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/eccstudent  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.
You will need to know:

Treat Possible Causes

<table>
<thead>
<tr>
<th>5 Hs</th>
<th>5 Ts</th>
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<td>Hypo xia</td>
<td>T amponade</td>
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<td>Hypo volemia</td>
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<td>Hyper-thermia</td>
<td>T oxins – poisons, drugs</td>
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<td>Hypo /hyper kalemia</td>
<td>T hrombosis – coronary (AMI)</td>
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<td>Hydro gen ion (acidosis)</td>
<td>T hrombosis – pulmonary (PE)</td>
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Spacing separations may help as a memory aid.

Rapid Cardiopulmonary Assessment and Algorithms

This is a systematic head-to-toe assessment used to identify in respiratory distress and failure, shock and pulseless arrest. Algorithms are “menus” that guide you through recommended treatment interventions.

Know the following assessment because it begins all ACLS case scenarios. The information you gather during the assessment will determine which algorithm you choose for the patient’s treatment. After each intervention you will reassess the patient again using the head-to-toe assessment.

<Start with general appearance:

Is the level of consciousness:  
A = awake  V = responds to verbal  P = responds to pain  U = unresponsive

<Then assess CABs:  (stop and give immediate support when needed, then continue with assessment)

Circulation: Is central pulse present or absent?  
Is the rate normal or too slow or too fast?  
Is the rhythm regular or irregular?  
Is the QRS narrow or wide?

Airway: Check Airway if patient can maintain / if not Open and hold with head tilt-chin lift

Breathing: Is it present or absent?  
Is the rate normal or too slow or too fast?  
Is the pattern regular or irregular or gasping?  
Is the depth normal or shallow or deep?  
Is it Noisy  
Is there stridor or wheezing?
<**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):**
    - 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**
      - Color change on exhalation = **CO2!!**
      - Original color on exhalation = **Oh-OH!!**
      - O2 is being inhaled: expected.
      - Tube is in trachea.
      - 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 | Displaced = tube is not in trachea or has moved into a bronchus (right mainstem most common) |
| O | Obstruction = consider secretions or kinking of the tube |
| P | Pneumothorax = consider chest trauma or barotraumas or non-compliant lung disease |
| E | Equipment = 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 peri-arrest 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 automatically, 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  
Max: 3mg  
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  
Max: 1mg for AV Block (First Degree, Second Degree Type I)  
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

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

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

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

Yes

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

No

Wide QRS? ≥0.12 second

Yes

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.

No

- IV access and 12-lead ECG if available
- Consider adenosine only if regular and monomorphic
- Consider antiarrhythmic infusion
- Consider expert consultation

- Vagal maneuvers
- Adenosine (if regular)
- β-Blocker or calcium channel blocker
- Consider expert consultation
Cardiac Arrest Algorithm

Shout for Help/Activate Emergency Response

1. Start CPR
   - Give oxygen
   - Attach monitor/defibrillator

2. Yes
   - Rhythm shockable?

3. VF/VT

4. CPR 2 min
   - IV/IO access

5. Yes
   - Shock

6. CPR 2 min
   - Epinephrine every 3-5 min
   - Consider advanced airway, capnography

7. Yes
   - Shock

8. CPR 2 min
   - Amiodarone
   - Treat reversible causes

9. No

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

11. CPR 2 min
   - Treat reversible causes

12. No
   - If no signs of return of spontaneous circulation (ROSC), go to 10 or 11
   - If ROSC, go to Post-Cardiac Arrest Care

   Rhythm shockable?

   Go to 5 or 7
ACLS
Cardiac Arrest, Arrhythmias, and Their Treatment

Cardiac Arrest Circular Algorithm

Shout for Help/Activate Emergency Response

Start CPR
- Give oxygen
- Attach monitor/defibrillator

2 minutes

Check Rhythm

Return of Spontaneous Circulation (ROSC)

Drug Therapy
IV/IO access
Epinephrine every 3-5 minutes
Amiodarone for refractory VF/VT

Consider Advanced Airway
Quantitative waveform capnography

Treat Reversible Causes

Continuous CPR

Monitor CPR Quality

Post-Cardiac Arrest Care

If VF/VT Shock
Immediate Post-Cardiac Arrest Care Algorithm

Return of Spontaneous Circulation (ROSC)

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

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

Consider induced hypothermia

Follow commands?
- No

STEMI OR high suspicion of AMI

Coronary reperfusion
- Yes

Advanced critical care

Doses/Details

Ventilation/Oxygenation
Avoid excessive ventilation. Start at 10-12 breaths/min and titrate to target PETCO₂ of 35-40 mm Hg. When feasible, titrate FiO₂ to minimum necessary to achieve Spo₂ ≥94%.

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

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

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

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

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

1

Rhythm **SINUS TACH**

2

a. Rhythm Sinus Rhythm
Rhythm SVT

a. Rhythm: Atrial Flutter

a. Rhythm: Sinus Brady
**Rhythm: Atrial Fibrillation (No regular Ps, variable rate and fibrillatory baseline)**

**Rhythm: Junctional Rhythm. ~ 60 bpm**

**Rhythm: Monomorphic V-Tach**
Rhythm: Sinus Rhythm W/ multifocal PVC's

Rhythm: Sinus Rhythm W/ PVC
Rhythm: Polymorphic V-Tach (Probably normal QT)

Rhythm: 2nd Degree type II

Rhythm: Fine V-Fib
a. Rhythm: 1 Degree AVB

Rhythm: Coarse V-Fib

Rhythm: Sinus Rhythm W/PAC
Rhythm: 2nd Degree type I

Rhythm: Polymorphic V-Tach / Torsades de Points
Rhythm: Asystole

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 PETCO₂ <10 mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
  - If relaxation phase (diastolic) pressure <20 mm Hg, attempt to improve CPR quality

**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

**Return of Spontaneous Circulation (ROSC)**
- Pulse and blood pressure
- Abrupt sustained increase in PETCO₂ (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

**Shock Energy**
- **Biphasic:** Manufacturer recommendation (e.g., 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