

ACLS *Study Guide*

2010

Bulletin: New resuscitation science and American Heart Association treatment guidelines were released October 28, 2010!

The new AHA Handbook of Emergency Cardiac Care (ECC) contains these 2010 Guidelines and is required study for this course. The 2010 ACLS Provider Manual is not yet available. This study guide will provide you with additional study information.

Website: www.heart.org/ecstudent Keyword: compression (Pretest & Video updates)
www.phsinstitute.com (study info. For class for rhythm review)

What is required to successfully complete ACLS?

- ♥ Completed ACLS Pre-test is required for admission to the course.
- ♥ Score 84% on the multiple-choice post-test.
It is a timed test and you may be allowed to use your ECC Handbook.
- ♥ You must be able to demonstrate:
 - the ACLS rapid cardiopulmonary assessment
 - using an AED
 - safe defibrillation with a manual defibrillator
 - maintaining an open airway
 - confirmation of effective ventilation
 - addressing vascular access
 - stating rhythm appropriate drugs, route and dose
 - consideration of treatable causes

What happens if I do not do well in the course?

The Course Director or Instructor will first “remediate” (tutor) you and you may be allowed to continue in the course. If it is decided you need more time to study, you will be placed into the next course.

Where do I start?

- CPR/AED: You will be tested with **no coaching**. If you cannot perform these skills well without coaching, you can/may be directed to take the course at another time. Know p. 7-11 of this study guide well.
- Arrhythmias: Before you come be sure you can identify: Sinus Rhythm (SR), Sinus Bradycardia (SB), Sinus Tachycardia (ST), Supraventricular Tachycardia (SVT), Ventricular Tachycardia (VT), Ventricular Fibrillation (VF), Torsades de Pointes, Pulseless Electrical Activity (PEA) and Asystole.

< **Next look at perfusion:**

Is the central pulse versus peripheral pulse strength equal or unequal?

< **And check:**

BP acceptable or hypotensive?

< **Now classify the physiologic status:**

Stable: needs little support; **reassess frequently**
Unstable: needs **immediate support** and intervention

< **Apply the appropriate treatment algorithm:**

- Bradycardia with a Pulse
- Tachycardia with Adequate Perfusion
- Tachycardia with Poor Perfusion
- Pulseless Arrest: VF/VT and Asystole/PEA

Advanced Airway

A cuffed Endotracheal Tube (ET).

Immediately confirm tube placement by clinical assessment and a device:

► **Clinical assessment:**

- Look for bilateral chest rise.
- Listen for breath sounds over stomach and the 4 lung fields (**left and right anterior and midaxillary**).
- Look for water vapor in the tube (**if seen this is helpful but not definitive**).

► **Devices:**

- **End-Tidal CO₂ Detector (ETD):**

f Attaches between the ET and Ambu bag; give 6 breaths with the Ambu bag:

- Litmus paper center should change color with **each inhalation** and **each exhalation**.

- **Original color** on inhalation = **Okay** **O₂ is being inhaled:** expected.

- **Color change** on exhalation = **CO₂!!** **Tube is in trachea.**

- **Original color on exhalation** = **Oh-OH!!** **Litmus paper is wet:** replace ETD.

Tube is not in trachea: remove ET.

Cardiac output is low during CPR.

- **Esophageal Detector (EDD):**

Resembles a turkey baster:

- Compress the bulb and attach to end of ET.
- Bulb **inflates quickly!** Tube is in the trachea.

- Bulb **inflates poorly?** Tube is **in the esophagus**.
- f No recommendation for its use in cardiac arrest.

► **When sudden deterioration of an intubated patient occurs, immediately check:**

- | | | |
|----------------------|--------------------------|--|
| D isplaced | = tube is not in trachea | or has moved into a bronchus (right mainstem most common) |
| O bstruction | = consider secretions | or kinking of the tube |
| P neumothorax | = consider chest trauma | or barotraumas or non-compliant lung disease |
| E quipment | = check oxygen source | and Ambu bag and ventilator |

Supraventricular Tachyarrhythmia

2010 (New): The recommended initial biphasic energy dose for cardioversion of atrial fibrillation is 120 to 200 J. The initial monophasic dose for cardioversion of atrial fibrillation is 200 J.

2010 (Modification of Previous Recommendation):

For ease of placement and education, the anterior-lateral pad position is a reasonable default electrode placement. Any of 3 alternative pad positions (anterior-posterior, anterior-left infrascapular, and anterior-right infrascapular) may be considered on the basis of individual patient characteristics. Placement of AED electrode pads on the victim's bare chest in any of the 4 pad positions is reasonable for defibrillation.

