TWO

Key Points Review

Overview of rhythms and algorithms / Code team concept

Break

Small group Patient Management Scenario Practice

Lunch

ACLS evaluation stations

- Multiple choice exam
- Patient Management Simulation

BLS Completion Video/Skills for those doing both certs

ACLS COURSE AGENDA
1-DAY REFRESHER PROGRAM

Introduction to ACLS, Overview of the ACLS Program

New Science Review / Key Points

Overview of Rhythms and Algorithm

Break

Airway Management, AED, and BLS

Begin Patient Management Scenarios

Lunch

Patient Management Evaluation Stations / Written Exam

BLS Completion Video/Skills for those doing both certs

Rules for Keeping Yourself out of Trouble…
In ACLS and in Life!

Be Nice - "**Good professionals get into trouble, bad professionals get into trouble… Nice professionals don't get into as much trouble."**

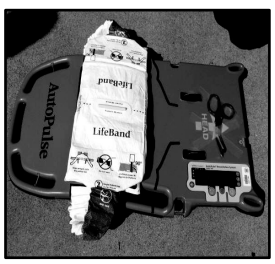
Rule #1 - Treat the patient, not the monitor, (check pulses and vital signs)
Rule #2 - Always remember rule #1
Rule #3 - If you ARE treating the patient for an arrhythmia
– Always treat in this order: *Rate*, then *Rhythm*, then *Blood Pressure*

TEAM CONCEPT

- Realize that resuscitation involves professionals of various levels throughout the code then following through to post resuscitation management.
- Team leader needs to clearly define each person's role. If you are assigned a role that you are not skilled to do immediately notify the team leader and offer to function in another capacity.
- Each team member performs a specific task: ventilations, compressions, medications, vascular access, defibrillation, and documentation / timing. The team must work together under the guidance of a Team Leader to coordinate the combined resuscitation attempt.
- The team must work together and understand what "the next step" is going to be in order to be prepared to carry out skills quickly and efficiently during "pause for evaluation" phase every 2 minutes.
- There should be a closed-loop communication from the team leader to the team and back.
  - Example: as the team leader requests the next procedure the team member should repeat back what they understood the direction to be. This makes for a clearer understanding and reduces mistakes. Keep in mind the team leader could make a mistake in an order and constructive intervention from other team members may be appropriate to maintain consistency within the ACLS Guidelines.

The Core Concepts of ACLS

- Coronary perfusion! The myocardium needs to receive adequate blood flow - poorly perfused hearts don't convert electrically
- Cerebral perfusion (restore, improve, maintain)
- Treat patients - not algorithms
- Crawl before you walk (BLS before ACLS)
- Time is of the essence
- Look for a cause after the basics are done
- Consider circulatory enhancing devices



CPR Compression Devices

2020 Outcome Driven Notes

Rapid Response teams are essential to improve patient outcomes by identifying and treating early clinical deterioration.

CPR Coach- helps the resuscitation team perform high quality CPR
Provides interactive feedback about the rate, depth, and recoil of compressions.
Monitors ventilatory performance & minimizes pauses in CPR. Optimizes CCF.

The following efforts increase the **chest compression fraction (CCF),** which ideally minimizes the hands off time during CPR.

- ✓ Pre-charge the defibrillator 15 sec before rhythm check/shock is due
- ✓ Compressor hovers over, but off, the chest during defibrillation
- ✓ Intubate without delay in compressions
- ✓ Try to keep other stops at 5 sec or less (10 is still acceptable)
- ✓ Administer meds during compressions

ACLS & BLS 2020 Updates:

1. Chain of Survival (6 links): Activate code team. Hi quality CPR, Defib, ALS Care, Post Resus Care,
   -Added addressing Recovery needs for team and family.
2. 02 sat in general should be 92-98%. Emphasizes monitoring $C0_2$ when using BVM or advanced airway.
   -Stroke or general cardiac: admin 02 if below 94%. ACS: administer if below 90%
3. BP should be maintained above 90 systolic or MAP greater than 65.
4. Early PCI- indicated for STEMI or cardiogenic shock, or if mechanical circulatory support is required
5. New algorhythm for TTM- 32-36' for at least 24hrs. Plus ICE care recommendations = (surface cooling devices, endovascular catheters, rapid ice cold isotonic infusions)
6. Atropine for Brady to 1mg q 3-5 min (up to 3mg total)
7. Epi infusion for Brady 2-10 mcg/min. Dopamine (if used) 5-20 mcg/ min)
   -Look for Brady causes: Hyper K̆, Beta or Că blocker OD, Hypoxia, Myocardial ischemia.
8. Epinephrine during arrest- give early in non-shockable rhythms (repeat q 4min to fit CPR sequences)
9. OB code: give Calcium if any Magnesium had been given prior.
10. OB code causes: (ABCDEFGH):
    A-anesthetic, B-bleeding, C-cardio vascular, D-drugs, E- embolic, F- fever, G- general cause, H-hypertension
11. Pregnant female needing CPR: move fetus to the Left. If resuscitated lay patient on left side.
12. No need to remove jewelry to defibrillate unless it is directly where the pads belong (just move pad if so)
13. Stress recognizing stroke. FAST (**f**ace droop, **a**rm weak, **s**peech issue, **t**ime to call stroke tx team)
14. Stroke- Use vessel specific scale to determine lg. vessel occlusion. Bypass stopping in ER go direct to scan.
    -Mechanical removal can be up to 24 hrs post sx. Consider direct transport or transfer to invasive facility.
15. Prognostication: (New 24-72 hr recommendations) TTM, Electro physiology, Serum NSG and
    -Brain imaging including EEG,
16. Opioids- GIVE Naloxone for Resp. Arrest. CONSIDER for Cardiac Arrest or still breathing adequately.

Basic Life Support (CPR) - A critical component of ACLS

The most current research available suggests that quality CPR is a crucial variable in survival from resuscitation attempts - even more important than previously thought. Every participant in an ACLS class must correctly demonstrate adult CPR skills and use of an AED.

Follow these guidelines when performing Basic Life Support skills:

PUSH HARD: Compress the chest of an adult at least 2 inches, allowing for complete recoil of the chest between compressions. 2.4 inches is the maximum depth. Do not lean on the chest in between compressions.

PUSH FAST: Compress the chest at a rate of at 100-120 compressions per minute. (30 compressions delivered between 15- 18 seconds)

USE CORRECT RATIOS: Deliver 30 compressions and 2 ventilations, in 2-minute blocks. Change compressors every two minutes during pauses in compressions. At that time, also check rhythm and pulses if indicated if the viewed rhythm is one that could produce a pulse. Patients with an advanced airway in place should receive continual compressions.

MINIMIZE INTERRUPTIONS IN COMPRESSIONS: Stop CPR only for essential procedures, such as rotating compressors, rhythm checks and pulse check if indicated, no more frequently than every 2 minutes. Ensure the pause in compressions is as brief as possible, no more than 10 seconds.

VENTILATE CAUTIOUSLY: Deliver breaths over 1 second, using just enough volume to produce visible chest rise. With an advanced airway in place, deliver 1 breath every 6 seconds (10 breaths per minute) while continuous compressions are being performed. For rescue breathing in a perfusing patient, deliver 10 -12 breaths per minute. This equates to one breath approximately every 5-6 seconds.

DEFIBRILLATE APPROPRIATELY: Deliver one shock, as soon as possible, and then immediately resume chest compressions. Check the rhythm and pulse if indicated after 2 minutes of CPR. At the end of each 2 minute cycle, have the defibrillator charged and ready, if needed.

Skills Review for Healthcare Providers
The CAB's of CPR

Simultaneously Determine unresponsiveness and check for <u>effective</u> breathing
If unresponsive: call a "code" or 911

C = Circulation- Check for a pulse Max - 10 seconds. If pulse is not <u>definite</u>, begin compressions.
A = Airway- Open airway (head tilt/chin lift)
B = Breaths- Give 2 breaths then back to compressions
D = Defibrillator- Attach a manual defibrillator or AED

CPR Reference

	Adults (> puberty)	Children (1 - puberty)	Infants (< 1yr)
Rescue breathing, Victim definitely has a pulse	10 breaths/min recheck pulse every 2 minutes	20-30 breaths/min recheck pulse every 2 minutes	20-30 breaths/min recheck pulse every 2 minutes
Compression landmark **No pulse** (or pulse <60 in infant or child with poor perfusion)	Middle of the chest, between the nipples	Middle of the chest, between the nipples	1 finger below nipple line
Compressions are performed with	Heel of 2 hands	Heel of 1 or 2 hands	2 fingers OR 2 thumbs when using encircling hands technique
Rate of compressions per minute	100-120/min	100-120/min	100-120/min
Compression depth	At least 2 inches ↑ 2 inches	At least 1/3 depth of chest 2 inches	At least 1/3 depth of chest 1 ½ inches
Ratio of compressions to breaths **Once an advanced airway is placed ventilations will be 1 every 6 sec. with continual compressions.*	30:2 Change compressors and reevaluate every 2 min	30:2 15:2 if 2 rescuer Change compressors and reevaluate every 2 min	30:2 15:2 if 2 rescuer Change compressors and reevaluate every 2 min

Foreign Body Airway Obstruction

** If not rapidly removed call Emergency Medical Service **

Conscious choking

Adult	Child	Infant
Abdominal Thrusts *(Red Cross Class – 5 Back Blows)*	Abdominal Thrusts *(Red Cross Class – 5 Back Blows)*	5 Back Blows/5 Chest Thrusts

Unconscious choking

Adult	Child	Infant
Call a "code" or call 911 Begin CAB's of CPR Before giving breaths: look in mouth for foreign body, remove object if it is seen. Repeat cycles of CPR if needed	Begin CPR If second rescuer is present, send them to call a "code" or 911, otherwise, call after 2 min of CPR Before giving breaths: look in mouth for foreign body, remove object if it is seen. Repeat cycles of CPR if needed	Begin CPR If second rescuer is present, send them to call a "code" or 911, otherwise, call after 2 min of CPR Before giving breaths: look in mouth for foreign body, remove object if it is seen. Repeat cycles of CPR if needed

Cardiac Arrest:

BLS ASSESSMENT (C.A.B.(D))

Determine unresponsiveness and briefly check for effective breathing. If unresponsive, call a "code" or 911.

C(1) = Circulation: evaluate for signs of a pulse (10 seconds max). If pulse is absent:
begin and maintain compressions, 30 rapid, deep compressions at 100-120 per min

A(2) = Airway: open it with a head tilt / chin lift or jaw thrust if neck trauma is suspected

B(3) = Breathing: administer 2 breaths after the 30 compressions. If an advanced airway device is placed, ventilate once each 6 seconds while compressions continue.

D(4) = Defibrillation: bring and attach a monitor/defibrillator or an AED to the patient
shock as soon as appropriate

PRIMARY ASSESSMENT (A.B.C.D)

A (1) - Advanced airway procedures: Reserved for those skilled at these procedures: Tracheal (intubation), or Perilaryngeal tube (LMA, King, I-gel, etc)

B (2) - Breathing: assessed, assured, and secured. Be sure whichever tube is placed is causing chest rise, apply supplemental O_2, then secure the device. Monitor CO_2 once intubated.
Exhaled CO_2 is an effective means for measuring ET placement and the quality of CPR.

C (3) - Circulatory interventions: Establish or confirm vascular access and begin cardiac pharmacology. What is the cardiac rhythm? Hint: in cardiac arrest the first medication is always a vasopressor such as Epinephrine. Then Epi may be administered every 3-5 minutes.

D (4) - Disability: check for neurologic function: Assess for responsiveness, level of consciousness and pupil dialation.
-- AVPU: Alert, Voice, Painful, Unresponsive

E (5) – Exposure: remove necessary clothing to perform a physical exam, look for obvious signs of injury, unusual marking, or medic alert bracelets.

SECONDARY ASSESSMENT

Evaluates differential diagnosis

Sign and symptoms
Allergies
Medications
Past medical history (especially relating to the current illness)
Last oral intake
Events

Potential reversible causes of cardiac arrest: 5 H's & 5 T's:

Hypoxia
Hypovolemia
Hyper/Hypokalemia
Hypothermia
Hydrogen ion (acidosis)

Toxins (overdose)
Thromboemboli - Pulmonary
Thromboemboli - Coronary
Tension Pneumothorax
Tamponade (cardiac)

Post Cardiac Arrest Induced Hypothermia: Targeted Temperature Mgmt.

Numerous studies show improved neurological recovery for post arrest patients who are cooled to the low 90's F° (32-36°C) following a successful resuscitation if the patient has no appropriate neurological response. The hypothermic state is maintained for 24+ hours. Follow ICE recommendations=(rapid ice-cold isotonic infusions, surface cooling devices or endovascular catheters)

For Perfusing Patients (people with pulses)

Begin with the basics of all patient care:

- Assess and maintain **C**irculation, **A**irway, and **B**reathing
- Evaluate the patient's symptoms and related (targeted) history, begin a physical exam

Things to do:

1. Administer oxygen - only if needed (Dyspnea, Hypoxia - O_2 sat < 92 % or (90%, ACS)
2. Assess and monitor vital and diagnostic signs (Pulse, Respirations, BP, O_2 sat, EKG rhythm)
3. Establish vascular access
4. Obtain 12 lead ECG and Chest X-ray
5. Obtain Labs-bleeding times, cardiac enzymes, etc.

PHARMACOLOGY

Ideally, all medications are given through a large bore IV of NS or LR in the antecubital or external jugular. ***If an IV site is unavailable the next choice is Intraosseous (IO)***. In reality use "what ya got."

For Patients in Cardiac Arrest:

- Give meds rapidly early in sequence during compressions
- Flush all meds with 20mL's of fluid
- Circulate meds with 2 minutes of CPR

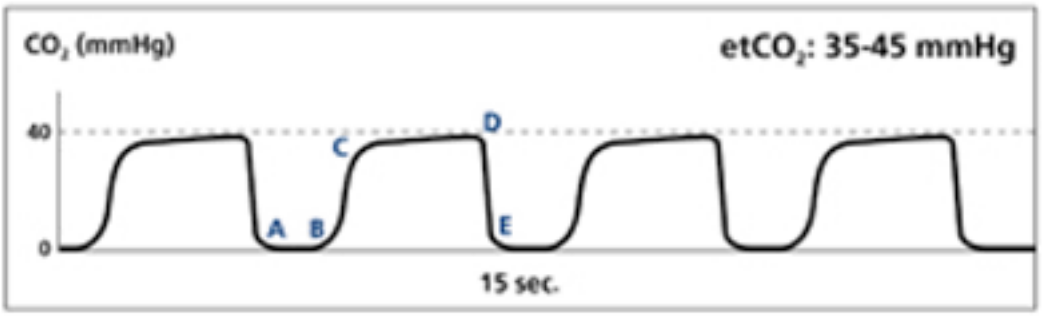
Humeral Head IO Tibial IO

ENDOTRACHEAL ADMINISTRATION

The LEAST effective route

(Epinephrine, Vasopressin & Lidocaine))

- Administer 2 - 2.5 times the IV dose
- Dilute in 5-10mL's total (dilute in NS or sterile water)
- Stop compressions briefly so the medication does not "regurgitate" up the ET tube
- Ventilate several times
- Resume CPR



Capnography: Waveform:

Phase I (A–B): Beginning of exhalation; (respiratory baseline)

Phase II (B–C): Respiratory upstroke

Phase III (C–D): Expiratory plateau; (***D** is the $ETCO_2$ measurement point)

Phase IV (D–E): Inspiratory downslope

Continual Exhaled CO_2 Monitoring

(Continuous Waveform Capnography, $PETCO_2$, $ETCO_2$)

- Specifically evaluates perfusion at the alveoli level (evaluates ventilation)
- CO2 waveforms provide a more sensitive and reliable evaluation of respiratory function than pulse oximetry
- Most reliable indicator of CPR quality and ET tube placement
- Normal CO2 is 35-45 mmHg
- High CO2 denotes respiratory acidosis (ineffective breathing)
  =ventilate more effectively and more frequently
- Low CO2 indicates low perfusion (could be hyperventilation in normally perfused pt)
  =may be common during arrest due to CPR being the only perfusion
- In a code, attempt to maintain CO2 above 10 mmHg (ideally higher)

Respiratory Distress: earliest stage of respiratory compromise. ETCO2 may start low; increases as compensatory mechanisms fail.

Respiratory Failure: SaO2 less than 90% + ETCO2 greater than 50mmHg

Respiratory Arrest: complete cessation of breathing.

OXYGEN

Indications:

- Cardiac patients with signs of hypoxia (dyspnea, rales,)
- Suspected hypoxia of any cause
- Cardiac arrest

Administer oxygen to maintain 0_2 sat as follows:
ACS: 90%
Stroke: 95-98%
Post arrest: 92-98%

Actions:

- Reverses hypoxia

Dosage:

- Nasal cannula @ 2 - 6 Lpm = 24 - 44% FiO_2
- Simple plastic face mask @ 6 - 10 Lpm = 40 - 60% FiO_2
- Non-rebreather mask @ 10 - 15 Lpm = 90 - 100% FiO_2
- *Patients with inadequate rate or depth of respirations:*
  Bag-valve mask @ 10 - 15 Lpm with an oxygen reservoir = 90 - 100% FiO_2

Side effects:

- High % for extended periods = O_2 toxicity
- Rare: Possible respiratory depression in a hypoxic drive patient
- NEVER withhold O_2 in patients who need it

Quick tip:

Let the patient's need be your guide. In general:

- Ideally maintain oxygen sat as per designated parameters of diagnosis.
- Monitor closely; high O_2 may cause oxygen toxicity and impede cellular healing
- Administer low flow oxygen for patients with chest pain or stroke.
- Ventilate 10 -12 breaths per minute for the apneic patient with a pulse,
  10 breaths per minute for the pulseless patient with an advanced airway in place
- Deliver just enough volume to see the chest rise, around 500 - 600mL

EPINEPHRINE

Classification:

Adrenergic (sympathetic) stimulator

Indications:

- Cardiac arrest *Give early in non-shockable rhythms. (Q4 min fits into CPR sequence)
- Symptomatic bradycardia refractory to Atropine & transcutaneous pacing (drip only)
- Severe hypotension where fluids are contraindicated or unsuccessful

Actions:

- Positive β effects, including increased heart rate, contractility, and automaticity
- Positive α effects, including peripheral vasoconstriction.

Dosage:

- Bolus: 1mg IV repeat at 3 - 5 minute intervals

Infusion:

- 4mg/250mL's (16 mcg/mL) D5W or NS.
- For Bradycardia: Infuse 2 -10mcg/min (14-70 mL/hr); titrate to HR greater than 60
- For Hypotension 2-10mcg/min; titrate to SBP above 90 or MAP above 65 mmHg

Route:

- IV/IO, ET, IV infusion

Side effects:

- Tachycardia, hypertension, increased O_2 demand, PVC's, tachyarrhythmias

ATROPINE

Classification:
Parasympatholytic (blocks acetylcholine from the parasympathetic nervous system)

Indications:
- Symptomatic bradycardia

Actions:
- Increases heart rate and conduction through the AV node.

