



PROVIDER MANUAL

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UNIT ONE: ACLS OVERVIEW

Advanced cardiovascular life support (ACLS) teaches the student to identify and intervene in cardiac dysrhythmias including cardiopulmonary arrest, stroke, and acute coronary syndrome (ACS). The purpose of the training is to increase adult survival rates for cardiac and neurologic emergencies.

In the ACLS course, the student will learn the appropriate use of:

- Basic life support (BLS) survey
- ACLS survey
- High-quality CPR
- ACLS cases for specific disorders
- Post-cardiac arrest care.

PREPARING FOR ACLS

The ACLS course assumes basic knowledge in several areas. It is recommended that the student has a very sound knowledge of the following areas before beginning the ACLS course:

- BLS skills
- ECG rhythm recognition
- Airway equipment and management
- Adult pharmacology including the common drugs and dosages used in resuscitation.

ORGANIZATION OF THE ACLS COURSE

Instruction in BLS (both one- and two-rescuer) will not occur in a classroom ACLS course; however, the skills are tested in the appropriate skills stations.

In ACLS, the student must demonstrate competency in the following learning stations that reflect the cases. In a classroom setting, the student will be required to show proficiency in megacode, respiratory arrest, and CPR and AED skills for each of the following cases:

- Ventricular fibrillation (VF)/pulseless ventricular tachycardia
- Pulseless electrical activity (PEA)/asystole
- Bradycardia
- Tachycardia
- Post-cardiac arrest care.

At the end of the course, the student will be required to pass a written exam that tests the student's knowledge of the cognitive components of the course. While it is not directly tested, the learner is strongly encouraged to participate in our megacode simulators.

2015 ACLS GUIDELINE CHANGES

Guideline	Old Guideline	2015 Guideline
Sequence	CAB (compressions, airway, breathing)	Confirmed in the 2015 guidelines; do not delay the first 30 chest compressions
Compression depth	At least 2 inches in adults	Between 5 cm and 6 cm (2 inches and 2.4 inches) in adults
Compression frequency	At least 100 compressions per minute	No less than 100, no more than 120
Chest recoil	Allow the chest to fully recoil between compressions	Confirmed in the 2015 guidelines; do not lean on the chest between compressions; allow the heart to fully fill with blood
Vasopressin	Vasopressin may replace first or second dose of epinephrine	Vasopressin plus epinephrine provides no advantage as a substitute for epinephrine
Epinephrine	CPR was recommended over epinephrine	Administer epinephrine ASAP for non-shockable cardiac arrest rhythm
Delayed ventilation	New recommendation for 2015	Witnessed cardiac arrest with shockable rhythm, EMS may delay positive-pressure ventilation for up to 3 cycles of 200 continuous chest compressions
Advanced airway	When using an advanced airway, give 1 breath every 6 to 8 seconds or 8 to 10 breaths a minute	Deliver 1 breath every 6 seconds (10 per minute) when using an advanced airway during CPR
Chain of survival	Same chain of survival for in-hospital and out-of-hospital cardiac arrest	In-hospital and out-of-hospital cardiac arrest chain of survival are different; primary providers and lay rescuers provide immediate care and then transfer care to the code team or EMS crew, respectively.
Extracorporeal CPR	Insufficient information to recommend routine use of extracorporeal CPR	Extracorporeal CPR may be considered instead of regular CPR for reversible cardiac arrest
Post-cardiac arrest	New recommendation for 2015	Inadequate evidence to support the routine use of lidocaine and/or beta-blocker
Post-cardiac arrest	Comatose patients should be cooled to between 32°C and 34°C for 12-24 hours	Comatose patients with ROSC should be cooled to between 32°C and 36°C for >24 hrs
Post-cardiac arrest	New recommendation for 2015	Consider avoiding/correcting hypotension systolic BP <90 or mean arterial pressure <65