2010 (New): Continuous quantitative waveform capnography

is now recommended for intubated patients throughout the periarrest period. When quantitative waveform capnography is used for adults, applications now include recommendations for confirming tracheal tube placement and for monitoring CPR quality and detecting ROSC based on end-tidal carbon dioxide

Capnography to monitor effectiveness of resuscitation efforts. PETCO₂ should read 35 to 40mm Hg in individual of ROSC, High Quality CPR is confirmed by a Capnography read of >10mm Hg on the vertical axis over time. This patient is intubated and receiving CPR. Note that the ventilation rate is approximately 8 to 10 breaths per minute. Chest compressions are given continuously at a rate of slightly faster than 100/min but are not visible with this tracing.

ACLS *Drugs*

In Arrest:

Epinephrine: catecholamine ECC Handbook

Increases heart rate, peripheral vascular resistance and cardiac output; **during CPR** increases myocardial and cerebral blood flow.

IV/IO: 1 mg of 1:10 000 solution (10ml of 1:10 000) repeat q. 3–5 min
IV Infusion 2 to 10 mcg/ kg/ minute
IV Infusion 0.1 to 0.5 mcg/ kg/minute (ROSC)

Antiarrhythmics:

Amiodarone: atrial and ventricular antiarrhythmic ECC Handbook

Slows AV nodal and ventricular conduction, increases the QT interval and may cause vasodilation.

VF/PVT: IV/IO: 300 mg bolus
Perfusing VT: IV/IO: 150 mg/kg over 10 min
IV Infusion: IV/IO: 1 mg/min first 6 hours
Max: 450 mg
Caution: hypotension, Torsade; half-life is up to 40 days

Lidocaine: ventricular antiarrhythmic to consider when amiodarone is unavailable ECC Handbook

Decreases ventricular automaticity, conduction and repolarization.

VF/PVT: IV/IO: 1 – 1.5 mg/kg bolus first dose, then 0.5 to 0.75 mg/kg, maximum 3 doses or 3mg/kg
Perfusing VT: IV/IO: 1 – 1.5 mg/kg bolus
Infusion: 20-50 mcg/kg/min
Caution: neuro toxicity → seizures

Magnesium: ventricular antiarrhythmic for Torsade and hypomagnesemia ECC Handbook

Shortens ventricular depolarization and repolarization (**decreases the QT interval**).

IV/IO: 1 - 2 g
Max: 2 gm
Caution: hypotension, bradycardia

Increase heart rate:

Atropine: vagolytic to consider after oxygen, ventilation and Fluid Bolus ECC Handbook

Blocks vagal input therefore increases SA node activity and improves AV conduction.

IV/IO: 0.5 mg; may double amount for second dose
1mg for AV Block (First Degree, Second Degree Type I)
Max: 3 mg
Caution: **do not give less than 0.1 mg** or may worsen the bradycardia

2010 (New): Atropine is not recommended for routine use in the management of PEA/asystole and has been removed from the ACLS Cardiac Arrest Algorithm. The treatment of PEA/asystole is now consistent in the ACLS

Decrease heart rate:

Adenosine: drug of choice for symptomatic SVT & Wide Complex Monomorphic VT See ECC Handbook

Blocks AV node conduction for a few seconds to interrupt AV node re-entry.

IV/IO: first dose: max: 6 mg
second dose: max: 12 mg
Third dose: max: 12 mg

Adenosine is recommended in the initial diagnosis and treatment of stable, undifferentiated regular, monomorphic wide-complex tachycardia

Increase blood pressure:

Dobutamine: synthetic catecholamine ECC Handbook

Increases force of contraction and heart rate; causes mild peripheral dilation; may be used to treat shock.

IV/IO infusion: 2- 10 mcg/kg/min infusion
Caution: tachycardia

Dopamine: catecholamine ECC Handbook

May be used to treat shock; effects are dose dependent.

Low dose: increases force of contraction and cardiac output.
Moderate: increases peripheral vascular resistance, BP and cardiac output.
High dose: higher increase in peripheral vascular resistance, BP, cardiac work and oxygen demand.
IV/IO infusion: 2–10 mcg/kg/min
Caution: tachycardia
IV/IO infusion: 5–10 mcg/kg/min (ROSC)

Miscellaneous:

Glucose: ECC Handbook p

Increases blood glucose in hypoglycemia; prevents hypoglycemia when insulin is used to treat hyperkalemia.

Naloxone: opiate antagonist ECC Handbook

Reverses respiratory depression effects of narcotics.

IV/IO: 0.4 to 2 mg/ **dose** IV/IM/subcutaneously. May repeat every 2 to 3 minutes

Caution: half-life is usually less than the half-life of narcotic, so repeat dosing is often required;
ET dose can be given but is **not preferred**; can also give IM or SQ.

Sodium bicarbonate: pH buffer for prolonged arrest, hyperkalemia, tricyclic overdose: ECC Handbook

IV/IO: Increases blood pH helping to correct metabolic acidosis.

Moderate metabolic acidosis: 50 to 150 mEq sodium bicarbonate diluted in 1 L of D5W to be intravenously infused at a rate of 1 to 1.5 L/hour during the first hour.