Dosage:
- Bolus 1.0 mg IV. Repeat at 3 - 5 minute intervals, not to exceed approximately 3mg

Route:
- IV/IO, ET

Side effects:
- Tachycardia, dilated pupils, angina. Doses < 0.5 mg may cause bradycardia

AMIODARONE

Cordarone

Classification:
Antidysrhythmic

Indications:
- VT or VF
- Rapid atrial arrhythmias (Usually not as an initial agent)

Actions:
- Prolongs the recovery period of cardiac cells after they have carried an impulse
- Effects sodium, potassium, and calcium channels and α and β channels

Dosage:
- VF/VT-Cardiac arrest: 300mg IV, may repeat 150mg in 3 - 5min X 1
- Perfusing patients (VT some SVT's): 150mg IV/IO over 10 minutes
    - May repeat in 10 minutes IF NEEDED
- Use infusion (below) for continued stabilization of a converted rhythm

Infusion:
- 900mg/500mL (1.8mg/mL) / Infuse @ 1mg/min (33mL/hr) x 6hrs then 0.5mg/min (17mL/hr)
  Max combined daily dose 2.2grams in any 24 hour period

Side effects:
- Hypotension, bradycardia (can be minimized by slowing drug infusion)
- Sinus bradycardia, atrioventricular block
- Congestive heart failure
- Ventricular proarrhythmias (especially if used in conjunction with Procainamide)

Contraindications:
- Marked sinus bradycardia due to severe sinus node dysfunction
- Second- or third-degree AV block
- Cardiogenic shock

AMIODARONE (Continued)

- Note*:* Early Amiodarone was diluted by some manufacturers in a carrier solution that foams when agitated. Draw up slowly and avoid shaking the drug vial.

- Note*:* Don't give antidysrhythmic drugs to bradycardic patients. Premature beats still deliver blood. *Remember to stabilize rate, then rhythm, then blood pressure*.

LIDOCAINE

Xylocaine

Classification:
Antidysrhythmic

Indications:
- VF, VT, PVC's

Actions:
- Sodium channel blocker
- Depresses ventricular irritability and automaticity
- Increases fibrillation threshold

Dosage:
- VF & Pulseless VT = 1.0 - 1.5mg/kg. Repeat at half dose if necessary. Max: 3mg/kg
- VT or PVC's = 0.5 - 0.75 mg/kg up to 1 - 1.5mg/kg
    - then 0.5 - 0.75mg/kg every 5 - 10 minutes IF NEEDED, not to exceed 3mg/kg

Infusion:
- Maintenance Infusion: Mix 2gm/500mL D5W (4mg/mL)
    - Infuse @ 1 - 4mg/min (15 - 60 mL/hr)

Route:
- IV/IO, ET

Side effects:
- Muscle tremors, paresthesias, CNS symptoms – seizures

PROCAINAMIDE

Pronestyl

Classification:
Antidysrhythmic

Indications:
- Stable monomorphic VT with normal QT interval
- Supraventricular arrhythmias especially A-fib and A-flutter
- Control of rapid ventricular rate due to accessory pathway in pre-excited atrial rhythms
- PSVT not controlled by Adenosine

Actions:
- Depresses atrial and ventricular automaticity
- Slows down conduction through all the pacemakers

Dosage:
- 20 - 50mg/min bolus (1gm/50mL @ 60 - 90mL/hr) not to exceed 17mg/kg

Infusion:
- Maint. Infusion: Mix 2gm/500mL D5W (4mg/mL). Infuse @ 1 - 4mg/min (15 - 60 mL/hr)

Side effects:
- Hypotension (especially with rapid injection), widening of QRS complex. Avoid use in patients with preexisting prolonged QT interval and Torsades de Points

End points of administration:
Arrhythmia suppressed, Hypotension develops, QRS widens by 50%, Max dose is (17mg/kg)

ADENOCARD

Adenosine

Classification:
Antidysrhythmic

Indications:
- Supraventricular Tachycardia (specifically Atrial Tachycardia)
  - may try in regular wide tach (aberrant SVT)

Actions:
- Abolishes reentry, slows AV conduction

Dosage:
- 6mg IV/IO rapidly, followed by saline flush. May be repeated at 12mg rapid IV if needed. Decrease dose to half for patients taking Persantine (Dipyridamole) or Tegretol (Carbamazepine)

Route:
- IV/IO push-rapid (Adenosine has less than 10 second half life)

Side effects:
- Transient reentry dysrhythmias, chest pain, palpitations, flushing, headache
- Warn the patient that he may not feel well and push the monitor's record button before pushing the drug. Push…flush…fast!!

CARDIZEM

Diltiazem HCl

Classification:
Antidysrhythmic (Calcium channel antagonists)

Indications:
- Supraventricular tachydysrhythmias (Especially A-fib and A-flutter)

Actions:
- Calcium channel antagonist
- Slows conduction
- Smooth muscle dilation

Dosage:
- 15 - 20mg (0.25 mg/kg) over 2 minutes, may repeat with 25mg (0.35mg/kg) IVP in 15 minutes if needed
- Infusion: Mix 1:1 (eg: 125mg/100mL) (1 mg/mL) infuse at 5 - 15mg/hr

Route:
- IV push slowly and IV infusion

Side effects:
- Bradycardia, hypotension (Do not use in patient with WPW history)
- Note: Reverse calcium channel blocker adverse effects with calcium administration

VERAPAMIL

Isoptin, Calan

Classification:
Antidysrhythmic (calcium channel antagonist)

Indications:
- Supraventricular tachydysrhythmias (Especially Afib and Aflutter)

Actions:
- Calcium channel antagonist
- Slows conduction
- Smooth muscle dilation

Dosage:
- 2.5 - 5mg IVP over 1- 2 minutes
- May repeat at 5 - 10mg after 15 - 30 minutes

Route:
- IV push slowly

Side effects:
- Bradycardia, hypotension (do not use in patient with WPW history)

MAGNESIUM SULFATE

Classification:
Antidysrhythmic (electrolyte)
(Electrolyte, which has antidysrhythmic properties if ectopy is due to hypomagnesemia)

Indications:
- Refractory ventricular dysrhythmias, Torsades de Pointes, hypomagnesemia

Actions:
- Stabilizes tissue membranes (including myocardial cells), elevates Magnesium levels

Dosage:
- Refractory VF or pulseless VT (if potentially Torsades): 1 - 2gm IV push
- Hypomagnesemia without ectopy: 0.5 - 1gm/hr infusion

Route:
- IV Push or IV infusion

Side effects:
- Mild bradycardia, hypotension

Caution:
- Overdosage: diarrhea, paralysis, circulatory collapse

SODIUM BICARBONATE

$NaHCO_3$

Classification:
Alkalinizer, buffer

Indications:
- Metabolic acidosis from any cause (arrest, shock, renal failure, ketoacidosis)
- Tricyclic antidepressant overdose
- Hyperkalemia

Actions:
- Increases pH, reverses acidosis

Dosage:
- 1mEq/kg IV push, followed by 0.5mEq/kg every 10 minutes based on ABG's
- (may be given as a slow infusion in overdoses where bicarb is indicated)

Route:
- IV push or IV infusion

Side effects:
- Hypernatremia, hyperosmolality, metabolic alkalosis
- Note: The "Give one amp of bicarb" routine only works on TV. Unless the patient weighs 50kg, one amp is under-dosing. Pay attention to weight based dosing.

DOPAMINE

Classification: Adrenergic stimulator (sympathetic nervous system), inotrope, and chronotrope

Indications:
- Symptomatic hypotension (SBP 70 -100 mmHg with signs of shock)
- Refractory bradycardia (administer 5-20mcg/min)

Actions:
- Beta effects (2 - 10mcg/kg/min): Primarily increased HR & force increasing cardiac output
- Alpha effects (10 - 20mcg/kg/min): Peripheral vasoconstriction, increasing afterload

Dosage:
- 5- 20mcg/kg/min (usual cardiac starting dose 5mcg/kg/min)
- Mix 800mg/500mL D5W = 1600mcg/mL. Begin @ 5mcg/kg/min & titrate to a systolic BP of 90

Initial drip rate to infuse 5mcg/kg/min = 10% of patient's weight in pounds
Example: 150 lb. patient: Rate = 15mL/hr, 90 lb. patient: Rate = 9mL/hr

Route:
- IV infusion only

Side effects:
- Chest pain, tachydysrhythmias, hypertension, PVC's
- Note: Consider adding fluid volume when administering an inotropic agent if the patient may be hypovolemic.
- Remember Starling's law: "You need stretch of the muscle before you get squeeze".

CALCIUM

Calcium Chloride, Calcium Gluconate

Classification:
Electrolyte (calcium ion)

Indications: (*Should not be administered unless these conditions exist)*
- Hypocalcemia
- Hyperkalemia
- Calcium Channel Blocker or Magnesium overdose

Actions:
- Increased inotropic effect, increased automaticity

Dosage:
- *Calcium Chloride*: 2 - 4mg/kg of a 10% solution repeated in 10 minutes if necessary. Usual dose 500mg - 1gm

Route:
- IV/IO

Side effects:
- Hypercalcemia, VF, exacerbates digitalis toxicity

NOREPINEPHRINE

Levophed

Classification:
Adrenergic stimulator (sympathetic nervous system). Vasopressor

Indications:
- Hypotension refractory to Dopamine
- SBP < 70 mmHg and low peripheral resistance

Actions:
- Primarily alpha effects causing an increase in systemic vascular resistance through vasoconstriction

Dosage:
- Mix 4mg/250ml D5W or NS = 16mcg/mL
- Begin infusion at 0.1-0.5mcg/kg/min (8-40mg=30-150mL/hr)

Route:
- IV infusion only

Side Effects:
- Increased myocardial work and oxygen consumption. May cause tachycardia and myocardial ischemia. Severe tissue necrosis if infiltrated

FUROSEMIDE

Lasix

Classification:
Loop diuretic

Indications:
- Pulmonary edema

Actions:
- Venodilation: causing reduced central venous pressure
- Inhibits the reabsorption of sodium in the kidneys, causing diuresis

Dosage:
- Generally given in 20mg increments (or double the patients PO dose).

Route:
- IV Push slowly

Side effects:
- Dehydration, Tinnitus, Hypokalemia

NITROGLYCERIN

Nitrostat, Tridil

Classification:
Antianginal, Antihypertensive

Indications:
- Angina, MI, CHF (provided patient has SBP > 90 mmHg)

Actions:
- Smooth muscle dilator causing a decrease in preload, afterload, and a resulting increase in venous pooling, thus reducing the workload of the myocardium
- May also reduce coronary artery vasospasm

Dosage:
- Tablet or metered spray: 1 SL (0.3 - 0.4mg dose) every 5 minutes
- Infusion: 10 mcg/min to start (Mix 50mg/250mL = 200mcg/mL. Start at approx. 3mL/hr & titrate)

Route:
- SL, IV infusion

Side effects:
- Hypotension, headache, tachycardia following hypotension

Caution / Avoid:
- Erectile Dysfunction Drugs ex: Viagra & Levitra (24hrs), Cialis (48hrs), Right Ventricular Infarct, Brady or Tachy (without CHF), Hypotension

Morphine

Classification:
Narcotic analgesic

Indications;
- Chest pain during STEMI not relieved by 3 doses of NTG
- Pulmonary edema

Actions:
- Potent analgesic
- Promotes venous pooling causing a decrease in preload
- Reduces anxiety

Dosage:
- 2 - 4mg increments

Route:
- IV push slowly

Side effects:
- Respiratory depression, Hypotension, Nausea
- Use with caution in unstable angina / Non ST elevated patients (mortality increase noted)

ASPRIN

Classifications:
Anticoagulant, antipyretic, analgesic

Indications:
- Chest discomfort of cardiac nature
- Unstable angina

Actions:
- Blocks formation of thromboxin A2 which is responsible for platelet aggregation and vasoconstriction, thus keeping platelets from becoming lodged in partially occluded coronary vessels.

Route:
- Oral

Dosage:
- 162 - 325mg chewable tablets

BETA BLOCKERS

Metoprolol (Lopressor), Sotolol (Betapace), Esmolol (Breviblock)

Classification:
Beta Adrenergic Blocker

Indications:
- Secondary management ACS after patient is stable; usually 6-8 hours
- Supraventricular tachydysrhythmias, refractory to other therapies

Actions:
- Decreases heart rate, stroke volume, automaticity, and conductivity

Dosage:
- Metoprolol (Lopressor): 5mg; may repeat in 5 minutes to max of 15mg
- Sotolol (Betapace): 100mg over 5 minutes (for VT)
- Esmolol (Brevibloc): Load with 500mcg/kg over 1 min, then maintenance = 50mcg/kg over 4 min, (may repeat loading and increase maintenance if unsuccessful)

Route:
- Depends on the drug
  *Oral doses are generally used unless acutely hypertensive

Contraindications:
- CHF, Hypotension, Asthma, Bradycardia, Heart Blocks

P2Y$_{12}$ INHIBITORS

Clopidogrel (Plavix), Prasugrel (Effient), Ticagrelor (Brilinta)

Classification:
Anticoagulant

Indications:
- ST segment elevation MI (STEMI)
- High risk ST depression or T wave inversion
- Patients with planned PCI
- Antiplatelet therapy in patients who cannot take Aspirin (especially during ACS)

Actions:
- Blocks ADP which inhibits glycoprotein and the effectiveness of the clotting process

Dosage:
- Specific to agent

Considerations:
- Caution in patients with hx of bleeding. Contraindicated in patients actively bleeding
- Metabolized by the liver - caution in patients with impaired hepatic function
- Do not administer if cardiac surgery planned in the near future

FIBRINOLYTICS

rtPA (Alteplase), Retavase (Reteplase), Tenecteplase (TNK)

Classification:
Fibrinolytic

Indications:
- AMI less than 12 hours old with 12 lead EKG showing ST elevation in 2 related leads
- Acute ischemic stroke of less than 3 hours with no bleed on CT scan

Actions:
- Lysis of fibrin, which holds together thrombi blocking coronary or cerebral arteries.
- Decrease in thrombus size allows enhanced blood flow distal to the clot and decreases the size of the infarct.

Dosage:
- Tenectaplase (TNK): Single bolus 30 - 50mg (depending on weight) IVP over 5 seconds
- Reteplase (Retavase): 10 Units IV followed by a 10 unit bolus 30 minutes apart
- Alteplase (Activase-tPA): 15mg IV bolus, then 0.75mg/kg over 30 minutes, then 0.5 mg/kg over 60 min
- **Activase for stroke*: 0.9mg/kg (max. 90mg) 10% as bolus and remaining over 60 minutes*

Side effects:
- Bleeding, allergic reaction, reperfusion arrhythmias

Contraindications:
- Active bleeding, hemorrhagic stroke, intracranial neoplasm, aortic dissection
- There are also numerous relative contraindications for physician consideration

HEPARIN

Classification:
Anticoagulant

Indications:
- Patients undergoing angioplasty
- Selected patients receiving fibrinolytic therapy
- In MI patients for pulmonary embolism prophylaxis until fully ambulatory

Actions:
- Prevents conversion of fibrinogen to fibrin and prothrombin to thrombin to inhibit clotting

Dosage:
- Bolus dose of 60U/kg followed by infusion of 12U/kg/hr

Side effects:
- Hemorrhage, thrombocytopenia

Contraindications:
- Active bleeding, peptic ulcer disease, severe hepatic disease, hemophilia

LOW MOLECULAR WEIGHT HEPARIN (FRACTIONATED HEPARINS)

Enoxaparin (Lovenox), Dalteparin (Fragmin)

Classification:
Anticoagulant

Indications:
- Chest pain with ST depression or positive cardiac markers

Actions:
- Inhibit clotting factor Xa. Only slightly effects thrombin, PT and PTT

Dosage:
- Enoxaparin (Lovenox): 30mg IV bolus in STEMI, then 1mg/kg SQ every 12 hrs
- Dalteparin (Fragmin): 120U/kg SQ every 12 hrs x 5 - 8 days

Contraindications:
1. Sensitivity to Heparin or pork products
2. Caution in patients with heparin induced thrombocytopenia, elderly, renal insufficiency

Adverse reactions:
- Bleeding, ecchymosis
- Spinal column hematomas in patient's post spinal or epidural anesthesia

GLYCOPROTEIN IIb/IIIa INHIBITORS

ReoPro (Abciximab), Aggrastat (Tirofiban), Integrilin (Eptifabide)

Indications:
- Chest pain with ST segment depression
- Non Q wave MI
- Unstable Angina

Action:
- Blocks enzyme glycoprotein IIb/IIIa, which is essential for platelet aggregation

Dosage:
- Eptifabide (Integrelin): 180mcg/kg IV over 1 - 2 min followed by infusion of 2mcg/kg/min (decrease to 0.5mcg/min pre cardiac cath). Drug available in 100mL bolus vials and 100mL infusion vials, which can be spiked directly for administration.
- Tirofiban (Aggrastat): Infuse 0.4mcg/kg/min x 30 min and then 0.1mcg/kg/min for 18 - 24 hrs
- Abciximab (ReoPro): 0.25mg/kg IV followed by infusion of 1mcg/min for 18 - 24 hrs

Side effects:
- Bleeding (more likely in females, pt < 75 lbs, > 65yr, hx of GI disease, or receiving fibrinolytics)
- Nausea, vomiting, hypotension, bradycardia
- Further risk of bleeding when used in combination with Aspirin and Heparin

Contraindications:
- Active internal bleeding / bleeding in past 30 days. Platelets < 100,000
- B/P Systolic >180, Diastolic >100

BIVALIRUDIN

(Angiomax)

Classification:
Anticoagulant

- Direct thrombin inhibitor anticoagulant
- Effective alternative to heparin, in certain instances
- Used to prevent blood clots in patients with severe chest pain
- May be used in angioplasty to prevent clot formation
- Quick onset & short half life
- Able to overcome many of the shortcomings of heparin

Dosage: 0.75 mg/kg bolus.
1.75 mg/kg/hr infusion, during the procedure.

ACE INHIBITORS

Enalapril (Vasotec), Captopril (Capoten), Lisinopril (Prinivil)

Classification:
Antihypertensive

Action:
- Selectively suppresses the renin-angiotensin-aldosterone system
- Inhibits conversion of angiotensin I to angiotensin II, resulting in dilation of arterial & venous vessels
- Attenuates cardiac remodeling post MI

Indications:
- Hypertension, CHF
- Post MI (first 24 hours then long term)

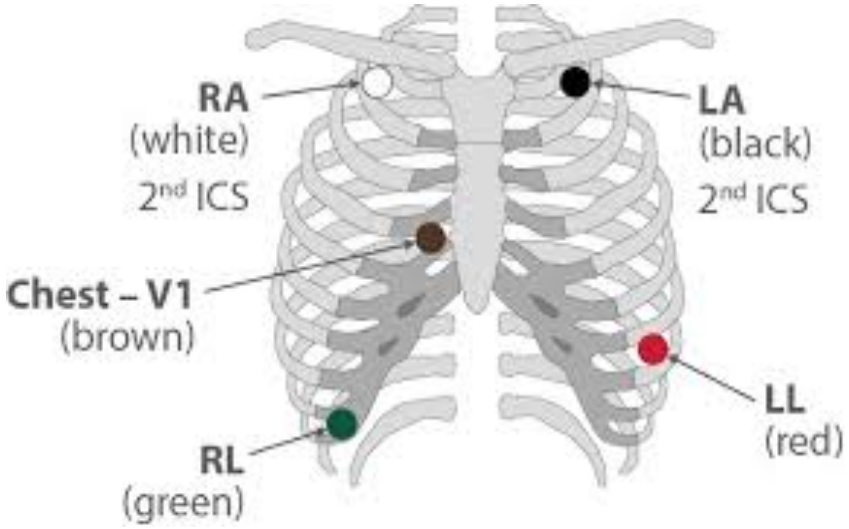
Dosage:
- Vasotec: 5 - 40mg po Q day, 0.625 - 1.25mg IV over 5 min every 6hr
- Capoten: 12.5 - 50mg po BID/TID
- Prinivil: 10 - 40mg po Q day

Route:
- IV, PO

Side effects:
- Hypotension, chest pain, tachycardia, dysrhythmias

EKG Points:

Rhythm Strip Lead Placement



EKG Rhythm Strip:
Utilizes 3-5 leads to record the electrical signals in the heart. Specifically measuring rate, regularity and origin of the activity. Proper lead placement is required to obtain a clear and accurate image.