TABLE 1: COMPARISON OF ACLS GUIDELINES

- Research shows that starting compressions earlier in the resuscitation process tends to increase survival rates.
- The assessment of the victim's breathing has been removed since responders often mistake gasping breathing for effective breathing.
- Experts define high-quality CPR for an adult as:
 - A compression rate of 100 to 120 compressions per minute
 - A compression depth of 2 to 2.4 inches (5-6 cm)
 - Allowing the chest to return to normal position after each compression
 - Not interrupting CPR for specific treatments such as intravenous catheter insertions, delivery of medications, and insertion of advanced airways; instead, wait until preparation for defibrillation and do treatments during that lull in CPR
 - Decreasing excessive ventilation.
- The pulse check is less critical since many providers cannot reliably detect a pulse in an emergency.
- Post-cardiac arrest care is formally started as soon as return of spontaneous circulation (ROSC) occurs.
- Administer a vasopressor every 3 to 5 minutes; use an endotracheal (ET) tube, if available, until IV access is established.

UNIT TWO: BLS AND ACLS SURVEYS

The end purpose of ACLS is to intervene early for the victim in cardiac arrest. The intent is to increase survival rates and ensure quality outcomes. ACLS teaches a systematic way of providing care utilizing BLS and ACLS surveys. If the patient is not responsive, the first survey to use is the BLS survey. The ACLS survey involves providing advanced treatments after the BLS survey is complete or when the victim is awake and responsive.

BLS SURVEY

Research about BLS for adults over the years supports the idea that it is rare for only one responder to be available during BLS. Therefore, the current emphasis is on doing several actions at the same time during the resuscitation process. In an ACLS classroom testing situation, however, each student will be required to demonstrate one- and two-rescuer resuscitation skills. The tasks are represented in Figure 1 below:

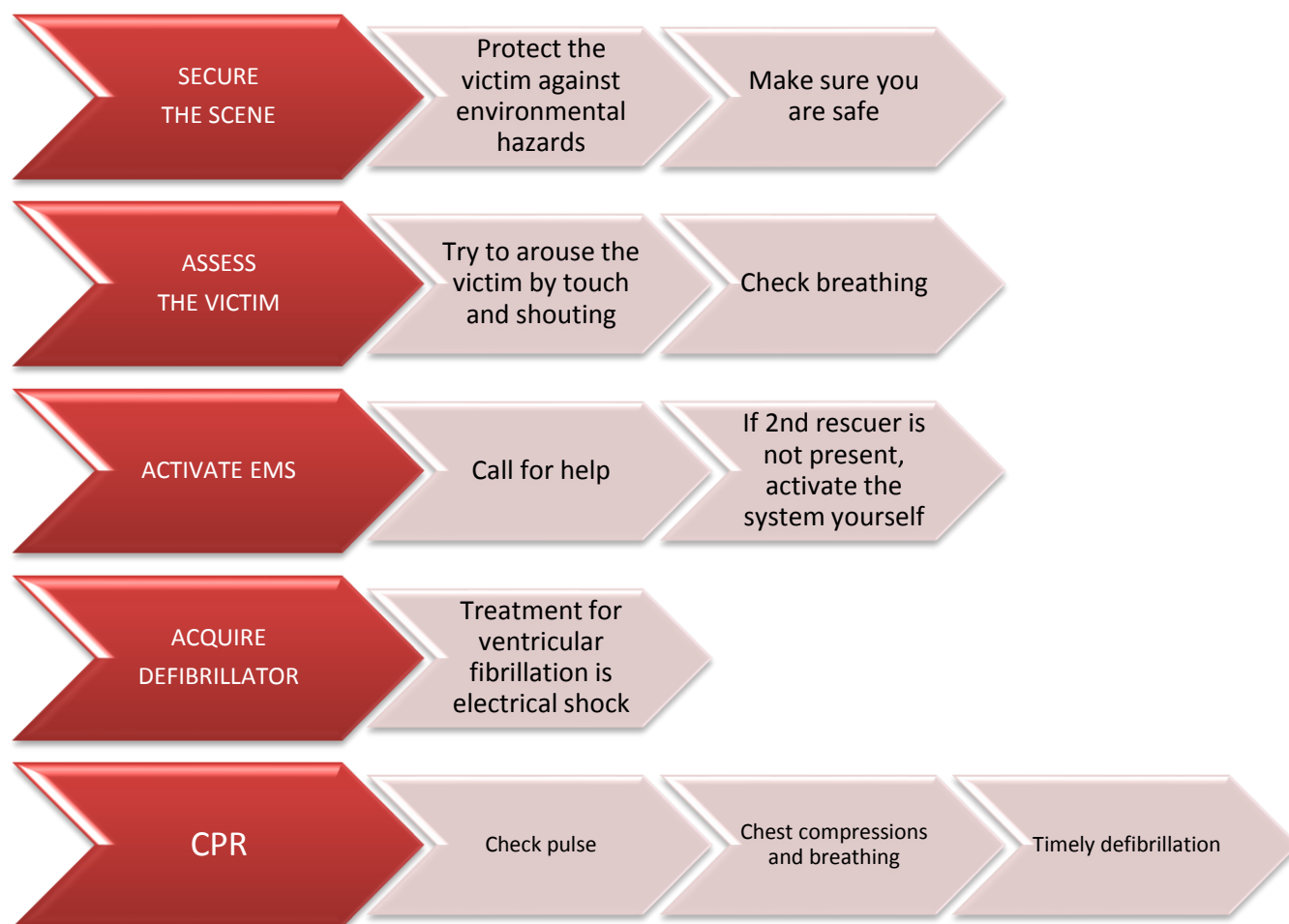


FIGURE 1: BLS SURVEY TASKS

ADULT BLS/CPR

The final step in the BLS Survey is to begin CPR. The steps below are a quick review of the CPR process. For a more in-depth review, refer to a BLS training manual. In classroom training and testing, the student will be required to demonstrate effective CPR.

1. Feel for the carotid pulse on the side of the neck behind the trachea. Since a pulse may be difficult to find, attempt to feel for the pulse for 5-10 seconds.
2. If you are not sure you feel a pulse, you should assume that the pulse is not there. Start alternating 30 compressions and 2 breaths.
3. If the victim is not on his back, place him on his back on a surface that will not compress as you do CPR.
4. Put the heel of your left hand on the bottom half of the victim's breastbone.
5. Rest the heel of your right hand on top of the left hand.
6. With your arms straight and shoulders directly over your hands, begin compressions HARD and FAST. For an adult, effective compressions will be at least 2 inches deep. Effective compressions will be between 100 and 120 per minute. Be sure that the chest fully expands between each compression so that blood can flow back into the victim's heart. Do not lean on the chest between compressions.
7. After performing 30 hard and fast compressions, do a head tilt and chin lift to open the victim's airway. If you think the victim may have a neck injury, use a jaw thrust to move the jaw forward and open the airway.
8. If you have a barrier device, apply it to the victim's nose and/or mouth.
9. Give a slow deep breath over one second as you watch the victim's chest expand. Give a second breath.
10. Give another round of 30 compressions followed by 2 breaths over one second each.
11. If two or more rescuers are available, switch out every 2 minutes.
12. When a defibrillator arrives and is prepared, attach the machine to the victim and defibrillate as soon as possible and as directed.
13. CPR interruptions should be minimal.

ACLS SURVEY

When the BLS survey is complete, or if the patient is conscious and responsive, the responder should conduct the ACLS survey with a focus on the identification and treatment of underlying cause(s) of the patient's problem.