Severe metabolic acidosis: 90 to 180 mEq sodium bicarbonate diluted in 1 L of D5W to be intravenously infused at a rate of 1 to 1.5 L/hour during the first hour.

If acid-base status is not available, dosages should be calculated as follows: 2 to 5 mEq/kg IV infusion over 4 to 8 hours; subsequent doses should be based on patient's acid-base status.

Caution: causes other drugs to precipitate so flush IV tubing before and after

ET drug administration: distribution is unpredictable as is the resulting blood level of the drug; **if there is no IV/IO access**, give the drug down the ET and flush with 5-10 mL NS then give 5 ventilations to disperse the drug.

Bradycardia With a Pulse Algorithm

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

Identify and treat underlying cause

- Maintain patent airway; assist breathing as necessary
- Oxygen (if hypoxemic)
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- IV access
- 12-Lead ECG if available; don't delay therapy

Persistent bradyarrhythmia causing:

- Hypotension?
- Acutely altered mental status?
- Signs of shock?
- Ischemic chest discomfort?
- Acute heart failure?

Monitor and observe

No

Yes

Atropine

If atropine ineffective:

- Transcutaneous pacing
OR
- Dopamine infusion
OR
- Epinephrine infusion

Consider:

- Expert consultation
- Transvenous pacing

Doses/Details

Atropine IV Dose:

First dose:
0.5 mg bolus
Repeat every
3-5 minutes
Maximum: 3 mg

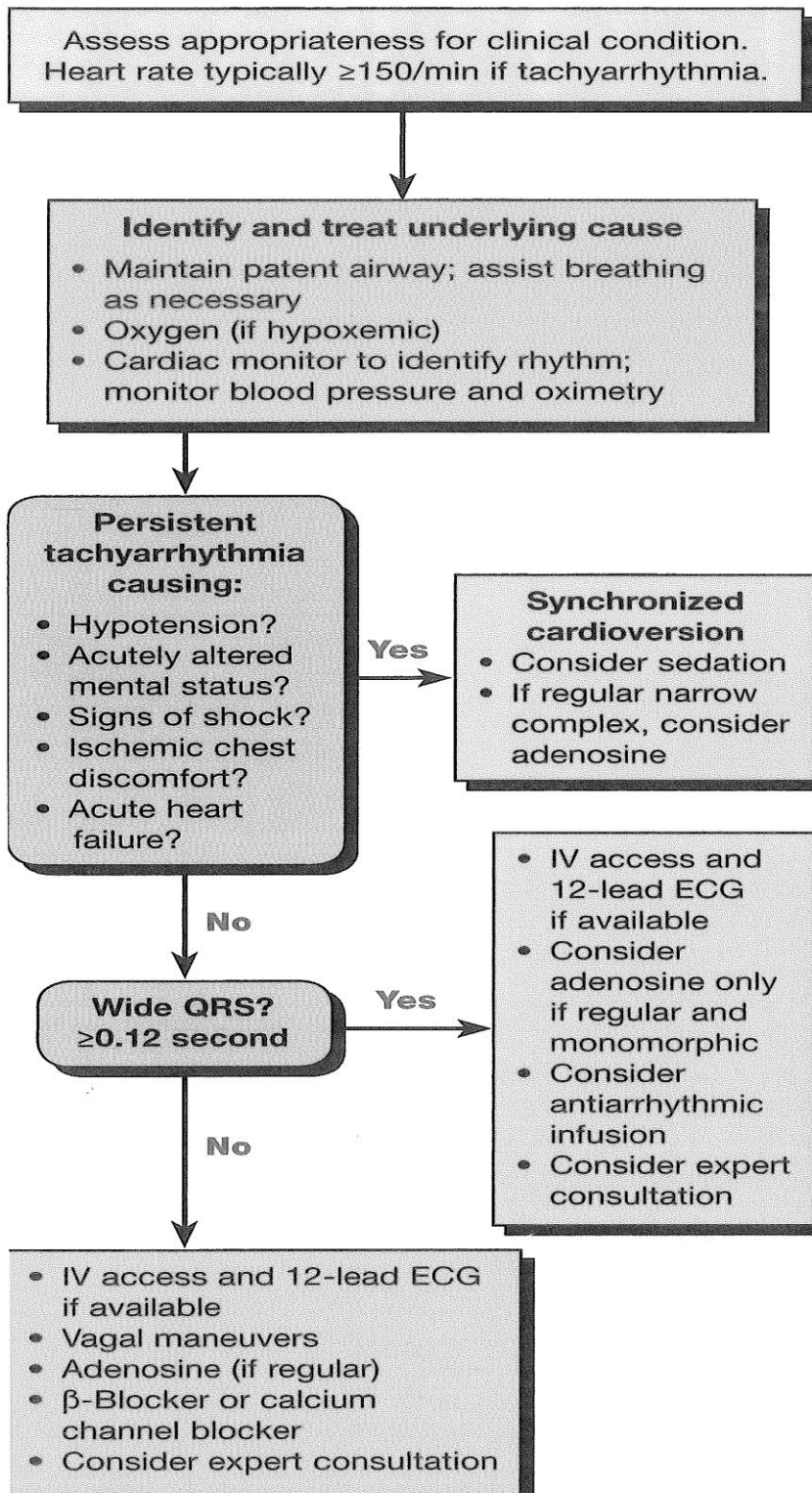
Dopamine IV Infusion:

2-10 mcg/kg per
minute

Epinephrine IV Infusion:

2-10 mcg per
minute

Tachycardia With a Pulse Algorithm



Doses/Details

Synchronized Cardioversion

Initial recommended doses:

- Narrow regular: 50-100 J
- Narrow irregular: 120-200 J biphasic or 200 J monophasic
- Wide regular: 100 J
- Wide irregular: defibrillation dose (NOT synchronized)

Adenosine IV Dose:

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

Antiarrhythmic Infusions for Stable Wide-QRS Tachycardia

Procainamide IV Dose:

20-50 mg/min until arrhythmia suppressed, hypotension ensues, QRS duration increases $>50\%$, or maximum dose 17 mg/kg given. Maintenance infusion: 1-4 mg/min. Avoid if prolonged QT or CHF.

Amiodarone IV Dose:

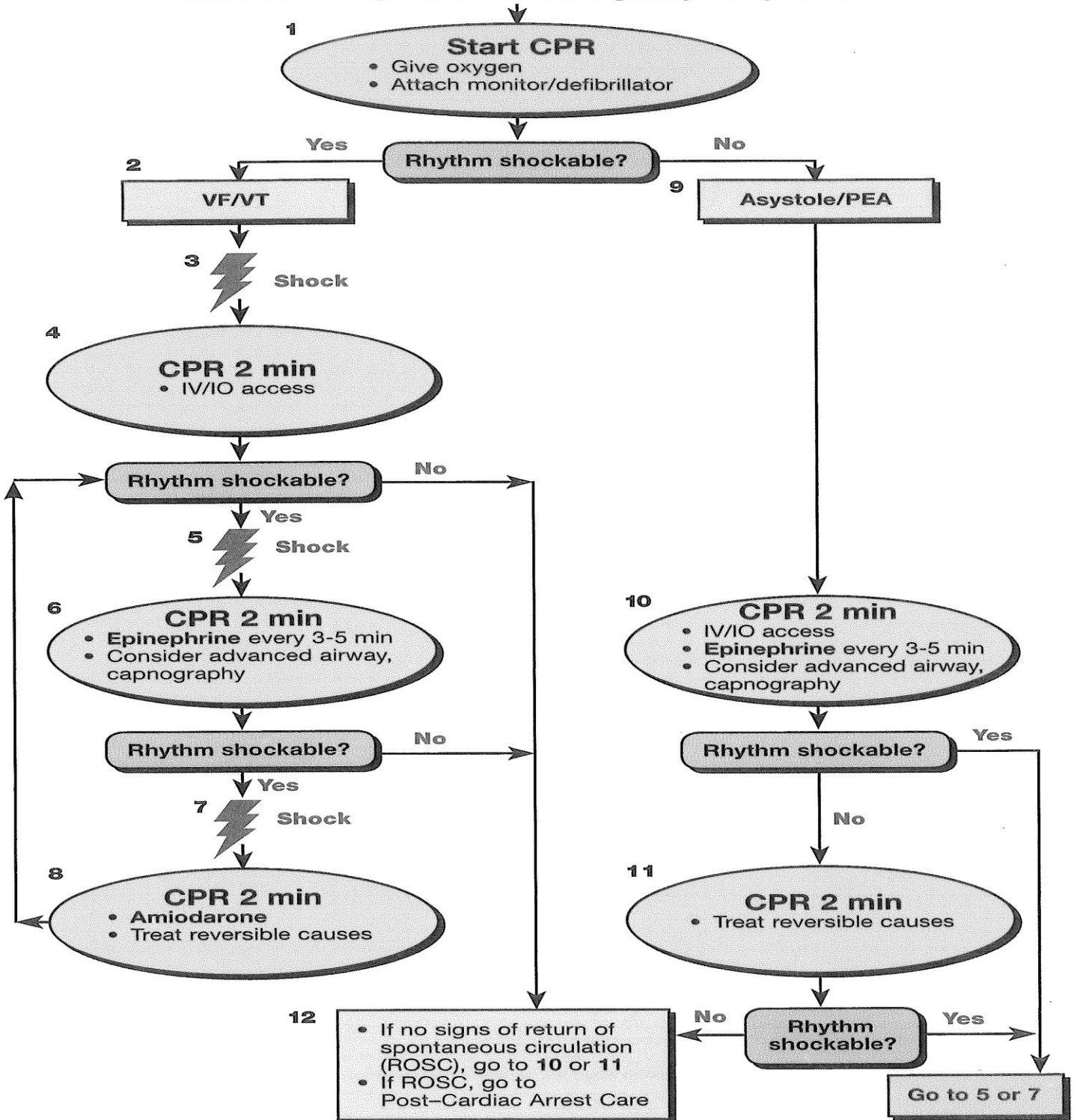
First dose: 150 mg over 10 minutes. Repeat as needed if VT recurs. Follow by maintenance infusion of 1 mg/min for first 6 hours.