12 Lead EKG: evaluates for evidence of decreased coronary artery blood flow (STEMI).
Requires a specific 12 lead EKG unit with 10 electrode cables properly placed to obtain an accurate image

STEMI: or ST-segment elevation myocardial infarction, is characterized by new ST-segment elevation in 2 related leads that suggests myocardial infarction.

OR

NSTE-ACS, or non–ST-segment elevation ACS, is characterized by ST-segment depression, T-wave inversion or transient T-wave elevation.
May be indicative of unstable angina (UA) as well.
Cardiac enzyme evaluation (Troponin) is utilized to diagnose myocardial injury, which is considered NSTEMI.

Unstable angina-often presents with complaints of chest pain, but displays no ST-segment elevation (NSTE-ACS), and normal cardiac serum markers. This patient will require further cardiology assessment and monitoring, as serum markers (cardiac enzyme test) could later become elevated and denote a high risk indicator for further progression.

Common physical signs of hemodynamic imbalance:

***Left Ventricular Failure*:** hyper or hypotension, crackles, weak peripheral pulses
***Cardiogenic Shock**:* hypotension, cool clammy skin

12 Lead ECG Management Goals:
- ✓ Identify patients with STEMI and determine their options for early intervention
- ✓ Relieve the ischemic chest pain
- ✓ Assess and manage complications

VENTRICULAR FIBRILLATION
or
PULSELESS VENTRICULAR TACHYCARDIA

"Circle of Life"
Core concepts of Resuscitation

Assess CAB's and Begin CPR
Attach monitor / defibrillator
Defibrillate
(*device specific dose)
Administer Oxygen
Continue CPR in 2 minute cycles
↓
[Secondary procedures]
Secure Airway and Establish IV or IO with NS or LR during CPR
↓
Defibrillate @ device specific dose
Continue CPR 2 minutes
↓
Given during CPR
Epinephrine 1mg
(Continue Epinephrine Q 3-5 min.)
↓
***Defibrillate @ device specific dose**
Continue CPR 2 minutes
↓
Antidysrhythmic of choice
Given during CPR
Amiodarone 300mg OR
Lidocaine 1-1.5 mg/kg
↓
***Defibrillate @ device specific dose**
Continue CPR 2 minutes

*Device specific dose relates to the type and brand of defibrillator used and may range from 120 joules to 360 joules depending on your specific machine.

***Biphasic** 120 -200J (initial)
*Subsequent dose=to or greater than first dose
***Monophasic** 360J
*If unknown, use max dose

*Subsequent shocks may be at the same or higher dose.

*Become familiar with the recommendations of your specific defibrillator

Repeat Sequence of CPR 2 min- Defibrillate-1 Medication
Repeat Epinephrine Q 3-5 minutes (q4 min)
Repeat Amiodarone 150mg 1x
OR
Lidocaine 0.5 - 0.75mg/kg up to 3mg/kg max

Tips for successfully managing this case:

- Don't forget:
  - Continue CPR
  - Throughout and for 2min between shocks
  - Monitor for effective CPR - Use $ETCo_2$
  - 2" compression
  - Full recoil
  - No rush to intubate
  - Start/upgrade IV or IO
  - Gather focused history
  - Charge defib prior to 2 min stop

Primary goal: continue effective CPR followed by rotating medications.

*Verbalize appropriate drug, dose, route, flush, and reevaluate patient every 2 minutes.

Once a rhythm is restored, maintain ventilations as appropriate then stabilize in order:
1. rate
2. rhythm
3. blood pressure

Evaluate for & treat reversible causes anytime during the sequence

Hypoxia	**T**oxins (overdose)
Hypovolemia	**T**hrombosis - Pulmonary
Hydrogen ion (Acidosis)	**T**hrombosis - Coronary
Hyper/**H**ypokalemia	**T**amponade - (Cardiac)
Hypothermia	**T**ension Pneumothorax

Quick tip

The sequence should be:
CPR → Drug → Shock →CPR

ASYSTOLE
or
PULSELESS ELECTRICAL ACTIVITY (PEA)

Assess CAB's and Begin CPR

Attach monitor / defibrillator

Administer Oxygen

Continue CPR in 2 minute cycles

Stop briefly every 2 min to assess

↓

[Secondary procedures]

Secure Airway & Establish IV or IO with NS or LR during CPR

↓

Given during CPR

Epinephrine 1mg (as soon as possible)

Continue CPR

↓

Give Epinephrine Q 3 - 5 min

Continue CPR

While searching for reversible causes:

↓

Evaluate for & treat reversible causes anytime during the sequence

Hypoxia	**T**oxins (overdose)
Hypovolemia	**T**hrombosis - Pulmonary
Hydrogen ion (acidosis)	**T**hrombosis – Coronary
Hyper/**H**ypokalemia	**T**amponade - (Cardiac)
Hypothermia	**T**ension Pneumothorax

↓

☛

Tips for successfully managing this case:

- Don't forget:
  - Continue CPR throughout
  - Monitor for effective CPR - Use $ETCo_2$
  - 2" compression
  - Full recoil
  - No rush to intubate
  - Start/upgrade IV or IO
  - Gather focused history

Primary goal: continue effective CPR followed by rotating medications.

*Verbalize appropriate drug, dose, route, flush, and reevaluate patient every 2 minutes.

Once a rhythm is restored, maintain ventilations as appropriate then stabilize in order:
1. Rate
2. Rhythm
3. Blood pressure

***If patient remains in asystole or other agonal rhythms after successful airway control and initial medications and no reversible causes are identified, for over 20 minutes, consider termination of resuscitative efforts**

☛

To work on Asystole or PEA:

*Think **DEAD:** **D**o CPR, **E**pi, **A**nd, **D**o it again or*

*Think **PEA*** (for both PEA and Asystole) ***P**ush **E**pi **A**nd… Consider the cause*

POST ARREST CARE

Return of spontaneous circulation (ROSC)

↓

Optimize Ventilation and Oxygenation

Secure airway as appropriate
Maintain respiratory rate approximately 10/min
Titrate oxygen saturation 92-98%
Maintain PaCO2 35-45mmhg
Maintain exhaled $ETCO_2$ 35 - 45 mmhg

↓

Optimize Cardiac Function

↓

↓ **Stabilize Heart Rate**
(above 60 BPM)

Only if needed:
Stabilize Rhythm
Antiarrhythmic Infusion
or
(bolus and infusion for serious ectopy)

↓ **Stabilize Blood Pressure**
Fluids up to 1-2 liters
Vasoactive Infusions

↓

Advanced Critical Care

↓ **Consider PCI Center:**
STEMI
Cardiogenic Shock
Mechanical Support required

↓

↓ **Inappropriate Neurological Response**
(not following commands)

↓

Induce Targeted Temperature Management
(32–36°C at least 24 hrs)
ICU: Neuro Eval, EEG etc.

Monitor, Address, and Maintain All:

Hypoxia	**T**oxins (overdose)
Hypovolemia	**T**hrombosis - Pulmonary
Hydrogen ion (Acidosis)	**T**hrombosis - Coronary
Hyper/**H**ypokalemia	**T**amponade (Cardiac)
Hypothermia	**T**ension Pneumothorax

While much of this is done simultaneously, the general mode of treatment is:
Stabilize the **Rate** → Stabilize the **Rhythm** → Stabilize the **Blood Pressure**

Excessive Ventilation

Although the delivery of oxygen is important to support breathing after ROSC some tips to keep in mind:

- Avoid **hyperventilation** due to potential for increased intrathoracic pressure, decreased cardiac output and decreased blood flow to the brain
- Titrate oxygen to achieve O_2 sat 92-98%. **Hyper-oxygenation** may cause cellular toxicity

SYMPTOMATIC BRADYCARDIA (HR<50)

(hypotension, ventricular ectopy)

Assess and maintain CAB's
Administer O_2 if needed
Assess vitals
Apply monitors (EKG, Pulse Ox, B/P)
Targeted history / Physical exam
Establish IV access

↓

Evaluate rhythm
Wide complex 3rd degree
or 2nd degree type II heart block?

↓

YES ——— **NO**

May attempt Atropine

↓

Prepare for transcutaneous Pacemaker, Dopamine or Epi-infusion

↓

Prepare for transvenous pacemaker

↓

Atropine 1.0mg IVP (repeat q 3 - 5 min, max 3mg)

↓

If unsuccessful and seriously symptomatic

↓

Apply transcutaneous pacemaker @ 60 BPM
or
Dopamine infusion
5-20mcg/kg/min titrate to heart rate >60
(not to exceed 20mcg/kg/min)
or
Epinephrine infusion
2-10 mcg/min titrate to heart rate >60

↓

Prepare for transvenous pacemaker if needed

☛ Tips for successfully managing this case:

☝ Don't forget:
- Administer O_2 if needed
- Start/upgrade IV

*Determine whether patient is stable or unstable
-Gather data
-Get vital signs
-Attach monitor(s)
-EKG
-Pulse oximeter
-BP

Start with:
-Level of consciousness
-Blood pressure
-Lung sounds
-Presence/absence of chest pain
-Gather problem focused history

*Your goal:
Control the rate, improve perfusion and maintain a normal rhythm

Consider Causes:
MI
Hypoxia

(Meds):
Ca channel blockers
Beta blockers
Digoxin
Electrolytes
(ie hyperkalemia)

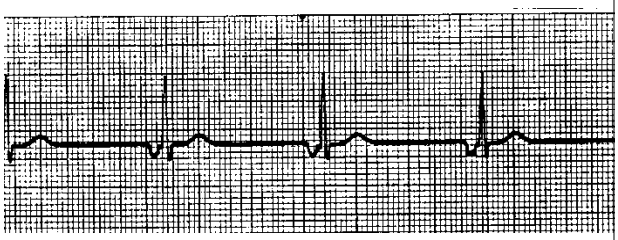
☛ **Quick Tip**

For symptomatic bradycardia's:

After Ten Don't Eat : Atropine, Transcutaneous Pacemaker, Dopamine Infusion, Epinephrine Infusion

Bradycardias

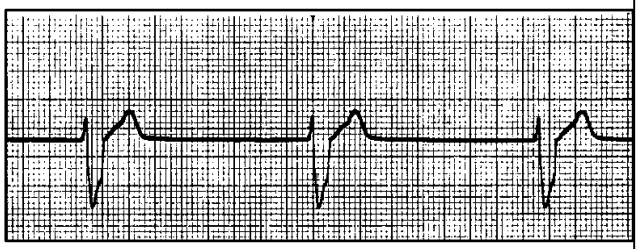
Bradycardias are treated if the patient is symptomatic. ie,- has signs of poor perfusion or PVC's



Junctional Escape Rhythm

When higher pacemaker sites fail, the AV JUNCTION takes over. The atria are depolarized via retrograde conduction. Ventricular conduction is normal

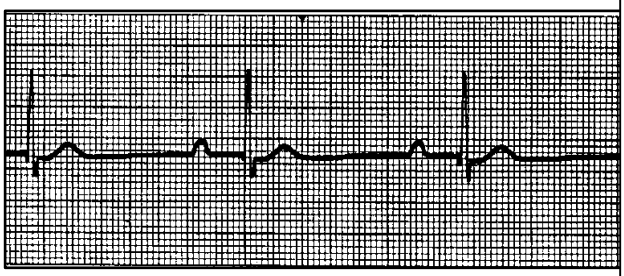
REGULARITY: The rhythm is regular
RATE: Usually 40 - 60
P-WAVES: The P-wave can come before or after the QRS complex, or it can be lost entirely within the QRS



Idioventricular Rhythm

In the absence of a higher pacemaker, the VENTRICLES initiate a regular impulse at their inherent rate of 20 - 40 beats/minute

REGULARITY: Is usually regular
RATE: Is usually 20 - 40 beats per minute
P-WAVES: No P-waves in this arrhythmia
PRI: There is no PRI
QRS: The QRS complex is wide and bizarre



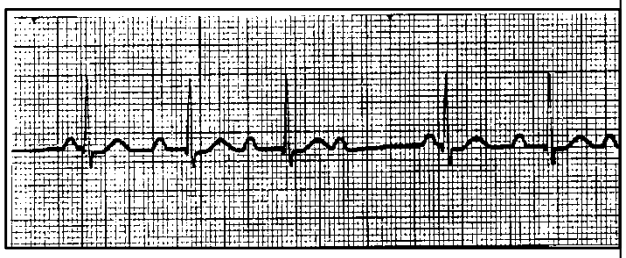
First Degree Heart Block

The AV NODE holds each sinus impulse longer than normal before conducting it through the ventricles. Each impulse is eventually conducted. Once into the ventricles, conduction proceeds normally.

REGULARITY: This will depend on the regularity of the underlying rhythm
RATE: Will depend on the rate of the underlying rhythm
P-WAVES: The P-waves will be upright and uniform. Each P-wave will be followed by a QRS complex.
PRI: The PRI will be constant across the entire strip, but it will always be greater than .20 seconds.
QRS: The QRS complex measurement will be less than 0.12 seconds

Heart Blocks

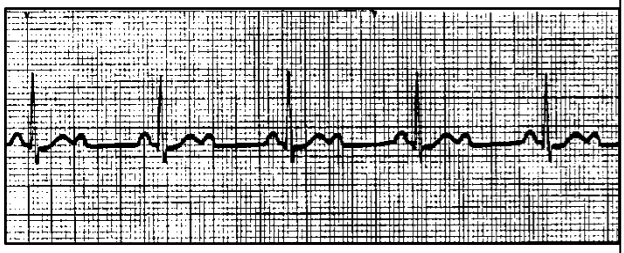
In the acute setting, heart blocks are treated as bradycardias. However, there is some controversy over whether to use Atropine in the MI setting. Also, for wide 3° blocks and 2° type II blocks, some experts choose to avoid Atropine and apply the pacemaker or chronotropic infusions.



Wenckebach (Mobitz Type I)

As the sinus node initiates impulses, each one is delayed in the AV NODE a little longer than the preceding one, until one is eventually blocked completely. Those impulses that are conducted travel normally through the ventricles.

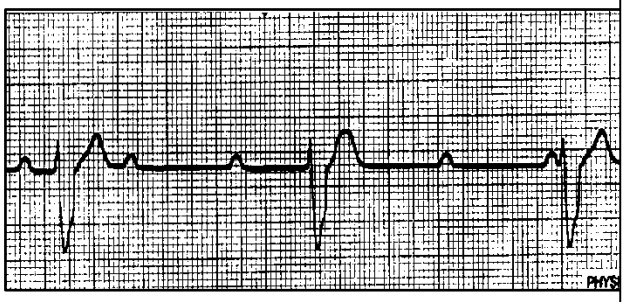
REGULARITY:	Irregular in a pattern of grouped beating.
RATE:	Since some beats are not conducted, the ventricular rate is usually slightly slower. The atrial rate is normal.
P WAVES:	Upright and uniform. Some P waves are not followed by QRS complexes.
PRI:	Get progressively longer, until on P wave is not followed by a QRS complex. After the blocked beat, the cycle starts again.
QRS:	The QRS complex measurement will be normal



Classic Second Degree Heart Block (Mobitz Type II)

The AV NODE selectively conducts some beats while blocking others. Those that are not blocked are conducted through to the ventricles. Once in the ventricles, conduction proceeds normally.

REGULARITY:	If the conduction ratio is consistent, the rhythm will be regular. If the conduction ratio varies, the rhythm will be irregular.
RATE:	The atrial rate is usually normal. Since many of the atrial impulses are blocked, the ventricular rate will usually be in the bradycardia range.
P WAVES:	Upright and uniform. There are more P waves than QRS complexes.
PRI:	Conducted beats will be constant.
QRS:	The QRS complex measurement will be normal



Complete (3°) Heart Block

The block between the atria and the ventricles is complete. The sinus beats are not conducted through to the ventricles. An escape mechanism from either the junction (if the block is high in the AV node) or the ventricles (if the block is in the bundle branches) will take over to pace the ventricles. The atria and the ventricles function in a totally dissociated fashion.

REGULARITY:	Both the atria and the ventricles are firing so the P-P intervals and the R-R intervals are regular.
RATE:	The atrial rate will usually be in a normal range. The ventricular rate may be 20-60.
P WAVES:	More P waves than QRS complexes.
PRI:	No atrial impulses conducted to the ventricles. The P-waves have no relationship to the QRS complexes. May occasionally see a P-wave on or near a QRS complex.
QRS:	If the ventricles are being controlled by a junctional focus, the QRS complex will measure less than .12 sec. If the focus is ventricular the QRS will be wide.

For Stabilization of Rhythm after VF or VT Conversion

Evidence recommends treating the underlying cause rather than treating the PVC's unless the PVC's occur frequently or in groups (i.e. Salvos or VT). "Routine use not recommended" .

Assess and maintain CAB's

Administer O_2 if needed

Assess vitals

Apply monitors (EKG, B/P, Resp Pulse Ox)

Targeted history/ Physical exam

Establish IV access

Look for underlying causes and consider whether pharmacologic intervention is appropriate. If indicated:

↓

Antidysrhythmic of choice

May bolus if not already done

Otherwise, move to infusion section below

Amiodarone 150mg over 10 min

OR

Lidocaine bolus 0.5-1.5mg/kg

↓

Repeat antidysrhythmic if needed

↓

If effective, consider an antidysrhythmic infusion of the agent used in the bolus

Infusions:

Amiodarone 1mg/min for 6 hours (900mg in 500mLs @ 33mLs/hr)

Then 0.5mg/min for 18 hours (17mLs/hr)

OR

Lidocaine or Procainamide 1-4mg/min (2grams in 500mLs @ 15mLs/hr)

Quick tip

Generally choose only 1 antidysrhythmic until expert consult:

Amiodarone bolus can be given 1x then repeated every 10 minutes (max 2.2 grams in 24 hrs bolus & infusion)

Lidocaine bolus 1 - 1.5mg/kg then repeated @ half doses to max of 3mg/kg

Procainamide 20 - 50mg/min to max of 17mg/kg

Magnesium 1 - 2 grams over several minutes (ok to mix with others if needed)

HYPOTENSION

(Symptomatic with systolic < 90 mmHg)

Assess and maintain CAB's

Administer O_2 if needed

Assess vitals

Apply monitors (EKG, B/P, Resp Pulse Ox)

Review history/ Physical exam

Establish IV access

↓

Administer fluid bolus' (1-2 liters)

(If lung sounds are clear)

↓

If needed and lung sounds are still clear

Repeat fluid bolus

↓

May Consider:
Norepinephrine:
If patient has profound shock
0.1-0.5 mcg/kg/min

← Reassess BP →
If still low

May Consider:
Epinephrine infusion
2-10 mcg/min

↓

Dopamine drip 5-20 mcg/kg/min
(not used as often)
(generally start at 5mcg/kg/min)
(not to exceed 20mcg/kg/min)

***Reminder: Treat the rate, <u>then</u> the rhythm, <u>then</u> the blood pressure**

Blood Pressure
GOAL:
SBP >90 mmHg
Or **MAP** >65 mmHg

☛ **Quick tip:**

<u>If hypotension is caused by a dysrhythmia, FIX THE RHYTHM:</u>

- Try to identify cause of hypotension (hypovolemia, pump failure, profound vasodilation) to help identify the most effective treatment
- Watch for unwanted cardiac symptoms such as tachycardia or ectopy when using Norepinephrine, Dopamine, or Epinepherine.