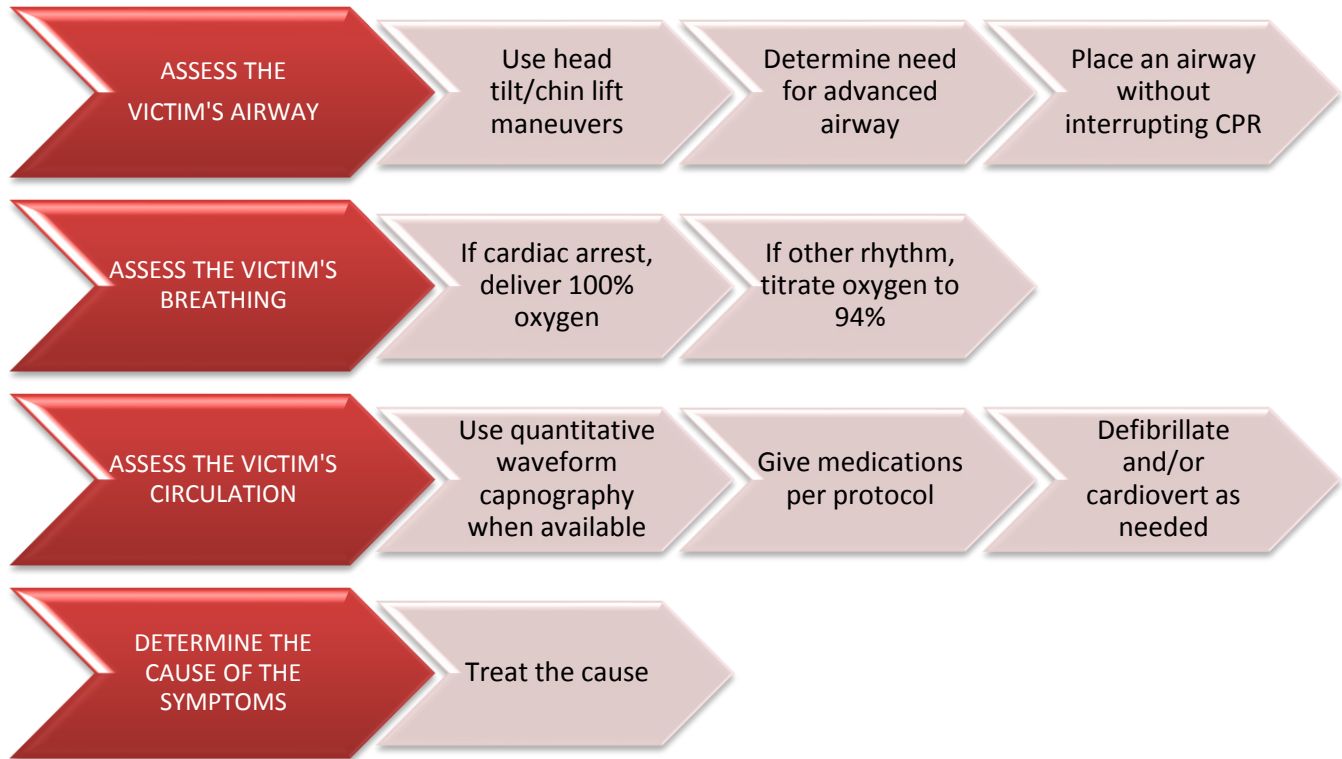


FIGURE 2: ACLS SURVEY TASKS

1. Assess the victim's airway:
 - Use the least advanced airway possible to maintain the airway and oxygenation (laryngeal mask, laryngeal tube, or esophageal tracheal tube).
2. Assess the victim's breathing:
 - Monitor tube placement and oxygenation using waveform capnography if available and avoid excessive ventilation.
3. Assess the victim's circulation:
 - Medications, CPR, fluids and defibrillation when needed according to the ACLS cases.
4. Determine the cause of the arrhythmia or symptoms; treat the causes.

UNIT THREE: TEAM DYNAMICS

One of the new features in the 2015 guidelines is an emphasis on team dynamics in the resuscitation team. In order to provide optimal outcomes, each team member must be able to perform the functions of his role and must understand how his role interfaces with other roles on the team. Usually, a resuscitation team will have one team leader. This leader is responsible for ensuring that the resuscitation effort flows smoothly and that each task is completed properly. This role is often filled by a physician but can be done by anyone who can:

- Organize the team
- Monitor the performance of each role
- Perform any skills if necessary
- Model appropriate behaviors
- Coach other members of the team as necessary
- Focus on provision of exceptional care
- Mentor the group by providing a critique of team and individual performance when the resuscitation is over.