Sotalol IV Dose:

100 mg (1.5 mg/kg) over 5 minutes. Avoid if prolonged QT.

Cardiac Arrest Algorithm

Shout for Help/Activate Emergency Response

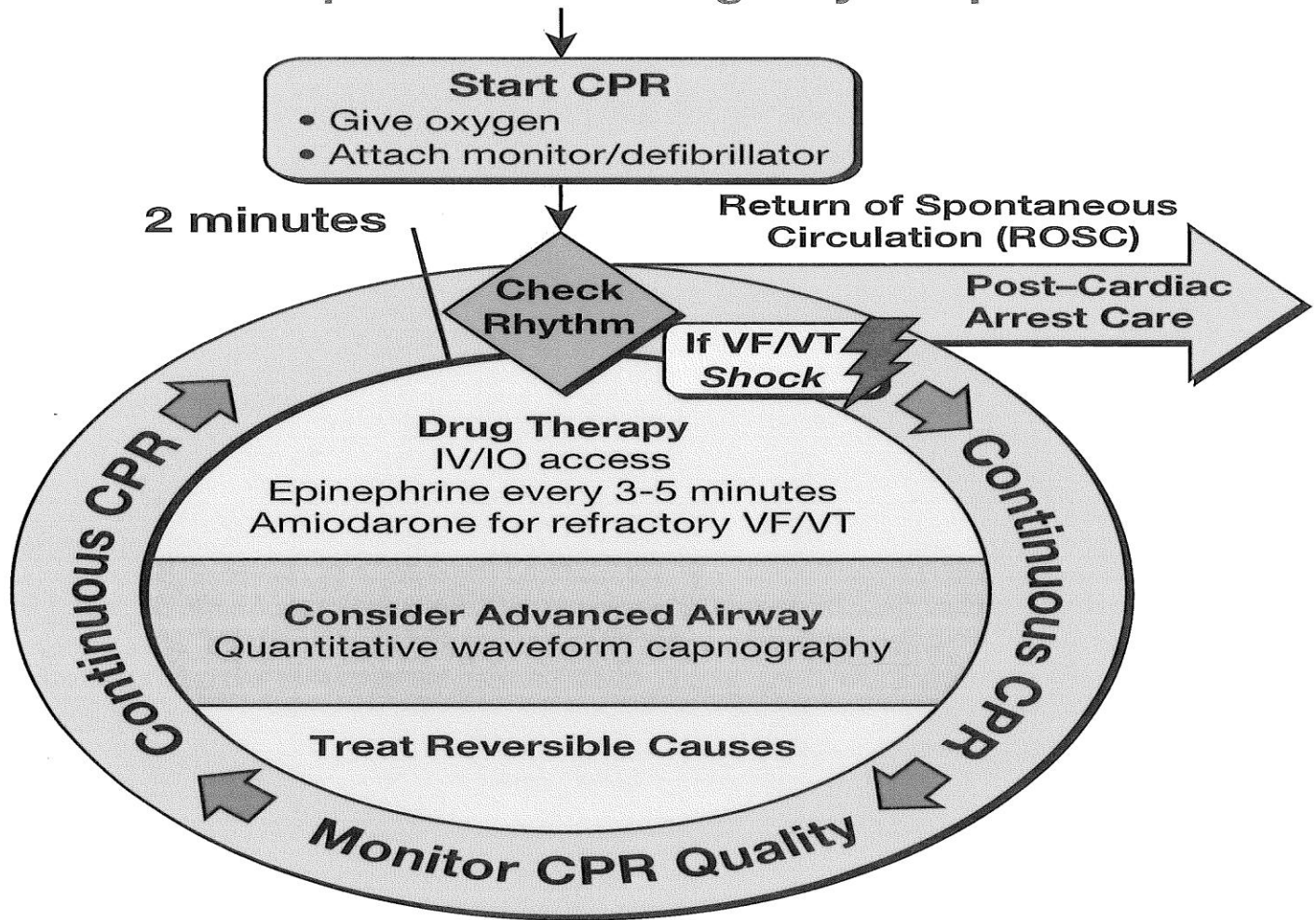




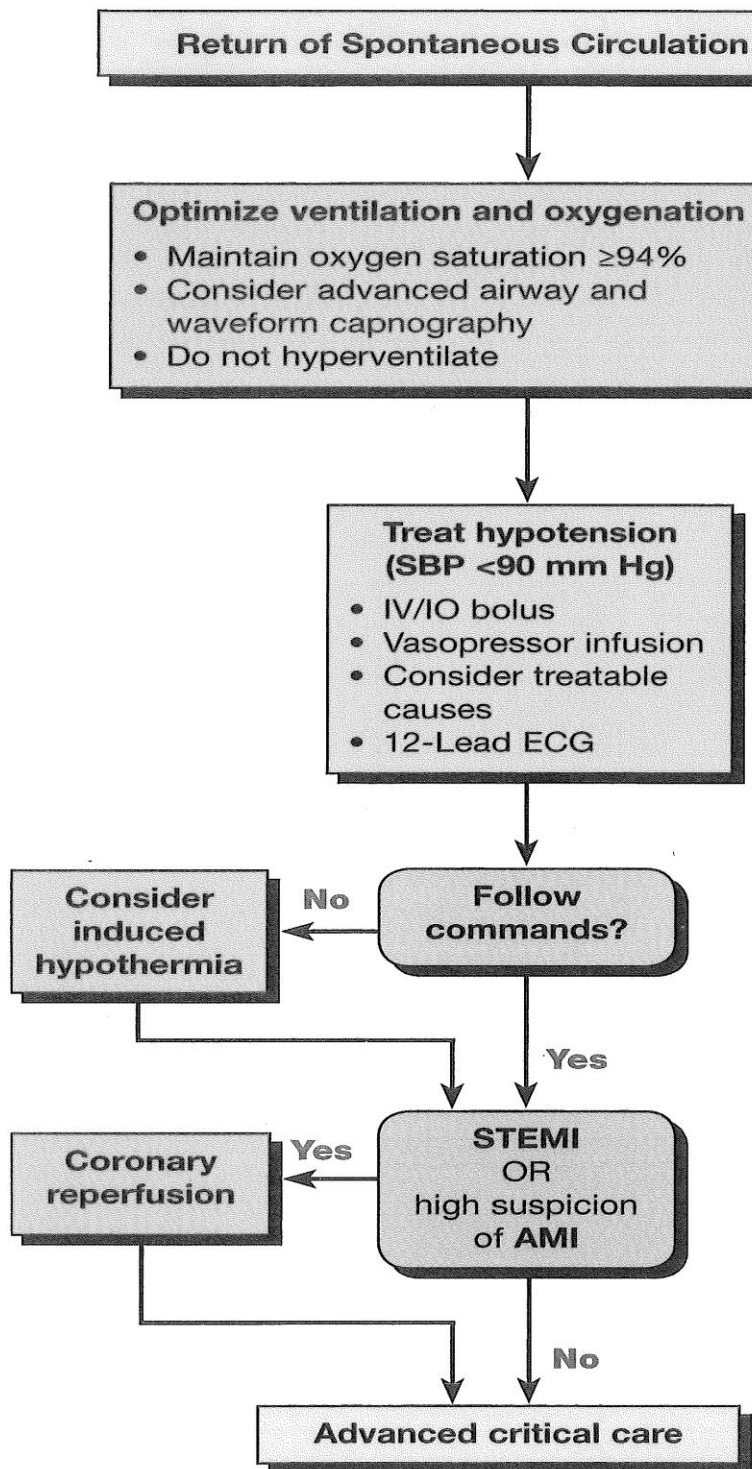
ACLS Cardiac Arrest, Arrhythmias, and Their Treatment

Cardiac Arrest Circular Algorithm

Shout for Help/Activate Emergency Response



Immediate Post-Cardiac Arrest Care Algorithm



Doses/Details

Ventilation/Oxygenation

Avoid excessive ventilation. Start at 10-12 breaths/min and titrate to target PETCO₂ of 35-40 mm Hg. When feasible, titrate FIO₂ to minimum necessary to achieve SpO₂ ≥94%.

IV Bolus

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

Epinephrine IV Infusion:

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

Dopamine IV Infusion:

5-10 mcg/kg per minute

Norepinephrine IV Infusion:

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

Reversible Causes

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

ECG REVEIW

1



Rhythm **SINUS TACH**

2



a. Rhythm **Sinus Rhythm**

3



Rhythm SVT



4

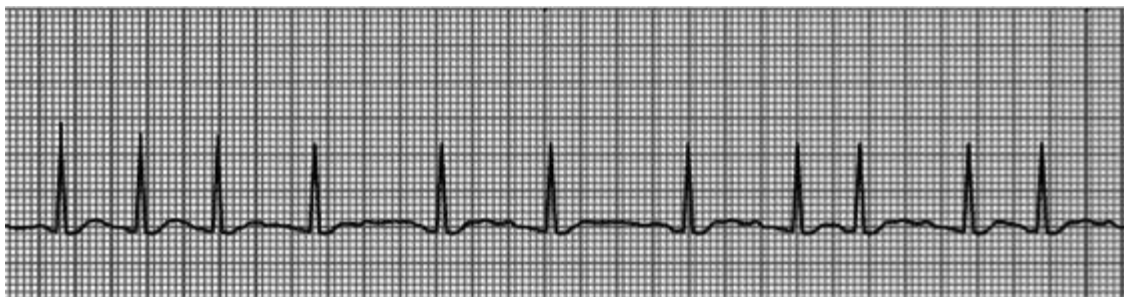
a. Rhythm : Atrial Flutter

5



a. Rhythm: Sinus Brady

6



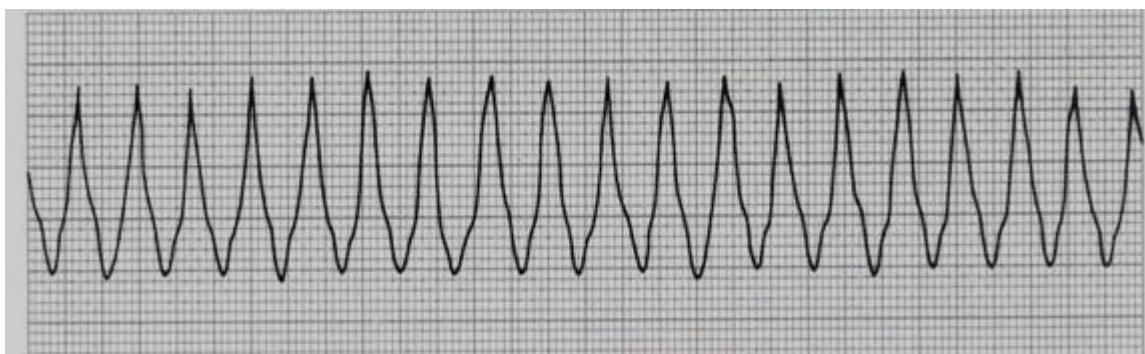
Rhythm : Atrial Fibrillation (No regular Ps, variable rate and fibrillatory baseline)

7



Rhythm : Junctional Rhythm.~ 60 bpm

8



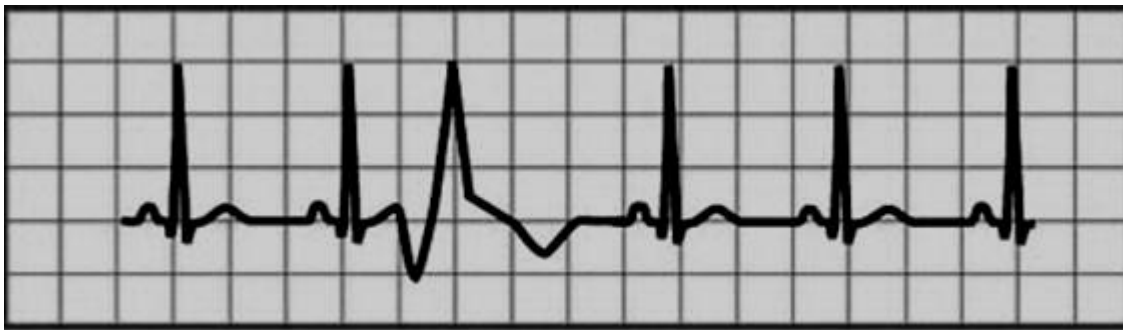
Rhythm : Monomorphic V-Tach

9



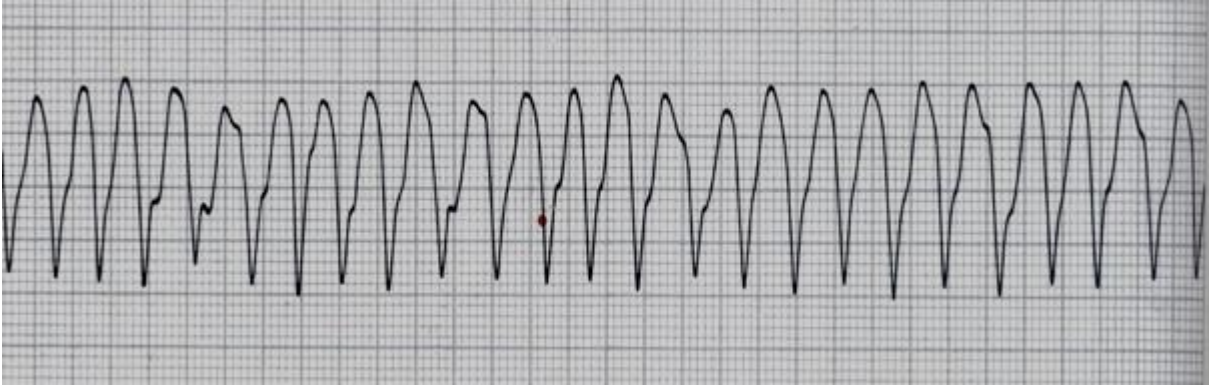
Rhythm : Sinus Rhythm W/ multifocal PVC's

10



Rhythm: Sinus Rhythm W/ PVC

11



Rhythm : Polymorphic V-Tach (Probably normal QT)