SUPRAVENTRICULAR TACHYCARDIA STABLE

Narrow complex, rate over 150- no signs of Afib or A Flultter

(Maintaining adequate mentation, blood pressure, respiratory status & absence of serious chest pain)

Assess and maintain CAB's

Administer O2 if needed

Assess vitals

Apply monitors (EKG, B/P, Resp, Pulse Ox)

Targeted history/ Physical exam

Establish IV access

RULE OUT NON CARDIAC CAUSES

↓

Consider ordering:

(12 lead ECG, Cardiac enzymes, CXR)

(Expert cardiology consult)

Atrial fib/flutter? See AF algorhythm (next page) ←

↓

Vagal Maneuvers

↓

Adenosine 6mg IVP rapidly followed by flush

If unsuccessful

Adenosine 12mg IVP rapidly followed by flush

↓

If rhythm fails to convert

↓

Choose 1:

Calcium Channel Blocker (one)

Diltiazem 15 - 20mg may repeat 20 - 25 mg in 15 minutes

OR

Beta Blocker (one)

Metoprolol (Lopressor) 5mg over 5 minutes may repeat Q 5 minutes X 2

Atenolol (Tenormin) 5mg over 5 minutes may repeat in 10 minutes

↓

If rhythm still fails to convert

↓

May choose sedation and elective cardioversion or other medications based on a more definitive diagnosis

ATRIAL FIBRILLATION STABLE

WITH RAPID VENTRICULAR RESPONSE

Sustained rate over 150
(maintaining adequate mentation, blood pressure, respiratory status, & absence of chest pain)

Assess and maintain CAB's

Administer O_2 if needed
Assess vitals
Apply monitors (EKG, B/P, Resp Pulse Ox)
Targeted history/ Physical exam
Establish IV access

↓

Consider ordering:
(12 lead ECG, Cardiac enzymes, CXR) (Expert cardiology consult)

↓

Control rate with: Choose 1:
Calcium Channel Blocker

Diltiazem 15 - 20mg may repeat 20 - 25mg in 15 minutes

(consider infusion)

OR

Beta Blocker

Metoprolol (Lopressor) 5mg over 5 minutes
may repeat Q 5 minutes X 2
May choose other Beta blockers: Atenolol, Esmolol

Convert rhythm after expert cardiology consult?
Duration of fib?

↓ <48 hrs

Convert rhythm by the same means as the patient who had emboli ruled out

↓ >48 hrs

Delay rhythm conversion unless unstable:
R/O emboli or Anticoagulation up to 4 weeks
**Once emboli R/O, May consider any of the following:*

1. Elective cardioversion.
   ~ Start: 120 - 200J Biphasic / 200J Monophasic
2. Amiodarone 150mg over 10min then infusion
3. Digitalis 10 - 15mcg/kg (0.5 - 1.0mg)

*Be cautious with medications that may convert A-fib prior to cardiac consult (Amiodarone)

SUPRAVENTRICULAR TACHYCARDIA UNSTABLE

(Any SVT with a rate over 150 with decreased LOC, hypotension, pulmonary edema, or chest pain)

Assess and maintain CAB's

Administer O_2 if needed
Assess vitals
Apply monitors
(EKG, Pulse Ox, B/P)

RULE OUT NON CARDIAC CAUSES

↓

Brief history
IV/IO access
(do not delay cardioversion)

↓

Immediate management

Sedation
(if conscious and B/P allows)

↓

← **Synchronized cardioversion**
Start at 50-100j
(based on machine - could increase stepwise between 120-360J)

For Atrial fibrillation:
Start with 120-200J biphasic,
**synchronized, but same energy as defibrillation*

If unsuccessful: medication sequence for stable

☛ Tips for successfully managing this case:

☝ Don't forget:
- Administer O_2 if needed
- Start/upgrade IV

- Determine whether patient is stable or unstable
- Gather data
- Get vital signs
- Attach monitor(s)
- EKG
- Pulse Oximeter
- BP

Start with:
- Level of consciousness
- Blood pressure
- Lung sounds
- Presence/absence of chest pain
- Gather problem focused history

*Your goal:
Control the rate; improve perfusion and maintain a normal rhythm

*Verbalize appropriate drug, dose, route, flush, and reevaluate patient after each intervention

☛ **Quick tip:**

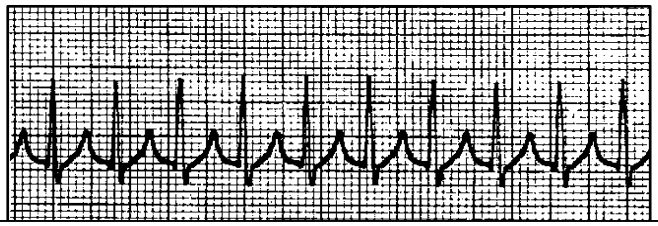
If tachycardic and awake (or otherwise stable) first we try to medicate
If tachycardic with a nap (or otherwise unstable) then the treatment is Zap Zap Zap!

Tachycardias

Tachycardias fall into one of two categories. Wide or Narrow and Stable or Unstable

- Consider wide rhythms to be Ventricular in origin
- Consider narrow rhythms to be Supraventricular in origin

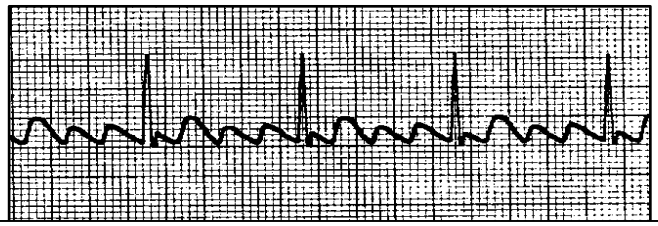
Unstable Tachycardias are those with decreased LOC, hypotension, pulmonary edema, or chest pain. These patients require synchronized cardioversion.



Atrial Tachycardia (SVT)

The pacemaker is a single irritable site within the ATRIUM which fires repetitively at a very rapid rate. Conduction through the ventricles is normal.

REGULARITY: Regular
RATE: Usually 150-250
P-WAVES: There is one P-wave for every QRS but it is usually hidden in the T-wave. As P-wave & T-wave come together they make a peak between complexes
PRI: Normal, but P-wave is hidden in the T-wave.
QRS: Should be normal width



Atrial Flutter

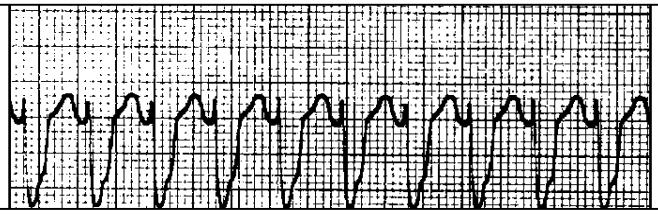
A single irritable focus within the ATRIA issues an impulse that is conducted in a rapid, repetitive fashion. To protect the ventricles from receiving too many impulses, the AV node blocks some of the impulses from being conducted through to the ventricles.

REGULARITY: May be regular or irregular
RATE: Atrial rate is 250-350 beats/min
Ventricular rate may range from normal to tachy
P-WAVES: In atrial flutter produce a saw tooth appearance.
PRI: Because of the unusual configuration of the Flutter and the proximity of the wave to the QRS complex, it is often impossible to determine a PRI.
QRS: Should be normal width

Atrial Fibrillation

The ATRIA are so irritable that they rapidly initiate impulses, causing the atria to depolarize repeatedly in a fibrillatory manner. The AV node blocks most impulses, allowing only a limited number through to the ventricles. (May increase stroke risk)

REGULARITY: The ventricular rate is grossly irregular
RATE: The atrial rate cannot be measured because it is over 300. The ventricular rate may range from bradycardia to severe tachycardia.
P-wave: The atria are fibrillating. No distinct P's
PRI: No PRI can be measured.
QRS: Usually normal.



Ventricular Tachycardia

An irritable focus in the VENTRICLES fires regularly at a rate of 150-250 to override higher sites for control of the heart.

REGULARITY: Usually regular
RATE: Atrial rate cannot be determined. Ventricular rate range is 150-250.
P-WAVES: None of the QRS complexes will be preceded by P-waves. You may see dissociated P-waves intermittently.
PRI: Since the rhythm originates in the ventricles, there will be no PRI.
QRS: Wide and bizarre.

VENTRICULAR TACHYCARDIA STABLE

(Maintaining adequate mentation, blood pressure, respiratory status, and absence of chest pain)
Wide complex, rate over 150, regular with no P waves or signs of A-fib or flutter

Assess and maintain CAB's

Administer O_2 if needed
Assess vitals
Apply monitors
(EKG, Pulse Ox, B/P)
Targeted history/ Physical exam
Establish IV access

↓

(Consider ordering)
(12 lead ECG, Cardiac enzymes, CXR)
(Cardiology consult)

↓

***Note: could try adenosine if regular and rhythm isn't diagnosed*

← Preferred Antidysrhythmic

↓

Consider the following at any time

↓

Sedation and synchronized cardioversion
Begin at 100j, and increase PRN.
(based on machine –
could increase stepwise between 120-360J)

Prepare an infusion of the antidysrhythmic medication used if conversion is successful

May use: (generally only one)

Procainamide 20-50 mg/min
~Or~
Amiodarone 150 mg IV drip over 10 min
May repeat 150 mg IV
~Or~
Sotolol 100 mg over 5 min
~Or~
Lidocaine bolus 0.5-1.5 mg/kg
½ initial dose for repeat dose May repeat to max total 3mg/kg
~Or~
Magnesium 1 - 2 gm IV for Torsades or suspected hypomagnesemia

Tips for successfully managing this case:

Don't forget:
- Administer O_2 if needed
- Start/upgrade IV

- Determine whether patient is stable or unstable
- Gather data
- Get vital signs
- Attach monitor(s)
- EKG
- Pulse oximeter
- BP

Start with:
- Level of consciousness
- Blood pressure
- Lung sounds
- Presence/absence of chest pain
- Gather problem focused history

*Your goal:
Control the rate, improve perfusion and maintain a normal rhythm

*Verbalize appropriate drug, dose, route, flush, and reevaluate patient after each intervention

Quick tip

Find the cause:

Patients don't have Ventricular Tach because they are low on Amiodarone (or any other antidysrhythmic). Medications are a temporary "Band-Aid" for ventricular irritability, but it is likely to recur if the cause is not diagnosed and treated.

VENTRICULAR TACHYCARDIA UNSTABLE

(Rate over 150 with decreased LOC, hypotension, pulmonary edema, or chest pain)

Assess and maintain CABs
Administer O_2 if needed
Assess vitals
Apply monitors
(EKG, Pulse Ox, B/P)

↓

Targeted history IV/IO access
(do not delay cardioversion for IV)

↓

Immediate management

↓

Sedation
(if conscious and B/P allows)

↓

Synchronized cardioversion
Start @100j;
(based on machine-
could increase stepwise between 120-360j)

If Torsades de Pointes
(wide irregular rhythm)
use unsynchronized countershock at defibrillation doses

☞ Tips for successfully managing this case:

☞ Don't forget:
- Administer O_2 if needed
- Start/upgrade IV

*Determine whether patient is stable or unstable Gather data
Get vital signs
Attach monitor(s)
- EKG
- Pulse oximeter
- BP

Start with:
- Level of consciousness
- Blood pressure
- Lung sounds
- Presence/absence of chest pain
- Gather problem focused history

*Your goal:
Control the rate, improve perfusion and maintain a normal rhythm

*Verbalize appropriate drug, dose, route, flush, and reevaluate patient after each intervention

If unsuccessful: follow medication sequence for stable

☞ **Quick tip**

If tachycardic and awake (or otherwise stable) first we try to medicate
If tachycardic with a nap (or otherwise unstable) then the treatment is Zap Zap Zap!

Unstable = **CASH**, which gets Joules ("Those with CASH get Joules")
(Chest pain, Altered LOC, SOB w/ Pulm. Edema/ Hypotension)

ACUTE CORONARY SYNDROMES

Potential Symptoms:
Chest Pain/discomfort
Dyspnea
Diaphoresis
Nausea
Pallor

Assess and maintain CAB's
Administer O_2 only if needed
Assess vitals
Apply monitors
(EKG, Pulse Ox, B/P)
Targeted history /Physical exam
Establish IV access
Perform 12 LEAD ECG
ED or Cath Lab: electrolytes, enzymes, troponin, coags
Chest X Ray
↓

Perform simultaneously with initial assessment

Oxygen- (if sat < 90, or dyspnea
Aspirin-162-325 mg PO
Nitroglycerine- SL or spray
Morphine IV if pain not relieved by 3 NTG. Only recommended if STEMI
P2Y12 inhibitors- considered ex: clopidogrel

Tips for successfully managing this case:

Don't forget to:
- Use a pain scale to help your patient rate the pain
- Perform PQRST assessment to determine if the cause of pain is likely myocardial ischemia or injury
- Determine time of onset early
- History/physical should include screening for Fibrinolytic contraindications
- Assess vital signs before and after administering Nitrates
- Obtain 12 lead EKG early
- Administer Morphine only if Nitro fails to relieve the pain
- EMS-notify ER
- ER-notify cath lab

↓

STEMI:

ECG + for AMI <12 hrs
(ST elevation in 2 or more related leads **or** new LBB)
↓
Immediate: Prepare pt for PCI
(Percutaneous Coronary intervention) stent or CABG
Ideal contact to procedure=90 min
↓
Adjunctive options:
- **-IV Nitroglycerine** (continued ischemia, HTN, PE)
- **-Heparin or LMWH**
- **-Bivalirudin**
- **-P2Y12 Inhibitors**
- **-Ace inhibitors** (once stable)
- **- β Blockers** (once stable)

↓
Fibrinolytics (if PCI unavailable)
Ideal door or EMS to drug time=30min
↓
CABG

Nondiagnostic ECG or enzymes, Admit to ED/ chest pain unit
Serial ECGs, Serial cardiac markers

High Risk Acute Coronary Syndromes

Non STEMI:
-ST depression/T wave inversion
-High risk unstable angina (female, rales Hx MI, diabetes, hypotension, tachycardia, v tach runs, atrial fib)
-AMI >12 hrs
↓
Adjunctive options:
- **- IV Nitroglycerine** (continued ischemia, HTN, PE)
- **- Heparin or LMWH**
- **- Bivalirudin**
- **- P2Y12 Inhibitors**
- **- Ace inhibitors** (once stable)
- **- β Blockers** (once stable)

↓
NSTEMI: who may receive urgent PCI
- continued symptoms-despite tx
- elevated troponin
- unstable vital signs
- runs of VT
- experienced cardiac arrest

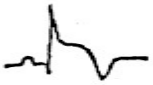
↓
CABG

THE 12 LEAD ECG

ST Elevation

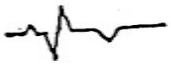
In 2 or more related leads
Arouses suspicion for injury

T-Wave Inversion



Arouses suspicion for ischemia
(may be Angina or early MI)

Q Wave



Small Q wave may be normal
> 0.04 sec wide or >1/3 depth of QRS
Represents infarction (old MI)

Related leads on the ECG:
S – Septal: V1, V2
A – Anterior: V3, V4
L – Lateral: V5, V6, I, AVL
I – Inferior: II, III, AVF

STEMI: look for-
1 mm ST elevation (in 2 or more contiguous leads), or
2 mm elevation in V2 V3, or
1.5 mm elevation in *all* women V2 V3
New, or presumed new, LBB

"The Imposters non AMI causes of ST and QRS changes

Left Bundle branch block	QRS > 0.12 sec, QRS inverted in V1, upright in V6, S-T elevation, depression, and T wave inversion seen throughout. Cannot accurately diagnose MI
Right bundle branch block	QRS 0.12 sec or wider, rSR pattern in V1, (QRS upright in V1), S-T elevation, depression, and T wave inversion may be seen throughout. May be able to detect MI, especially if comparison ECG available
Other causes of Wide QRS	Ventricular rhythms, (PVCs, VT), electronic pacemakers, medications, (Quinidine, Pronestyl), any depolarization abnormality can cause repolarization abnormalities
Left Ventricular hypertrophy	Strain pattern of depressed S-T segments, large QRS complexes in chest leads
Digitalis	ST segment "sags". May also be seen with calcium ingestion
Pericarditis	Widespread ST elevation, T waves upright, no pathological Q waves, Possible PR interval depression in V6. Clinical correlation is necessary. Look for viral syndrome: fever, malaise. Patient will prefer to lean forward, obtaining some relief
Angina Pectoris	Flat (plane) depressions of S-T segment. Inverted T waves possible. ECG changes may improve with pain relief.
Prinzmetal's angina	Slope elevation of S-T, especially in V4-V6. Changes may resolve with pain relief.
Early repolarization	Normal variant. S-T slightly elevated with normal concave slope in most leads. J point is elevated, possibly with "fishhook" appearance.

SUSPECTED STROKE

Immediate assessment - Stroke scales / scores
Notify Hospital-Alert Stroke Team
Assess and maintain ABC's
Administer O_2 to 95-98% sat
Assess vitals
Apply monitors (EKG, Pulse Ox, B/P)
Review history /Physical exam
Establish IV access

(2020) Current practices advises direct transport to a designated stroke center for best outcomes.
*Report directly to imaging area.

Conservative IV sticks and blood draws. Blood sugar/Rule out other non-stroke causes

Establish onset Time
Rapid Noncontrast CT

↓

No ---- CT positive for stroke? (hemorrhagic) ---- **Yes**

↓ ↓

Repeat Neuro Exam :
Symptoms improving?
No, to all of the above

↓

- Consult Neurology
- Consider **Fibrinolytics** if <3 hours since onset of symptoms.
- Since 2010 this has been extended to 4.5 hours for certain patients
- Consider Interventional Facility (Comprehensive Stroke Center for Endovascular Treatment-EVT)

Consult Neuro Team/ICU

Noncontrast: CT or MRI scan of the brain within 20 minutes of the patient's arrival. *Bypass ER-direct to CT scan*
Results should be read within 45 min.
Goal: door to treatment time= 60 min.