Team members should be assigned to roles based on their scope of practice and training for the assigned tasks. A team member must be able to:

- Understand his role in this resuscitation
- Perform the tasks assigned
- Understand the ACLS protocols and algorithms
- Promote and contribute to the success of the team.

The effective dynamics of the team depend on the ability of each member to meet the expectations of his role in the team.

Expectation	Team Leader Actions	Team Member Actions
Roles	Knows the abilities of each of the team members	Team member will let the team leader know if a task is beyond his skill level; asks for help if unable to complete a task
Communication	Clearly defines each task and verifies that assignments are understood; confirms performance of task	Informs the leader that task is understood; Informs the leader when each task is completed
Messages	Speaks clearly and in a normal tone of voice when giving assignments and orders	Speaks clearly and in a normal tone of voice when acknowledging assignments and orders, and feels comfortable questioning unclear orders
Knowledge sharing	Asks for suggestions from team members for alternative actions when needed	Shares information with team, and helps to identify actions that may be inhibiting the resuscitation effort
Intervention	Intervenes quickly but gently if a team member is about to perform an incorrect action or if a task is taking too long	Asks the leader to repeat an order if the member thinks an error will occur and feels comfortable suggesting alternative courses of action
Evaluation and summary	Asks for suggestions for alternative actions from team members; is constantly aware of patient's responses; keeps team members informed of patient's current status and plans for change in actions; provides positive and corrective feedback as needed	Draws attention to changes in the patient's status or response to treatments

TABLE 2: TEAM DYNAMICS

UNIT FOUR: SYSTEMS OF CARE

Teaching basic and advanced life support in a community increases survival rates for a victim of cardiac arrest or stroke. The Adult Chain of Survival is composed of systems that must work optimally to increase survival rates of acute coronary syndromes (ACS) and stroke victims.