12



a. Rhythm: 2nd Degree type II

13



Rhythm : Fine V-Fib

14



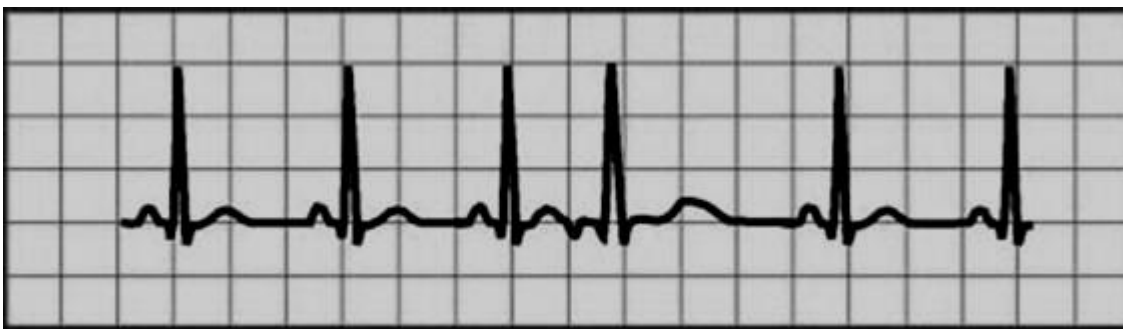
a. Rhythm : 1 Degree AVB

15



Rhythm: Coarse V-Fib

16



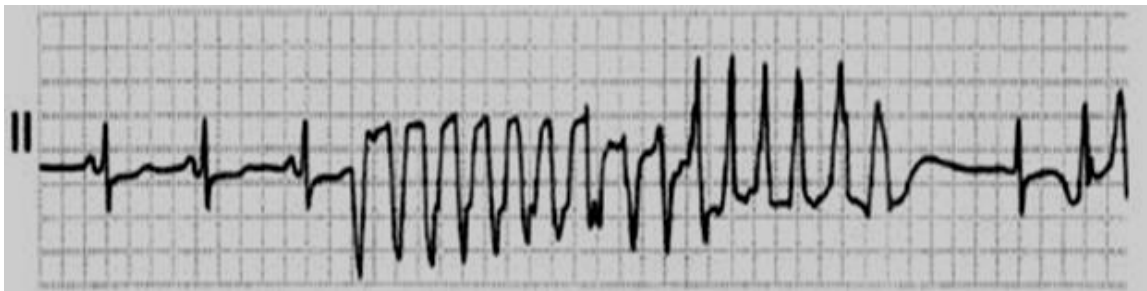
Rhythm : Sinus Rhythm W/PAC

17



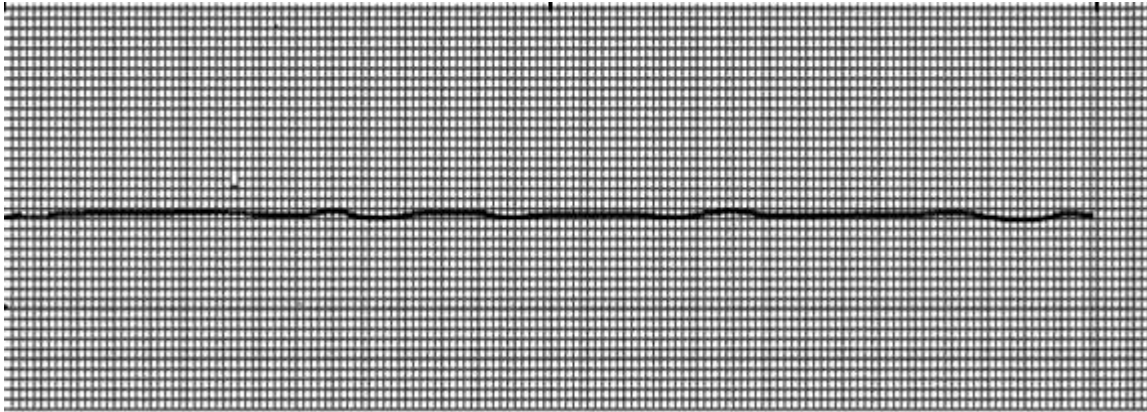
Rhythm: 2nd Degree type I

18



Rhythm: Polymorphic V-Tach / Torsades de Points

19



Rhythm: Asystole

20



Rhythm: 3rd Degree

Doses/Details for the Cardiac Arrest Algorithms

CPR Quality

- Push hard (≥ 2 inches [5 cm]) and fast (≥ 100 /min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 30:2 compression-ventilation ratio
- Quantitative waveform capnography
 - If $PETCO_2 < 10$ mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
 - If relaxation phase (diastolic) pressure < 20 mm Hg, attempt to improve CPR quality

Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Abrupt sustained increase in $PETCO_2$ (typically ≥ 40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Shock Energy

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

Drug Therapy

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

Advanced Airway

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

Reversible Causes

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