Don't forget:
- Administer O_2 to 95-98% sat
- Establish IV access
- Assess for subtle signs of stroke
- Determine time of onset
- Rule out non-stroke causes of deficits
- Alert receiving facility of stroke alert if pre-hospital
- Reassess neurologic status frequently

**Endovascular therapy may be considered up to 24 hours. (EVT)*

Various tools such as the National Institutes of Health Stroke Scale **(NIHSS)** effectively evaluate:
Level of consciousness
Visual function
Motor function
Sensation and neglect
Cerebellar function
& Language deficits

Cincinnati PreHospital Stroke Scale **(CPSS)**
Rapid Stroke Assessment Tool
Screens for 3 indicators only:
- Facial droop
- Arm drift
- Abnormal speech

1 abnormal finding = 72% probability of stroke

Rapid Arterial Occlusion Evaluation Scale **(RACE)**
*Scores 5 areas-to screen for possible large vessel occlusion, which is best treated w/ Endovascular Therapy

INCLUSION CRITERIA FOR FIBRINOLYTICTHERAPY

CARDIAC

Inclusion criteria:

- ❑ Chest pain &/or symptoms of acute MI
- ❑ QRS duration <120 ms (.12 sec)
- ❑ ST segment elevation >1mV (1mm) in 2 or more related leads
  - ❑ II, II, aVF
  - ❑ V1, V2, V3, V4, V5, V6
  - ❑ I, aVL

Exclusion criteria:

- ❑ Active internal bleeding
- ❑ History of CVA/TIA

Recent (< 2 months)

- ❑ Intracranial/intraspinal surgery, trauma
- ❑ Brain tumor, aneurism
- ❑ Arteriovenous malformation
- ❑ Bleeding disorder/anticoagulant

Recent (<2 weeks)

- ❑ Major surgery
- ❑ Trauma
- ❑ Organ biopsy
- ❑ GI or GU bleeding
- ❑ Severe uncontrolled HTN (200/120)
- ❑ Pregnancy/ Menses
- ❑ Diabetic eye problems &/or other hemorrhagic opthalmic condition
- ❑ Disoriented, uncooperative
- ❑ Prolonged/traumatic CPR
- ❑ Aortic dissection
- ❑ Allergy to steptokinase

STROKE

Inclusion criteria:

- ❑ Diagnosis of ischemic stroke causing measurable neurologic deficit
- ❑ Onset of symptoms <3 hours before beginning treatment
- ❑ Age ≥ 18 years

Exclusion criteria:

- ❑ Head trauma or prior stroke in previous 3 months
- ❑ Symptoms suggest subarachnoid hemorrhage
- ❑ Arterial puncture at noncompressible site in previous 7 days
- ❑ History of previous intracranial hemorrhage
- ❑ Elevated blood pressure (systolic >185 mm Hg or diastolic >110 mm Hg)
- ❑ Evidence of active bleeding on examination
- ❑ Acute bleeding diathesis, including but not limited to
  - -Platelet count <100,000/mm3
  - -Heparin received within 48 hours, resulting in an aPTT greater than the upper limit of normal
  - -Current use of anticoagulant with INR >1.7 or PT >15 seconds
- ❑ Blood glucose concentration <50 mg/dl (2.7 mmol/L)
- ❑ CT demonstrates multilobar infarction (hypodensity>1/3 cerebral hemisphere)

Relative Exclusion Criteria

Patients may receive rtPA but risk/benefit must be carefully weighed if presented with the following:

- ❑ Only minor or rapidly improving stoke symptoms (clearing spontaneously)
- ❑ Seizure at onset with postictal residual neurologic impairments
- ❑ Major surgery or serious trauma within previous 14 days
- ❑ Recent gastrointestinal or urinary tract hemorrhage (within previous 21 days)
- ❑ Recent acute myocardial infarction (within previous 3 months)

PULMONARY EDEMA

Assess and maintain CAB's
Administer O_2
Assess vitals
Apply monitors
(EKG, Pulse Ox, B/P)
Targeted history/ Physical exam
Establish IV access
Fowler's position
Consider positive pressure
(CPAP/BIPAP)

↓

Nitroglycerine 0.4mg SL may
repeat or begin paste or infusion
(if systolic BP above 100 mmHg)

↓

Note: Lasix and Morphine are used less frequently in areas that utilize BiPAP/CPAP initially

Morphine 2-4mg slow IVP

↓

Lasix up to 0.5 to 1mg/kg slow IVP (generally given in 20mg increments)
(contraindicated if systolic BP < 100 mmhg)

↓

Reassess pulmonary status Consider positive pressure ventilation

↓ ↓

Tips for successfully managing this case:

- Don't forget:
- Administer O_2
- Start/upgrade IV
- Monitor oxygenation,
- Reassess airway status frequently
- Administer dilators and diuretics
- Keep an eye on BP

For CHF with hypotension consider:

* Dopamine 2.5-20mcg/kg/min (if shocky)
* NorEpinephrine 0.5-30mcg/min (if B/P < 70 systolic)
*Dobutamine 2-20mcg/kg/min (with no other signs of shock)

For CHF with systolic > 100 consider:

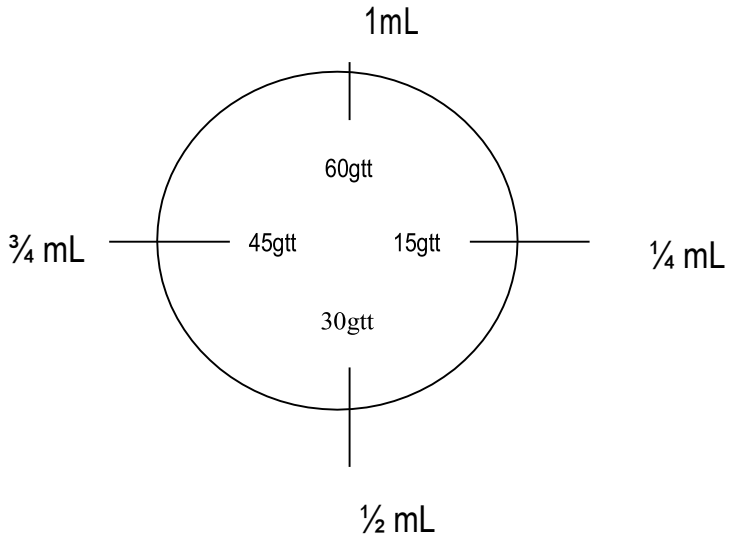
* Nitroglycerin 10-20mcg/min
* Nitroprusside 0.5-8mcg/kg/min

TIPS FOR DRIPS

The following is merely one of the methods for calculating drip medications. It should not be considered "the only way" or "the ACLS way" to mix and administer infusions. If you are familiar with another method, use what works for you. Many IV pumps will provide dose calculations.

Clock Method:

Think of a mini drip chamber or IV pump as a clock. A clock has 60 seconds in 1 minute.
A drip chamber has 60 drops in 1mL.

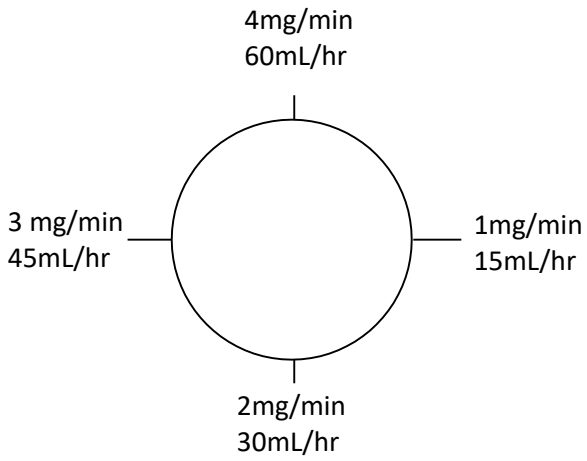


To use the clock method to calculate your drip rate you must figure the mixed concentration (the amount of drug per mL). This is done by dividing the amount of the fluid volume in the IV bag (500mL, etc) into the supplied drug amount. This number gives you the amount of medication administered per mL. Then, insert this number in the "60" slot on your clock, ½ of it at the 30. ¼ of it at the 15 and ¾ of it at the 45. Remember, when drugs are diluted for infusions, the concentration becomes the next lowest unit (for example, add a gram of drug to a bag and the concentration becomes mg/mL).

FOR EXAMPLE:

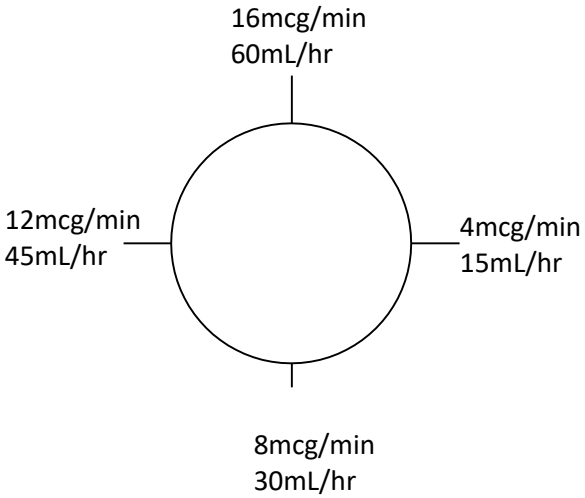
Antidysrhythmic: mix 2gm in 500mL

2000mg/500mL=4mg/mL



Cardiac stimulants: Mix 4mg in 250mL

4000mcg/250mL=16mcg/mL



Special Arrest Situations
Other Considerations in ACLS Management

In general, Critical Care Personnel are quite good at performing ACLS skills-intubations, defibrillation, vascular access, and appropriate medical treatment according to ACLS type protocols. However, in our haste to rapidly treat patients, we may miss clues as to why this person arrested and why he is not responding to your best ACLS treatment.

Occasionally, the provider may need to pull some "tricks" out of their drug box based on history labs, bystander information, the scene, and the fact that the patient is not responding to the standard ACLS treatment.

PLEASE NOTE: These are merely recommendations from the AHA guidelines and should not be construed as the only standard. All treatment should be approved by the supervising physician.

Some interesting facts to keep in mind:

These things will cause PEA:
Pulmonary emboli, Acidosis, AMI, Tension Pneumothorax, Cardiac Tamponade, Hypoxia, Hypovolemia, Hyperkalemia, Drug overdose.

These things will case Asystole:
Hypoxia, hypothermia, hypokalemia, hyperkalemia, acidosis, drug overdose, and death.

V-Fib or pulseless VT can be caused by anything.

Electrolyte Imbalances

Certainly, if labs have been "drawn" or if values are rapidly available this information can be utilized to guide treatment.

Since providers do not all have the ability to rapidly obtain and evaluate ABG's or blood work, here are a few clues for patients not responding to your routine regime; consider these early:

Renal dialysis patients
- May have Pre dialysis Acidosis, Hyperkalemia, Hypoglycemia, or Post dialysis Hypokalemia & Hypovolemia.

Diabetics
- May have Acidosis, Hypoglycemia, Hypovolemia, Hyperkalemia, Hypokalemia.

Alcoholics
- May have Hypokalemia, Hypoglycemia, Hypomagnesemia.

Prolonged Vomiting
- May have Dehydration, Metabolic, Alkalosis, Hypokalemia.

Prolonged Diarrhea
- May have Dehydration, Acidosis, Hypokalemia, Hypomagnesemia.

Ventricular Tachycardia? Suspect Hypocalcemia, Hypomagnesemia & Hypokalemia

Management of Electrolyte Related Arrests, <u>In Addition To Standard ACLS,</u> could Include:

Hyperkalemia (>6.5 mmol/L) (One of the most potentially life threatening):

- Most Commonly occurs in renal failure patients, though other conditions can cause "release" from the cells.

While Performing Standard ACLS:

1. Administer Calcium Chloride 500mg-1gram to stabilize myocardial cells
2. Administer Sodium Bicarbonate 50 mEq to shift potassium into the cells
3. A mix of Glucose (25g) and Insulin 10u may be infused over 15 minutes

Hypomagnesemia (< 1.3 mEq/L)

- Most commonly occurs in the malnourished, chronic alcoholic, or chronic diarrhea
- May cause VT, Polymorphic VT (Torsades de point)
- Administer 1-2g magnesium IV bolus

Metabolic Acidosis (Ph < 7.35)

- Occurs during an extended period of arrest or in a patient who is without CPR for an extended period of time initially
- May occur with medical conditions (Ketoacidosis) or overdoses
- Initially provide adequate CPR and ventilations
- Ideally use ABG's to guide treatment, but may be given based on history
- Administer Sodium Bicarbonate 1mEq/kg, repeat at half dose

Unique Respiratory Conditions

- COPD and asthma have caused arrests in the old and the young from respiratory failure and acidosis. There have also been numerous cases of Tension Pneumothoraxes.
- The Pneumothorax patient may require pleural decompression if they fail to respond to standard ACLS, have poor BVM compliance, absent lung sounds, and other TPT signs.
- Lateral pressure applied to the chest during exhalation may help expel trapped air and reduce intrathoracic pressure and the incidence of barotrauma during resuscitation.
- Intubated asthma patients in arrest should be ventilated slower and with less tidal volume.

Unique Respiratory Conditions (Continued)

- Any Intubated patient who deteriorates after stabilization, along with managing cardiac dysfunction, should be evaluated for the following:
    - **D**islodged ET Tube
    - **O**bstructed ET Tube
    - **P**neumothorax
    - **E**quipment Failure (ventricular)

Drowning

- Hypoxia and Acidosis are the initial causes.
- Consider **S**pinal **M**otion **R**estriction, if indicated.
- Consider sodium bicarbonate (for extended down time)
- Hypothermia BLS management
    - Protect from heat loss; cover victim.
    - Begin CPR without delay (even though pulse may be difficult to detect).
    - Check rectal or tympanic temperature. <86°F(30°C)=Severe, >86°F(30°C)=mild to moderate.
- Hypothermia ALS management
    - Perform ALS skills (ET) gently especially in severe hypothermia.
    - Move towards aggressive core warming (warm lavages, bypass, etc.) as primary.
    - Withhold antiarrhythmics until core temp is >86°F(30°C).
    - Perform all other ACLS procedures.
- Do not terminate efforts until temperature is near normal.

Trauma Arrests

- Though survivability rates are low, scene management should include **S**pinal **M**otion **R**estriction, airway control, bleeding control, and a rapid search for reversible conditions such as Tension Pneumothorax, and V-Fib. IV fluids, and medication should take place enroute to a trauma facility
- Utilize the H's and T's to rapidly evaluate reversible causes.
- Some areas may choose not to resuscitate trauma arrests due to poor prognosis.

Obesity

- Be prepared for a difficult airway and a smaller glottic opening
- If Pulmonary Embolism is suspected, consider Emergent Fibrinolytics (for obesity)

Pregnancy

- Do not change the standard ACLS protocols
- Manually, shift fetus to the left. (as effective as tilting and easier to perform CPR).
- Consider C-Section if there is no response to 5 minutes of ACLS
- If the pregnant female was receiving Magnesium, administer 1 gram Calcium Chloride
- Compressions may need to be performed slightly higher on the chest due to the larger abdomen
- Consider potential causes of arrest (ABCDEFGH):

A-anesthetic **B**-bleeding **C**-cardiovascular **D**-drugs **E**-emboli **F**-fever **G**-general cause **H-**hypertension

Anaphylaxis

- Allergic reactions, while usually easily reversible, may progress to cardiovascular collapse due to profound vasodilation and hypoperfusion
- For patients in near arrest or arrest states, administer Epinephrine IV .05-0.1mg IV
  ~ rather than SQ or IM, then follow standard ACLS to manage arrhythmias
- Emphasis should be placed on securing an appropriate airway early on
- In severe shock, administer large fluid boluses – 1 liter at a time (4-8 liters)
- Norepinephrine or Vasopressin can be considered in profound hypotension if Epi and fluids have failed.
- Glucagon 1-5mg can be given if treatment is unsuccessful on a patient who takes beta blockers.

Arrests Related to Overdose

- **The initial management for drug induced arrests is basically unchanged. Follow the standard BLS and ACLS regime while searching for reversible causes.**

The following will outline consideration in specific overdoses:

Cocaine - Tachyarrhythmias, vasoconstriction, pulmonary edema, seizures, HTN, & hypothermia

- **SVT**: Often short-lived, not requiring therapy
  - ~However, for sustained SVT consider administering benzodiazepines (Valium, Ativan, etc.)
- **Hemodynamically stable VT**: Consider benzodiazepines. If persistent, administer standard antidysrhythmics. Follow with Sodium Bicarbonate 1 mEq/kg IV

Arrests Related to Overdoes (Continued)

- **Hypertension**- Treat initially with benzodiazepine. Follow with vasodilator such as Nitroglycerine or Nitroprusside. (Nitroglycerine preferred if concurrent chest pain)
- ***Do not use β blockers* – blocking β stimulus may allow the α blocking properties of cocaine to function unopposed, potentially increasing blood pressure
  ~A pure -blocker such as Phentolamine (1mg q 2 - 3 min up to 10mg) may be used
- **Pulmonary edema -** Standard medical management including + pressure ventilation
- **Acute Coronary Syndromes -** With cocaine use, more often due to spasm rather than thrombus. Use O_2, ASA, NTG, titrated doses of benzodiazepine

Tricyclic Antidepressants (Elavil, Tofranil, Amitryptyline, etc.) - Cardiotoxic when overdosed. Expect mental status changes, Tachycardias, Prolonged QT intervals, and anticholinergic effects. Interventions include:

- Symptoms = 3 C's – Convulsions, Coma, Cardiac dysrhythmia
  - then Acidosis and Hypotension
- Consider activated charcoal in non cardiac arrest within 1 hour of ingestion
- Terminate seizures with benzodiazepines
- During arrest consider sodium bicarbonate 1mcg/kg
- Pre arrest or post arrest cardiovascular collapse with widened RS
  - Administer sodium barcarbonate, consider fluid bolus NaCL as needed

Digitalis - Overdose may cause bradyarrhythmias and heart failure, ventricular arrhythmias, and hyperkalemia. There is no evidence to support antidotes during cardiac arrest. Pre or post arrest cardio-toxicity treatment should include:

- Activated charcoal within 1 hour of ingestion
- Use standard ACLS treatment for critical bradycardias
- Cautious use of transvenous pacemakers due to pacemaker induced dysrhythmias.
- K + >5mEq/L patients have a poor prognosis
- Fab fragment therapy (digibind):
  - 2 vials per mg of drug ingested
  - 10-20 vials for unknown amount ingestion

Calcium Channel Blocker and β Blocker toxicity –

May cause hypotension, decreased contractility, bradycardias, decreased LOC, seizures, hypoglycemia & hyperkalemia. With β blockers, hyperglycemia with Ca+ Channel Blockers, rapid progression to shock.

There is no evidence to support antidotes during cardiac arrest. Cardiovascular Toxicity (collapse) pre or post cardiac arrest could include:

- O_2, ECG, monitor BP, establish vascular access
- Volume for hypotension
- Check blood glucose
- Activated charcoal within 1 hour of ingestion with mild hemodynamic effects
- A mix of high dose Insulin 1u/kg + 0.5g/kg dextrose may improve hemodynamic ability by improving myocardial energy utilization

For Calcium Channel Blocker overdose, to treat myocardial dysfunction ~ (not cardiac arrest):

1. NS boluses 500 - 1000mL
2. Epinephrine infusion 2 - 100 mcg/min
3. Calcium chloride 0.2mL/kg if shock refractory to fluids and Epinephrine
4. May use calcium gluconate 10% (0.3mEq/kg)
5. Pacing for bradycardia

For β blocker overdose, to treat myocardial dysfunction (not cardiac arrest):

- NS boluses
- Epinephrine infusion 2-100 mcg/min
- Calcium chloride 0.2 mL/kg
    - May use calcium gluconate 10% (0.3mEq/kg)
- Glucagon 3 - 10mg IV

Narcotics or Benzodiazepines - Generally cause CNS and respiratory depression.

Narcotic (Opioid) Overdose:

- With pulse-(resp depression) support ABC's and *give* Naloxone
- With pulse-(still breathing) *consider* Naloxone to prevent deterioration
- No pulse- CPR/ACLS protocol, *consider* Naloxone

Naloxone may be administered IV, IM or nasally for the most rapid response (1-2 min) in emergency situations. Warning—patient may be combative upon rapid opioid reversal.