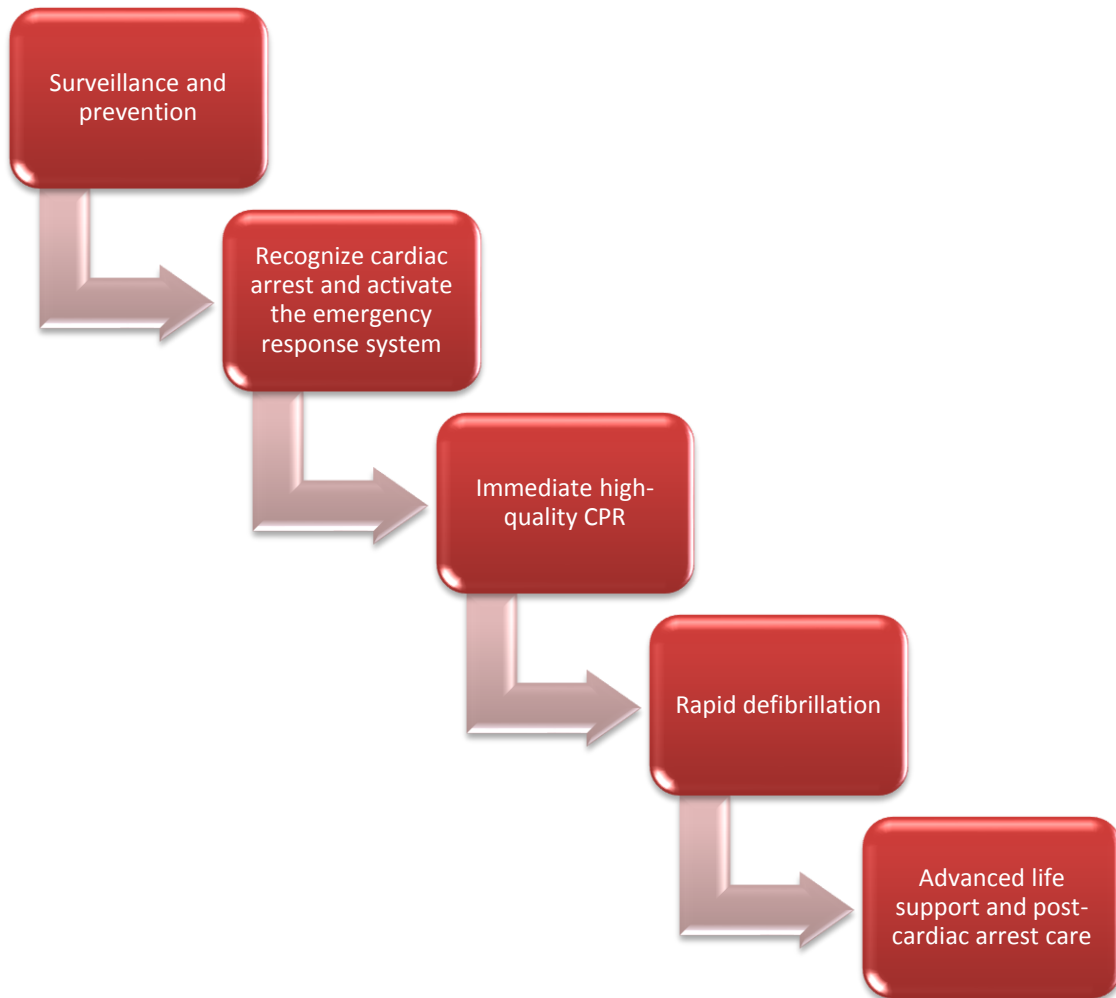


FIGURE 3: IN-HOSPITAL CARDIAC ARREST CHAIN OF SURVIVAL

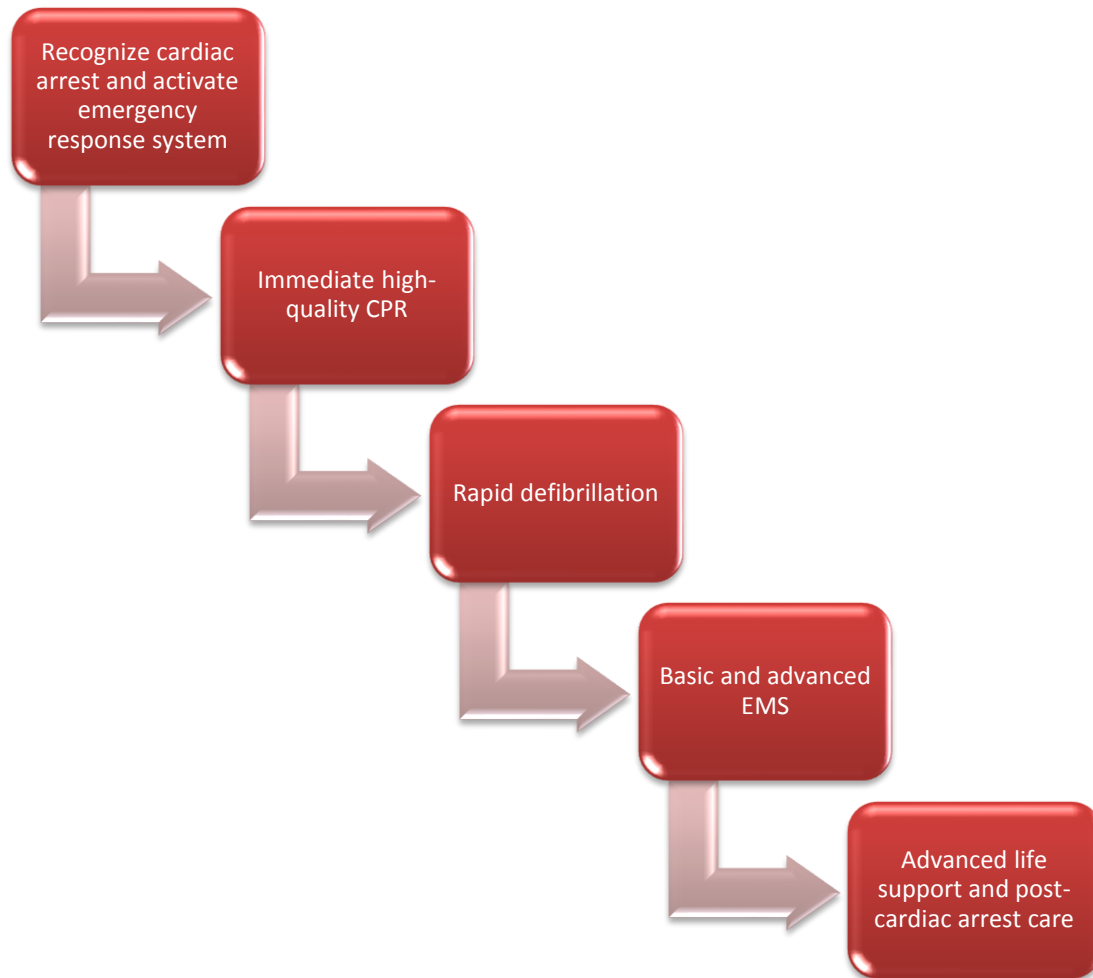


FIGURE 4: OUTSIDE-OF-HOSPITAL CARDIAC ARREST CHAIN OF SURVIVAL

POST-CARDIAC ARREST CARE

Research indicated that survival rates and optimal outcomes of ACLS are positively influenced by the post-cardiac arrest care that the victim receives. Critical post-resuscitation treatments include:

- Therapeutic hypothermia: If the victim has ROSC but does not respond to verbal stimulation, therapeutic hypothermia is recommended. Lower the victim's core temperature to 32-34 degrees Celsius (89.6-93.2 Fahrenheit) for 12-24 hours post resuscitation.
- Use quantitative waveform capnography to keep the PETCO₂ at 35-40 mm Hg. This monitoring is the most accurate way to optimize hemodynamics and ventilation.
- Transport the victim to a facility capable of surgical coronary reperfusion using percutaneous coronary intervention (PCI).
- Control the glucose level to 144-180 mg/dL; do not attempt to achieve a lower level since the risk of hypoglycemia outweighs the benefits.
- Perform neurological testing before withdrawing treatment after successful resuscitation.

ACUTE CORONARY SYNDROMES (ACS)

For ACS patients, systems of care must be in place to prevent complications and further cardiac events. These systems must include:

- Public education for recognition of ACS symptoms
- Education of health care providers for quick recognition and appropriate treatment of ACS
- Early activation of the emergency response system (ERS) so that evaluation and treatment can begin in the field before arrival at the emergency department (ED)
- Emergency medical system training must include recognition of acute myocardial infarction (AMI) in the field to effect early notification of the hospital and decreased time to treatment in the ED