Benzodiazepines:

- **No** indication to treat during cardiac arrest
- May treat respiratory depression secondary to overdose only in known nonhabitual users (i.e.: overdoes given during a procedure)
- Flumazenil 0.2mg increments up to 1mg

Cyanide Poisoning

- Found in industry and jewelry cleaners
- Very common in smoke inhalation from fires
- Causes CNS depression, metabolic acidosis, and cardiovascular collapse
- Along with standard BLS and ACLS resuscitation regimes:
  Administer Cyanide poison kit-
  - IV Sodium Nitrate, IV Sodium Thiosulfate (for cyanide not from toxic smoke)
  - Cyano kit-Hydroxocobalamin IV- for any cyanide including toxic smoke. (most common/popular kit)

Local Anesthetic Toxicity

- Accidental IV administration of anesthetics such as Lidocaine and Mepivacaine may cause toxicity, seizures and cardiovascular collapse
- A rapid IV of 20% long chain fatty acid emulsion (LipidRescue™) may redistribute the toxin or stabilize the myocardial cells
- Studies document 1.5 mL/kg repeated Q5 may be more effective than epinephrine in these cases

Glossary
(Guide to ACLS abbreviations and terms)

ACLS - Advanced Cardiac Life Support

ACS (Acute coronary syndrome) - A range of cardiac conditions involving decreased oxygen delivery to myocardial tissue. Includes; myocardial ischemia, angina, unstable angina, and acute myocardial infarction.

Bolus - IV push, or administration of moderate or high volume of fluid over a relatively short period of time.

Cardiac output - The amount of blood ejected from the left ventricle in 1 minute. Expressed by the equation: Cardiac output = Heart rate x stroke volume.

Chronotropic effect - Pharmacologic effect causing increase in heart rate.

Code - A semi slang term denoting cardiac arrest or the management of cardiac arrest. (i.e., The patient "coded" or we're "coding" the patient)

Combitube or King Airway - Two Peri-laryngeal type airway devices used as an alternative to intubation. These require less time and skill than placing an ET tube.

Ejection fraction - The percentage of blood in the ventricle that is ejected each time the ventricle contracts.

Hypothermia - Low body temperature. For ACLS, defined as core body temperature <94° F.

Inotropic effect - Pharmacologic effect causing increase in force of contraction of the ventricle.

Infarction - Death of tissue,in the case of myocardial infarction; due to lack of oxygen, most often occlusion of coronary artery.

IO (Intraosseous) - an alternative route for administration of medications and fluids when intravenous access is not available. Utilizes a marrow aspirating type needle placed in the marrow cavity of the lower leg, upper arm or sternum.

Ischemia - A state of low oxygenation in myocardial cells.

LMA (Laryngeal mask airway) - a noninvasive airway, used as a BLS airway device, when intubation is delayed or not possible. Occludes the supraglottic area and facilitates oxygen flow to the trachea.

PCI (Percutaneous cardiac intervention) - Invasive cardiac procedures, such as angioplasty or stenting.

Perfusion - Delivery of oxygenated blood to tissues.

Perfusing - A state where oxygenated blood is delivered to tissues. (i.e., a patient with a pulse)

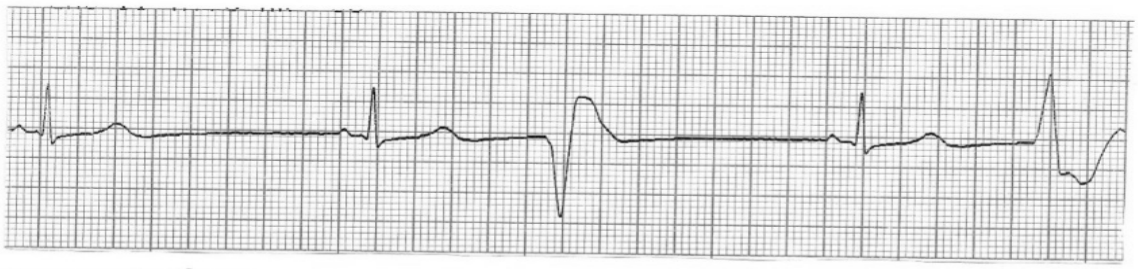
Stroke volume - The amount of blood ejected from the ventricle in 1 contraction.

Tidal volume - The amount of air taken into the lungs in one breath or ventilation.

Vasopressor- Medication which causes vascular constriction.

EKG Practice Exam

1.



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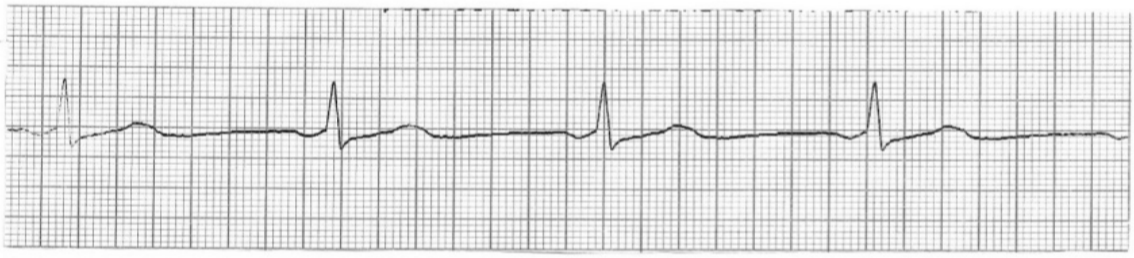

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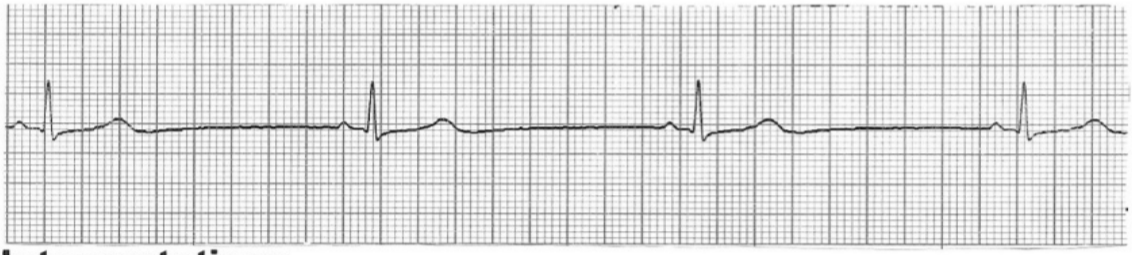

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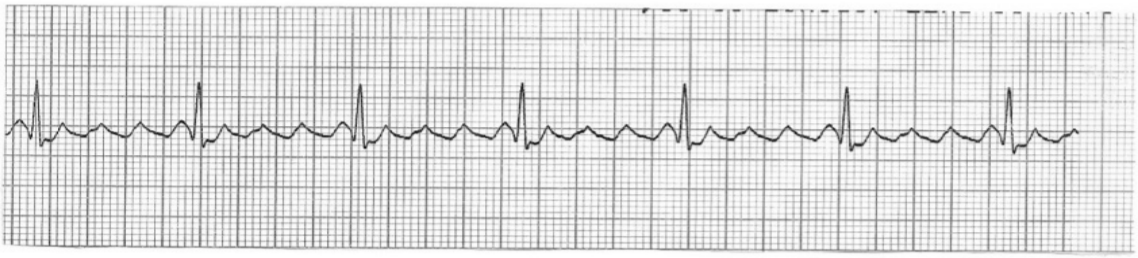

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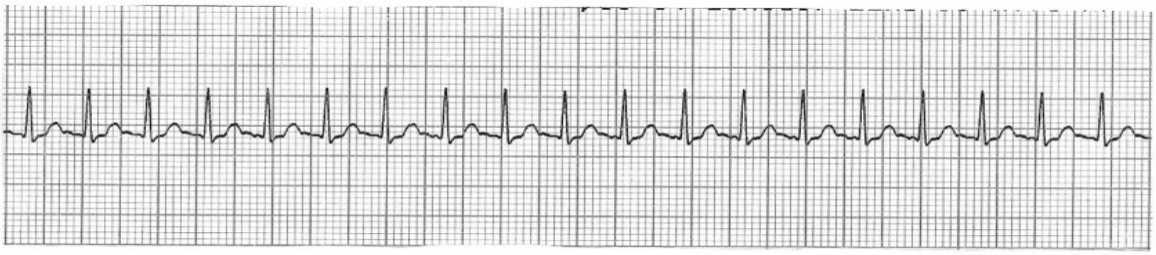

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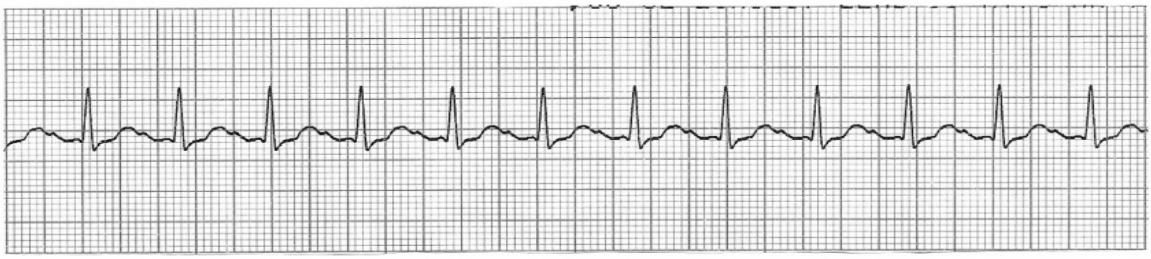

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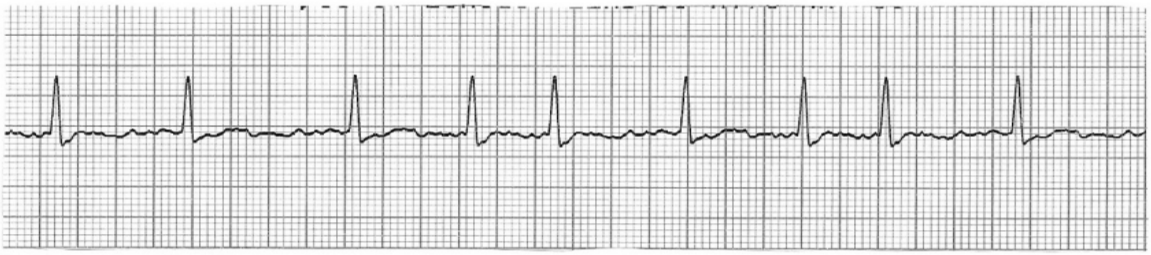

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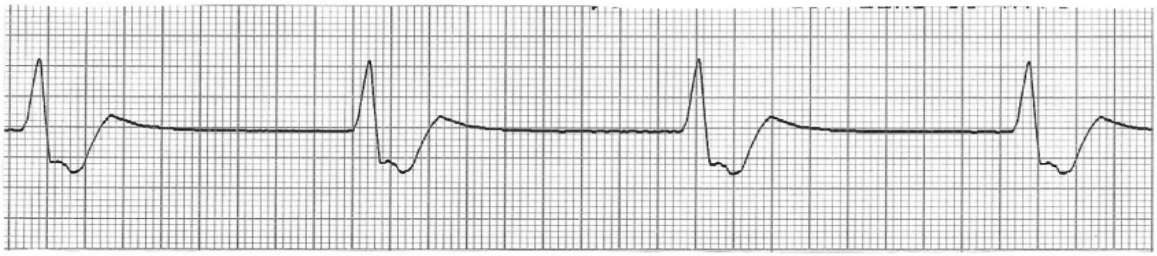

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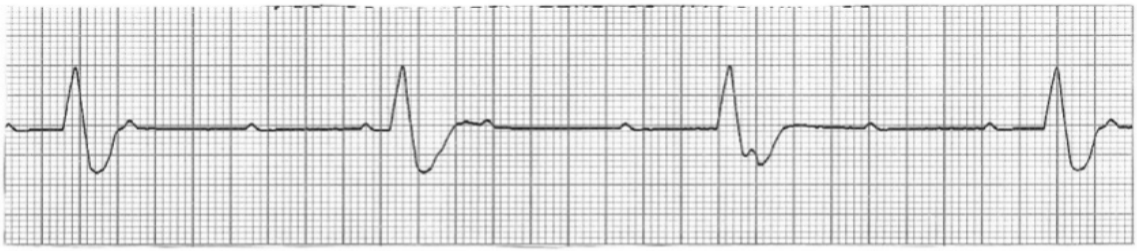

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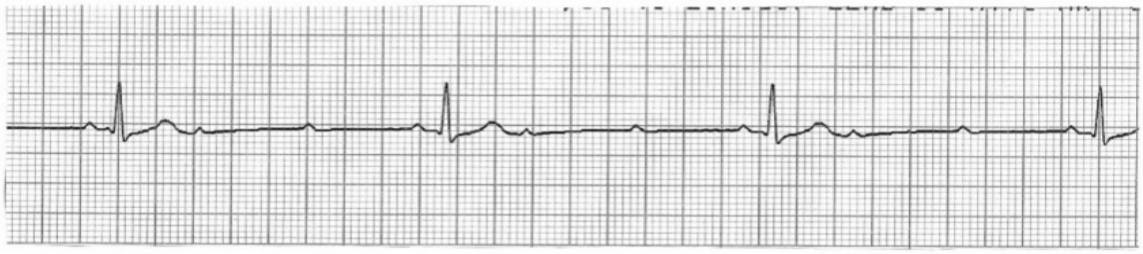

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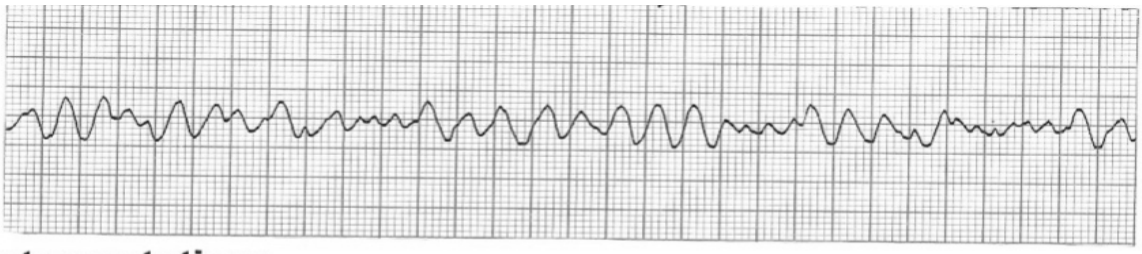

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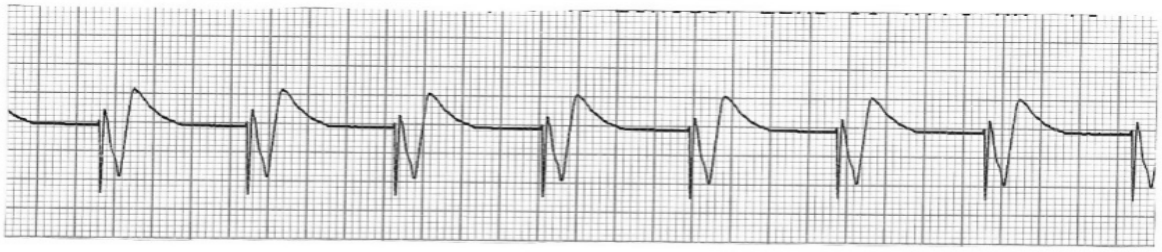

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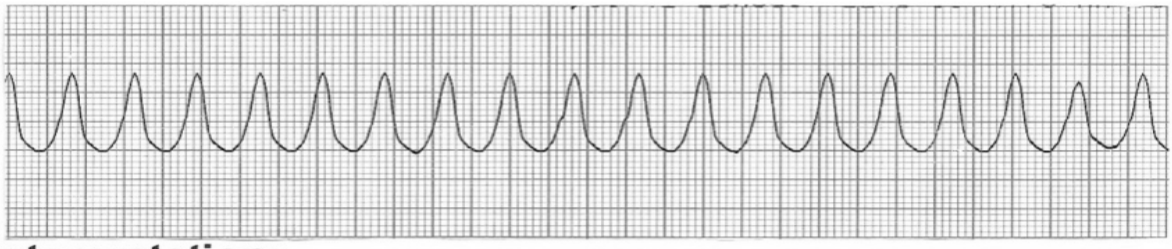

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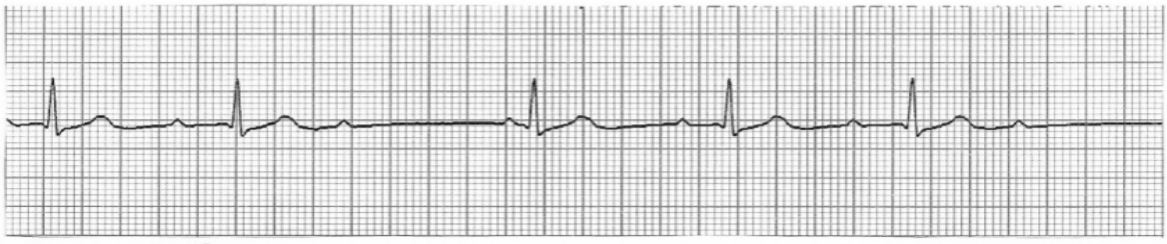

Interpretation: _____

EKG Practice Exam - Key

1. Sinus Bradycardia with Multifocal PVC's

2. Junctional Rhythm

3. Sinus Bradycardia

4. Atrial Flutter

5. Supraventricular Tachycardia, A-Tach

6. Sinus Tachycardia

7. Atrial Fibrillation

8. Idioventricular Rhythm

9. Complete Heart Block, 3rd Degree AVB

10. Mobitz II, 2nd Degree AVB type II

11. Ventricular Fibrillation

12. Normal Sinus Rhythm

13. Ventricular Pacer, 100% capture

14. Ventricular Tachycardia (monomorphic)

15. Mobitz 1, 2nd degree AVB type 1, Wenkebach

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The following pages contain a Pretest for anyone choosing to complete the BLS course after ACLS.

This information in this packet comes from the current BLS textbook; Please use the book to review.

You must score a 84% (-5)
In order to take this program

Completing these test questions prior to the course is mandatory if you plan on attending the CPR section after the ACLS program.

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Skills Review for Healthcare Providers
The CAB's of CPR

Simultaneously Determine unresponsiveness and check for effective breathing
If unresponsive: call a "code" or 911

C = Circulation- Check for a pulse Max - 10 seconds. If pulse is not definite, begin compressions.
A = Airway- Open airway (head tilt/chin lift)
B = Breaths- Give 2 breaths then back to compressions
D = Defibrillator- Attach a manual defibrillator or AED

CPR Reference

	Adults (> puberty)	Children (1 - puberty)	Infants (< 1yr)
Rescue breathing, Victim definitely has a pulse	10 breaths/min recheck pulse every 2 minutes	20-30 breaths/min recheck pulse every 2 minutes	20-30 breaths/min recheck pulse every 2 minutes
Compression landmark **No pulse** (or pulse <60 in infant or child with poor perfusion)	Middle of the chest, between the nipples	Middle of the chest, between the nipples	1 finger below nipple line
Compressions are performed with	Heel of 2 hands	Heel of 1 or 2 hands	2 fingers OR 2 thumbs when using encircling hands technique
Rate of compressions per minute	100-120/min	100-120/min	100-120/min
Compression depth	At lease 2 inches ↑ 2 inches	At least 1/3 depth of chest 2 inches	At least 1/3 depth of chest 1 ½ inches
Ratio of compressions to breaths **Once an advanced airway is placed ventilations will be 1 every 6 sec. with continual compressions.*	30:2 Change compressors and reevaluate every 2 min	30:2 15:2 if 2 rescuer Change compressors and reevaluate every 2 min	30:2 15:2 if 2 rescuer Change compressors and reevaluate every 2 min

Foreign Body Airway Obstruction

** If not rapidly removed call Emergency Medical Service **

Conscious choking

Adult	Child	Infant
Abdominal Thrusts *(Red Cross Class – 5 Back Blows)*	Abdominal Thrusts *(Red Cross Class – 5 Back Blows)*	5 Back Blows/5 Chest Thrusts

Unconscious choking

Adult	Child	Infant
Call a "code" or call 911 Begin CAB's of CPR Before giving breaths: look in mouth for foreign body, remove object if it is seen. Repeat cycles of CPR if needed	Begin CPR If second rescuer is present, send them to call a "code" or 911, otherwise, call after 2 min of CPR Before giving breaths: look in mouth for foreign body, remove object if it is seen. Repeat cycles of CPR if needed	Begin CPR If second rescuer is present, send them to call a "code" or 911, otherwise, call after 2 min of CPR Before giving breaths: look in mouth for foreign body, remove object if it is seen. Repeat cycles of CPR if needed

INFORMATION TO KEEP IN MIND:

1. Know the maximum time that should be spent checking for the presence of a pulse.

2. Know the preferred techniques/devices for providing ventilations if you are a single rescuer versus having multiple resources in the professional setting.

3. Know the concept of scene safety/awareness before providing care.

4. Know which patients require ventilations and which require ventilations plus compressions.

5. Know the best way to open the airway for an Adult, Child, Infant or spinally injured patient.

6. Know the location, depth and rate of compressions for an Adult, Child and Infant.

7. Know when to start compressions for an Adult, Child and Infant, be able to explain chest recoil (release) and high quality CPR.

8. Know the compression to ventilation ratio for both 1 and 2-rescuer for Adult, Child and Infant.

9. Know how to reduce the incidence of air being introduced into the patient's stomach versus their lungs.

10. Understand how an AED affects the heart (shock to organize the rhythm), and know the steps for using an AED on an Adult, Child or Infant; pediatric use and placement.

11. Know how to incorporate CPR before, during and after AED use.

12. Know the changes in CPR, which are incorporated once a victim has an advanced airway "tube" placed by a medical professional.

13. Know the sequence, procedures and roles for 1 rescuer versus 2-rescuer CPR.

14. Know the procedures for conscious and unconscious choking for Adult, Child and Infant.

15. Know how to determine effectiveness of ventilations and compressions being provided during CPR

16. Know the elements of effective team dynamics and communicating during an emergency.

17. Know that in Opioid OD's CPR is still most important for no breathing or pulse, but Naloxone can be administered along with CPR.

18. Know that in late pregnancy, during CPR the fetus should be shifted to the left if possible.

BLS Pre-Course Exam

1. An elderly woman collapses to the floor in a bingo hall. Your first action should be:

A. Open the airway and give 2 breaths. (mouth to mouth rapid is best)
B. Go grab the defibrillator off the wall in the hallway.
C. Yell out/ call for help while simultaneously assessing for pulse and respirations. (carotid or femoral is best)
D. Check for a carotid or radial pulse.

2. You are performing 1 rescuer CPR on a 75-year-old female with a history of chest pain and diabetes. An AED has just been made available to you. What is the first action that you should take at this time?

A. Finish the 5 cycles of chest compressions that you have started.
B. Place the AED pads on the chest.
C. Secure an electrical outlet to plug the AED into.
D. Turn the AED on.

3. You are attending a birthday party when an infant suddenly starts choking on a hotdog. What should you do if he is not breathing and cannot breathe?

A. Administer 2 rescue breaths using a barrier device.
B. Perform a blind sweep of the victim's mouth using a soft cloth to keep him from biting.
C. Deliver 2 back-slaps followed by looking into the mouth.
D. Perform back slaps and chest thrusts.

4. Opioids are medications that are used to treat pain but have a high potential for abuse. Addiction rate to the medications is a growing problem and they can cause respiratory and or cardiac arrests. While the first and most important step is to perform CPR, what is the name of the medication that is utilized to reverse the effects of respiratory depression?

A. Naloxone.
B. Ativan.
C. Lasix.
D. Magnesium Sulfate.

5. Your middle age neighbor is mowing his grass when he clutches his chest and drops to the ground. He has no pulse or respirations. Your son calls 911 while you initiate chest CPR. How fast should the compression rate be?

A. 100 compressions per minute.
B. 100-120 compressions per minute.
C. 80-100 compressions per minute
D. 120-150 compressions per minute.

6. Bystanders have pulled a young woman with a pulse but no respirations out of a lake. One of them is administering rescue breaths at a rate of one every 5-6 seconds while waiting for EMS to arrive. Which of the following is true about rescue breaths?

A. Each breath should result in visible chest rise.
B. Give each breath over 1 second.
C. The pulse should be checked every 2 minutes.
D. All of the above.

7. Which of the following situations will slightly delay AED usage while the situation is made safe for AED application?

A. A person found lying on a metal floor inside a meat cooler.
B. A person found submerged in a bathtub.
C. A person who collapsed in snow.
D. A person who has a transdermal nitro patch on their arm.
E. The patient being in late stage pregnancy.

8. When utilizing a bag valve mask device it is important to remember:

A. That this device requires training and is best suited for a 2-rescuer situation.
B. The E-C clamp technique should be used while lifting the jaw to provide a good seal.
C. To squeeze the bag for 1 second while watching the chest rise.
D. All of the above.

9. What is the correct ratio for compressions to ventilations in infant CPR with 2 rescuers present?

A. 20 compressions to 4 breaths.
B. 15 compressions to 2 breaths.
C. The rate remains 30 compressions to 2 breaths.
D. 15 compressions to 1 breath.

10. The maximum amount of time that should be taken to check for a pulse or perform any procedure on an adult, infant or child in cardiac arrest is?

A. 15 seconds
B. 10 seconds
C. 30 seconds
D. 5 seconds

11. You are watching a resuscitation attempt at a medical facility. You observe the hand placement of the person who is providing compressions to be incorrect. Your next step as a team member should be?

A. Wait 10 seconds to see if the team leader notices.
B. Tell the person doing compressions that you will take over.
C. Alert the team leader for him/her to address.
D. Tell another team member to take over.

12. While providing CPR to a child or adult, an AED becomes available and a shock is indicated and administered. (Since it is OK to shock children with adult AED pads if necessary), what should you do next?

A. Administer 2 more shocks; to total 3.
B. Immediately restart CPR, starting with compressions.
C. Give 2 breaths first then resume CPR.
D. Check the carotid pulse for no longer than 10 seconds.

13. What is the purpose of defibrillation?

A. To stop a chaotic rhythm and restore the heart's normal rhythm.
B. To increase the rate of complete heart block.
C. To provide a blood pressure.
D. To treat cardiac standstill.

14. Current guidelines suggest that adult compressions should be administered at a depth of at least 2 inches. Which of the following is not true regarding chest compression depth?

A. Compressions are often delivered too hard rather than too shallow.
B. It may be difficult to accurately judge compression depth without the use of a feedback device.
C. Consistent compression depth of at least 2 inches is associated with better outcomes.
D. Potential complications can occur at depths of greater than 2.4 inches.

15. When 2 or more personnel are available during a resuscitation, the team should

A. Have the strongest person continue compressions.
B. Ventilate slightly faster.
C. Perform 1 minute of rapid compressions, then slightly slower.
D. Change compressions every 2 minutes.

16. You begin your shift on the med/surg floor. You begin your rounds and when you walk into a patient's room, you notice the patient has agonal respirations. What should you do if following the concepts of resuscitation?

A. Give the patient oxygen. (Airway, Revive, Care)
B. Check a pulse, and begin compressions if indicated. (Assess, Recognize, Care)
C. Do nothing, the patient is asleep. (Accept, Care, Revive)
D. Begin the Heimlich maneuver. (Assess, Airway, Complete)

17. When is the two thumb encircling technique is used?

A. During infant CPR (if your hands are big enough).
B. When the infant is choking.
C. When performing CPR on a pediatric victim.
D. When performing one rescuer CPR on an infant and you become tired.

18. At the beginning of your work shift, your team leader assigns you the role of compressor during a cardiac arrest. This is known as:

A. Mutual respect.
B. Closed loop communications.
C. Clear roles and responsibilities.
D. Constructive intervention.

19. While assisting with a cardiac arrest, you are instructed to take over bag valve mask ventilations. You repeat back " you would like for me to take over bag valve mask ventilations." In team dynamics, what is this called?

A. Closed loop communications
B. Knowing your limitations
C. Knowledge sharing
D. Mutual respect

20. A person is found lying next to an electrical line, unresponsive. You assure that the power is disconnected before you attempt resuscitation. In this case, you identified the information you saw, and took appropriate action. This concept of taking action based on information gathered is called?

A. Critical thinking.
B. Unified team approach.
C. Problem identification.
D. Solving issues.

21. You arrive to find a hospital maintenance worker lying on the ground, next to a ladder. He appears unconscious, your first action should be?

A. Check for breathing and a pulse
B. Shake and shout, check unresponsiveness
C. Begin compressions at 30:2
D. Assure the area is safe for you to be in

22. After performing the choking procedure for a conscious victim who becomes unconscious, the next procedure is to?

A. Perform a finger sweep
B. Attempt ventilations
C. Straddle the victim
D. Begin CPR compressions

23. High quality CPR is the critical component to resuscitation, especially compressions; which concept is correct?

A. Compression depth has a higher priority than recoil or relaxation
B. Compression and recoil (refill) are equally important
C. Ventilation is the priority for all victims
D. 35 ventilations per minute are optimum for the best outcome

24. When performing compressions on a child for CPR or unconscious foreign body airway procedures the proper depth is?

A. ½" or ½ the depth of the chest
B. 1 ½ " to 2 1 ½ " inches
C. Varies based on age and weight
D. 2" or 1/3 the depth of the chest

25. While at a school event, a teacher chokes on gum. He runs towards the office before falling unconscious. Immediately after performing 30 compressions, the next step is?

A. Open the airway and look into the mouth before ventilating
B. Perform a finger sweep and attempt breaths
C. Readjust the airway with a jaw thrust maneuver
D. Check pulse for no more than 10 seconds

26. The resuscitation team is made up of various professionals with different levels of license and skill sets. In order to function efficiently the team members must?

A. Wait for a physician to order CPR and defibrillation
B. Always be prepared to perform any skills, even if not licensed to
C. Realize their strengths, abilities and limitations
D. Decide if they feel CPR is worth the physical effort

27. A victim begins to choke, and you find them grabbing their throat and coughing uncontrollably, you should?

A. Perform the Heimlich maneuver
B. Perform the modified Heimlich maneuver
C. Perform chest thrust if they are pregnant or obese
D. Allow them to continue coughing

28. You are assisting with a cardiac arrest at a surgi- center. Someone brings in an AED that you are not familiar with, in relation to utilizing this:

A. Have an overhead page put out for someone familiar with the unit
B. Perform 2 minutes of CPR, then apply the pads
C. Wait for EMS or someone familiar with the AED before using
D. Turn on the unit and follow the directions

29. The accepted ratio of compressions to ventilations for a 6 year old drowning victim when only 1 rescuer is available is?

A. 15:1
B. 30:1
C. 30:2
D. 15:2

30. AED Pads require firm contact to the skin to be most effective, which of the following will negatively effect that contact?

A. Water on the patients chest
B. Suntan oil on the skin
C. Hair on the chest
D. All of the above

NAME: _____

COURSE: **Mandatory** Pre-Test Questions for those completing BLS After ACLS or PALS

MISSED: _____ GRADE: _____

1. A B C D E
2. A B C D E
3. A B C D E
4. A B C D E
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24. A B C D E
25. A B C D E
26. A B C D E
27. A B C D E
28. A B C D E
29. A B C D E
30. A B C D E

REMINDER:

You must score a 84% to be eligible for the BLS Completion section after ACLS or PALS
You can miss no more than 5

# Missed	
-1 = 98 -2 = 96 -3 = 94 -4 = 92 -5 = 90 -6 = 88 -7 = 86 -8 = 84	**PASSING**
-9 = 82 -10 = 80 -11 = 78	**FAIL-** Self Review: Take only those missed on new answer sheet. If below 84 review then take next version of exam 1 time.
-12 = 76 -13 = 74 -14 = 72 -15 = 70 -16 = 68 -17 = 66	**FAIL-** Instructor Review: Can look up correct answer in their text. Then take another exam 1 time. If still below 84 – cannot pass today
-18 = 64 -19 = 62 -20 = 60 -21 = 58 -22 = 56	

American Heart Association ACLS Program

NON mandatory (just for fun) Practice Exam

This Exam is merely a good practice test for those taking ACLS.

It does not take the place of the mandatory on line Self Assessment.

Answer sheet and key are attached, you do not have to turn this in.

Name: _____ Date: _____ Location: _____

Practice test- NOT MANDATORY- You do not have to turn this in.

1. An individual is intubated and CPR is in progress. What is a good indicator that proper CPR is being performed?

   A. $PETCO_2$ reading of 8-10mmHg

   B. $PETCO_2$ reading of 0-5mmHg

   C. $PETCO_2$ reading of 15-18mmHg

   D. There is no value of monitoring $PETCO_2$ during cardiac arrest

2. CPR is in progress and the team leader requests that Epi 1 mg be administered to a patient who is in PEA. The individual who is accessing the medication states: "I am going to administer 1mg of Epinephrine IVP now." This is an example of:

   A. Knowing your limitations

   B. Closed loop communication

   C. Summarizing and reevaluating

   D. Constructive intervention

3. A 49 year old male calls 911 for substernal chest pain that radiates to this left jaw and arm. Which of the following drug & dosage combinations might you expect to see administered in this patient?

   A. Oral aspirin 500 mg & Plavix

   B. Oral aspirin 160-325 mg & Nitroglycerine

   C. Atropine 0.5 mg IV & Dopamine 2-10mg/kg

   D. Morphine 10mg IV & fentanyl 50 mcg

4. An elderly woman collapses in church. The paramedics arrive to discover fine VF on the monitor. What is the next course of action?

   A. Deliver 2 precordial thumps to the chest

   B. Ask the bystanders if she was choking prior to collapsing

   C. Start chest compressions at a rate of 15:2

   D. Initiate CPR while setting up the defibrillator

5. Following an electrocution, the Pt. is in V-Fib. Which antidysrhythmics may be considered?

   A. Vasopressin or Epinephrine
   B. Epinephrine or Plavix
   C. Lidocaine or Amiodarone
   D. Procainamide or Atropine

6. When performing CPR, interruptions to compressions (intubation, defibrillation, rhythm analysis) should not take longer than:

   A. 10 seconds
   B. 20 seconds
   C. 30 seconds
   D. You cannot interrupt CPR once it has been started

7. What is the correct formula for targeted temperature management (TTM) for those individuals who meet the criteria following ROSC in cardiac arrest?

   A. 32-36'C for 12-20 hours
   B. 30-34'C for 24-48 hours
   C. 32-36'C for at least 24 hours
   D. 34-38'C for at least 24 hours

8. EMS responds to a known hypertensive patient having slurred speech, facial droop and difficulty raising up her left arm. Which of the following actions is advised?

   A. Advise the hospital that you will be transporting a suspected stroke patient
   B. Administer extra strength aspirin 500 mg
   C. Review the patient's hypertensive medications
   D. Prepare the patient for a contrast brain CT upon arrival to the facility

9. The correct way to estimate sizing for an Oral Pharyngeal Airway (OPA) is:

   A. Weight based
   B. Measure device from the angle of the mandible to the corner of the mouth
   C. Measure the distance between the lip and the adam's apple
   D. Open the mouth and estimate the tongue size

10. An individual in stable SVT fails to respond to one dose of Adenosine. What should the next step be assuming the patient is still stable?

    A. Cardioversion

    B. Adenosine 12mg IV

    C. Sotalol 300 mg IV

    D. Repeat Adenosine 6 mg IV

11. If a patient with a heart rate of 195's blood pressure suddenly drops to 70 palpable and they become diaphoretic and confused, what action should be taken?

    A. Defibrillation

    B. Vagal maneuvers

    C. Adenosine 12 mg rapid IVP

    D. Synchronized cardioversion

12. A coworker is not holding the bag valve mask device correctly and is therefore not getting a good seal around the mouth area during CPR. The latest guidelines call for having a person specifically assigned to watch for issues such as this…the title of this position is?

    A. Grand resuscitator

    B. Sargent at arms

    C. CPR coach

    D. Resuscitation coordinator

13. A 67 year old woman presents to the emergency room with chest pressure, diaphoresis and nausea. A 12 lead EKG shows evidence of an acute inferior wall MI. Which of the following is the suggested maximum time frame for percutaneous coronary intervention (PCI) following first medical contact?

    A. 12 hours

    B. 90 minutes

    C. 30 minutes

    D. 2 hours

14. In order to ensure optimal CPR is being performed, which of the following statements is false?

A. Rotate compressors every 2 minutes

B. Compress at a rate of 100-120/min

C. Check for a pulse after each defibrillation

D. Depth of compression should be at least 2 inches

15. A patient complaining of dizziness has a heart rate of 44 and a blood pressure of 84/50. The monitor shows a 2nd degree type 2 heart block. Atropine was attempted and was unsuccessful. What is your next action?

A. Apply a transcutaneous pacemaker

B. Administer IV Dopamine at 20-30mcg/kg/min

C. Administer an Epinephrine infusion at 1mg/min

D. Prepare the patient for a transvenous pacemaker

16. You respond to an elderly man who collapsed in a bank lobby. He is unresponsive with agonal gasps noted. Which of the following actions takes priority at this time?

A. Check for a pulse and, if absent, start CPR

B. Give 2 rescue breaths

C. Apply the defibrillator to see if a shock is indicated

D. Look for an allergy bracelet in case the man is in anaphylaxis

17. During a code the team leader assigns various roles (medication administration, airway, recorder) to the healthcare professionals who are participating in the event. This is known as:

A. Closed loop communication

B. Systematic evaluation

C. Knowledge sharing

D. Clear delegation of roles and responsibilities

18. You enter the room of a patient who was admitted in the morning with pneumonia. He is cool to the touch, responds to noxious stimuli, has a respiratory rate of 32. His blood pressure is 84/62. What should you do before further deterioration occurs?

A. Place a stat call to the patient's physician

B. Call for the rapid response or medical emergency team

C. Obtain a 12 lead EKG

D. Request ABG's for analysis

19. An elderly trauma patient is receiving CPR. Defibrillation is indicated for his pulseless V-tach. What action should be taken immediately following each defibrillation?

A. Check for a pulse for 5-10 seconds

B. Perform a quick rhythm analysis

C. Resume chest compressions

D. Administer 2 breaths with a bag valve device

20. Unless otherwise indicated, the current recommended emergent treatment of a suspected stroke patient with a 2 hour window of symptoms is: (CT scan is negative for hemorrhage)

A. Low dose heparin infusion

B. Fibrinolytic or endovascular therapy

C. IV mannitol and mild hyperventilation

D. Lumbar puncture to assess for bleeding

21. Fire Rescue delivers a suspected stroke patient to the ED. The hospital's goal should be to have a CT scan completed within?

A. 3 hours from symptom onset

B. 20 minutes

C. 90 minutes

D. As soon as the scanner is freed up

22. EMS responds to a call where a manager at a fast food restaurant was seizing in the break room from a suspected drug overdose. Now, the patient has a pulse of 128 but is not breathing. What is the initial correct course of action?

A. Provide oxygen and rescue breathing at 20 breaths per minute

B. Intubate, assure correct placement and place on 100% oxygen

C. Provide oxygen and rescue breaths every 6 seconds

D. Administer Naxolone and oxygen by non-rebreather mask

23. The ability to communicate clearly in an emergency situation is very important. What should you do if you are assigned a role that you are not skilled in or have not had the proper training to do?

A. Try to do the task to the best of your ability

B. Ask the person next to you if they will instruct you on the assigned task

C. Review your protocols

D. Ask the team leader for a different role

24. A 69 year old male has presented with chest pain that started 45 minutes ago. His heart rate is 90, BP 170/94, Resp 16 with an oxygen sat of 95%. He rates the pain as a 7, on a 1-10 scale. What should this patient receive next?

A. 12 lead EKG

B. Morphine

C. Oxygen

D. Chest X ray

25. You observe the individual next to you in a post-code setting who is ventilating the intubated patient too fast at 22 breaths per minute. You respectfully remind them to slow the ventilation rate down to one breath every 6 seconds because you know that excessive ventilation can cause:

A. Blindness

B. Decreased intra-thoracic pressure

C. Oxygen toxicity

D. Decreased cerebral blood flow and cardiac output

26. Post cardiac arrest, a patient has a blood pressure of 62 palpable, HR of 170 and clear respirations at 10/min. How should this initial hypotension be managed?

A. Dopamine at 5mcg/kg/min

B. NS or LR bolus of 1-2 L

C. Epinephrine infusion of 1mg/min

D. NS or LR bolus of 500mL

27. What would you expect a normal PETCO2 reading to be in a perfusing patient?

A. 35-40 mmHg

B. 40-45 mmHg

C. 10-20 mmHg

D. 8-10 mmHg

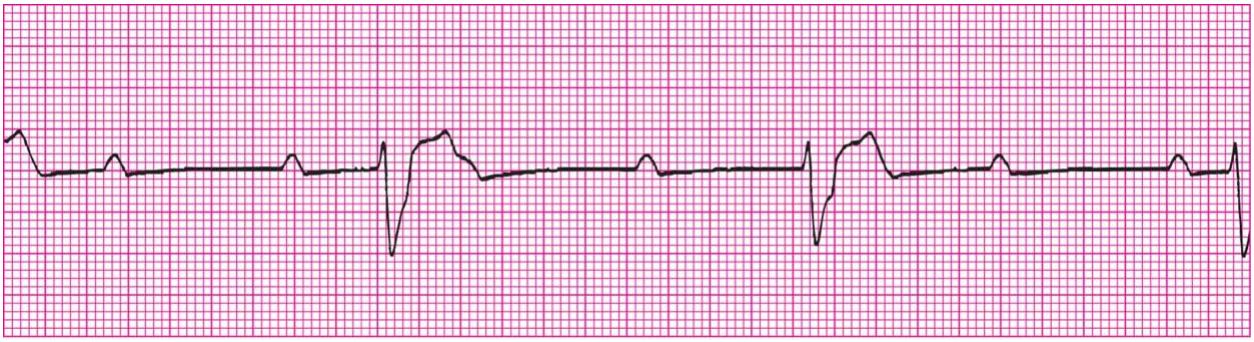
28. A 37 year old woman is experiencing SVT with a rate of 190. She is complaining of dizziness and shortness of breath. Her blood pressure is 80/48. The appropriate management is?

A. Administer Adenosine 3mg IV

B. Synchronized cardioversion

C. Administer Amiodarone 150mg

D. Request a 12 lead EKG



29. A confused, dizzy, diaphoretic 66 year old female complains of “not feeling right” for the past 2 hours. Part of your assessment reveals the EKG above. You diagnose the patient’s condition as:

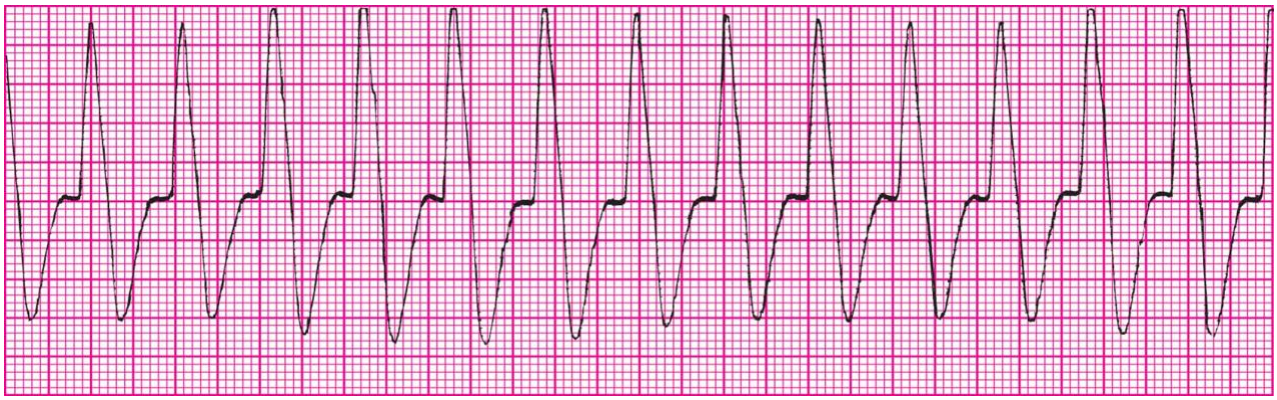
    A. Stable Bradycardia
    B. Symptomatic Complete Heart Block
    C. Mobitz II with acute symptoms
    D. Pulseless Electrical Activity

30. In a patient with complete heart block, which of the following would be inappropriate?

    A. Atropine IV push
    B. Transcutaneous pacemaker
    C. Epinephrine IV bolus 1.0mg
    D. Transvenous pacemaker

31. If a patient suddenly becomes unconsciousness, the next action is:

    A. Defibrillate
    B. Apply the pacemaker
    C. Check breathing and pulse
    D. Begin CPR until the pacemaker arrives



32. A 39 year old presented in asystole. Following 2 minutes of CPR, you note the rhythm above on the monitor. A pulse check reveals “no pulse”, the most appropriate action is:

    A. Defibrillate at 120-360 joules (depending on your machine)
    B. Synchronized cardiovert 50-100 joules
    C. Administer 300mg Amiodarone IV push
    D. Administer Epinephrine 1.0mg IV push

33. In Pulseless VT, the team leader calls for an antidysrhythmic, which is appropriate med and dose?

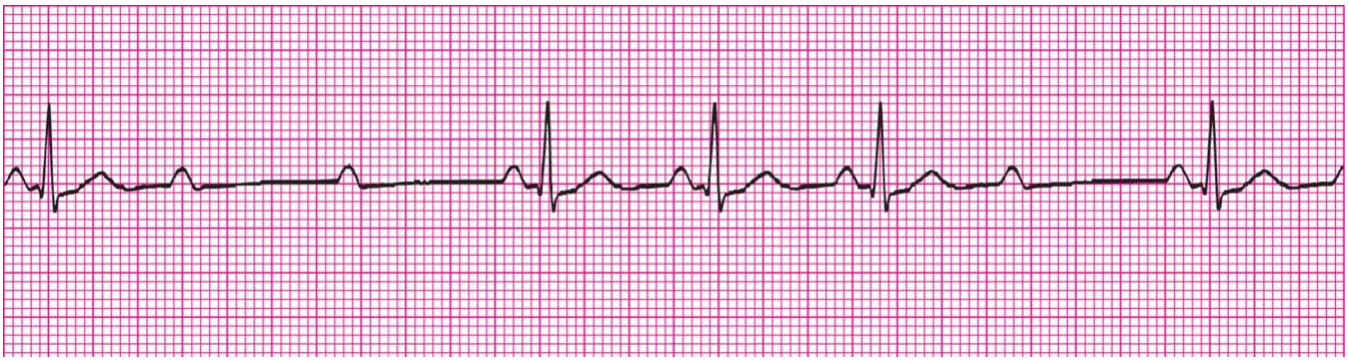
    A. Amiodarone 150mg IV push
    B. Atropine 1.0mg IV push
    C. Lidocaine 1 - 1.5mg/Kg iV push
    D. Procainamide 100mg IV push

34. Following 10 minutes of resuscitation, the patient regains a normal EKG and palpable pulse. Along with ensuring adequate ventilations, one of the goals is to maintain an adequate blood pressure, which is considered?

    A. 120/80
    B. Systolic of at least 90mmHg
    C. Diastolic equal to 100 minus the MAP
    D. Systolic of 100 plus the patient’s age

35. The treatment for any supra- (narrow) or ventricular (wide) tachycardia with a heart rate over 150, who is unstable (serious Chest Pain, Altered consciousness, Shortness of breath with pulmonary edema, or Hypotension) is:

    A. Expert consult (Cardiology)
    B. Rapidly choose the IV antidote (medicate)
    C. Non-synchronized counter-shock
    D. Synchronized cardioversion

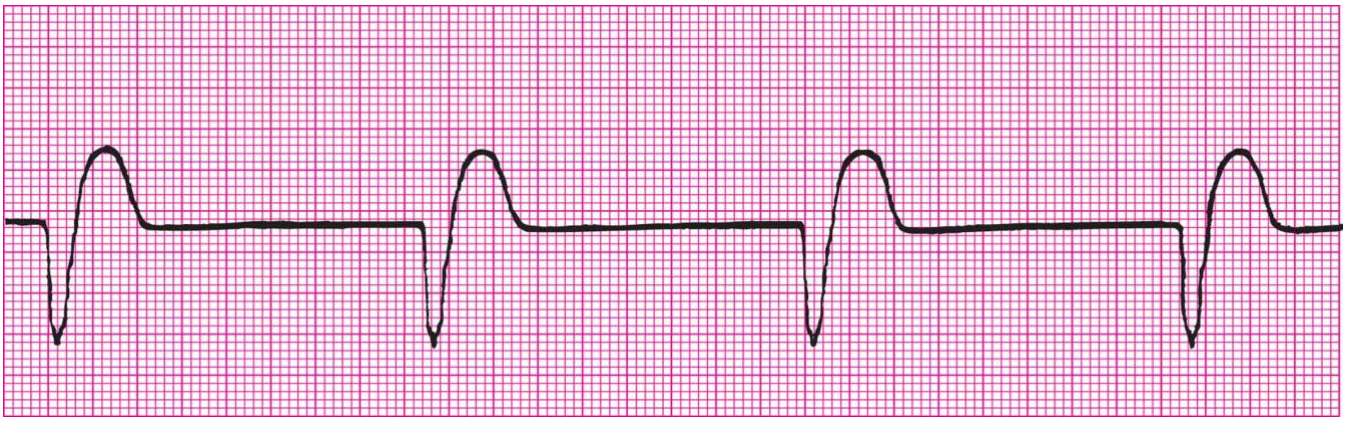


36. A patient complains of several near syncopal episodes. All of his vital signs are within normal limits and tests normal. He suddenly becomes pale and dizzy. You note his EKG has changed to the strip above, which you diagnose as?

    A. Second Degree Heart Block, Mobitz II
    B. Sinus Bradycardia
    C. Third Degree Heart Block
    D. Decompensated junctional rhythm

37. According to the latest guidelines, patients with Acute Coronary Syndromes should be given oxygen?

    A. When they have chest pain
    B. When their oxygen saturation falls below 90%
    C. When the End Tidal CO_2 falls outside of 35-45 mmHg
    D. When their pulse oximetry falls below 96%



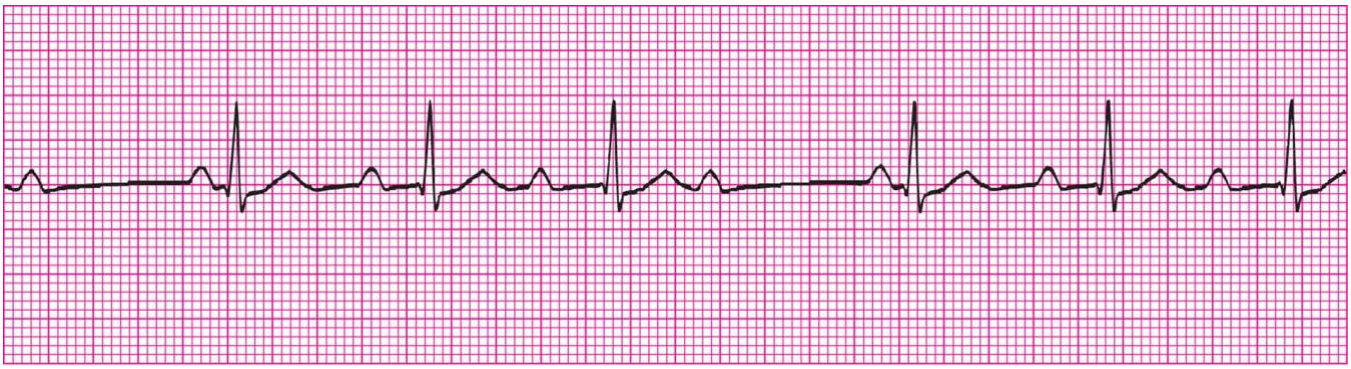
38. Following CPR and several defibrillations, the rhythm above appears on the monitor; there is no palpable pulse. The most appropriate medication to administer is?

    A. Atropine 1mg IV

    B. Lidocaine 1-1.5mg/kg IV (50-100mg)

    C. Epinephrine 1mg IV

    D. Amiodarone 150mg slow IV



39. A stable patient had chest pain 30 minutes ago which was relieved with SL nitroglycerine x 1. He is currently asymptomatic, you note the above EKG, which you diagnose as:

    A. Second Degree Heart Block, Mobitz II

    B. Sinus Rhythm with a status pause

    C. Second Degree Heart Block, Mobitz I, (Wencheback)

    D. Third Degree or Complete Heart Block

40. A patient has been resuscitated from cardiac arrest. Currently he is breathing on his own with a saturation of 95% CO_2, 38 mmHg B/P 105/70 EKG is sinus at 60/min. Which of the following is appropriate?

A. Transport to a coronary reperfusion hospital

B. Air transport to a stroke center

C. BLS transport to closest facility

D. ALS transport to a large urban or corporate hospital

Match each cardiac rhythm strip with the appropriate description.

41.

A. Third-degree (complete) atrioventricular (AV) block

B. Atrial dysfunction

C. Second-degree atrioventricular (AV) block type II (Mobitz type II block)

D. Sinus Tachycardia

42.

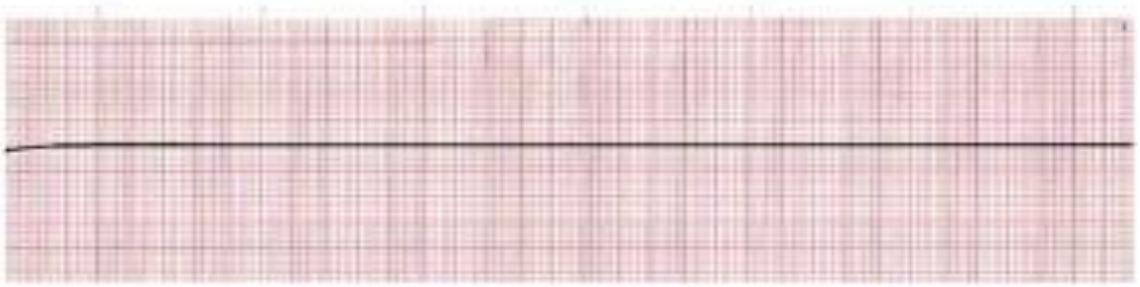
A. Asystole

B. Atrial flutter

C. First-degree atrioventricular (AV) block (Mobitz type II block)

D. Monomorphic ventricular tachycardia

43.



A. Asystole

B. Atrial flutter

C. First-degree atrioventricular (AV) block (Mobitz type II block)

D. Monomorphic ventricular tachycardia

44.

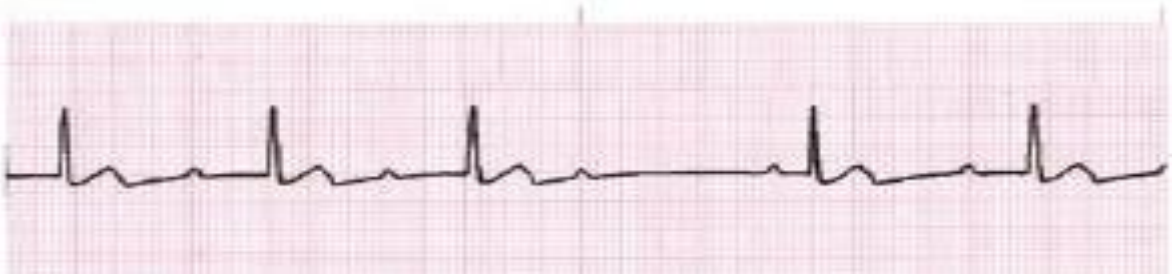
A. Asystole

B. Atrial flutter

C. First-degree atrioventricular (AV) block (Mobitz type II block)

D. Monomorphic ventricular tachycardia

45.



A. Normal sinus rhythm

B. Polymorphic ventricular tachycardia

C. Second-degree atrioventricular (AV) block type I (Mobitz type I block, Wenckebach)

D. Sinus bradycardia with second degree atrioventricular (AV) block (Type II)

46.

A. First-degree AV block

B. Third-degree (complete) atrioventricular (AV) block

C. Pulseless electrical activity (PEA)

D. Idioventricular Rhythm

47.

A. Normal sinus rhythm

B. Polymorphic ventricular tachycardia

C. Second-degree atrioventricular (AV) block type I (Mobitz type I block, Wenckebach)

D. Sinus bradycardi

48.

A. Normal sinus rhythm

B. Polymorphic ventricular tachycardia

C. Second-degree atrioventricular (AV) block type I (Mobitz type I block, Wenckebach)

D. Sinus Bradycardia

49.

A. Torsades de pointes

B. Atrial fibrillation

C. Second-degree atrioventricular (AV) block type II (Mobitz type II block)

D. Sinus Tachycardia

50.

A. Torsades de pointes

B. Atrial fibrillation

C. Second-degree atrioventricular (AV) block type II (Mobitz type II block)

D. Sinus tachycardia

NAME: _____

COURSE: AHA NON-MANDATORY PRACTICE TEST 2021

GRADE: _____

1. A B **C** D E
2. A **B** C D E
3. A **B** C D E
4. A B C **D** E
5. A B **C** D E
6. **A** B C D E
7. A B **C** D E
8. **A** B C D E
9. A **B** C D E
10. A **B** C D E
11. A B C **D** E
12. A B **C** D E
13. A **B** C D E
14. A B **C** D E
15. **A** B C D E
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31. A B **C** D E
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44. A **B** C D E
45. A B **C** D E
46. A **B** C D E
47. **A** B C D E
48. A B C **D** E
49. A **B** C D E
50. **A** B C D E

Missed
-1 = 98
-2 = 96
-3 = 94
-4 = 92
-5 = 90
-6 = 88
-7 = 86
-8 = 84
-9 = 82
-10 = 80
-11 = 78
-12 = 76
-13 = 74
-14 = 72
-15 = 70