- Systems of care in the hospital must shorten the time to definitive treatment
- Emergency personnel must be trained in emergency care, especially selection of reperfusion strategies.

ACUTE STROKE CARE

For patients with stroke, systems of care must include:

- Public education to recognize symptoms of stroke
- Public education regarding the importance of seeking treatment within the first hour of symptom onset
- Early activation of the ERS so that evaluation and treatment can begin in the field prior to arrival at ED
- Emergency medical system training must include recognition of stroke in the field for early notification of the hospital to minimize time to treatment in the ED
- When possible, development of regional stroke centers that have systems in place.

EDUCATION AND TEAMS

Even in ideal situations, survival rates for patients who experience cardiac arrest are only about 21%. This rate decreases as time increases between the cardiac event and definitive treatment. Most hospitals have cardiac arrest teams that respond to a cardiac arrest once it occurs. These teams have not lowered the mortality rates in hospitals because of the relatively late response to an event.

For this reason, it is critical for all providers to receive education about recognizing patients at risk for cardiac arrest. Many hospitals are beginning to adopt systems of care for early intervention that may include:

- Cardiac arrest teams in most hospitals that respond to a cardiac arrest once it occurs.
- Replacement of cardiac arrest teams with rapid response teams (RRTs). RRTs are activated when anyone feels that a patient may be deteriorating. The intent is to intervene BEFORE the cardiac arrest happens. Hospitals develop their own criteria for activating the RRT but these criteria often include:
 - A change in respiratory status
 - An extreme change in heart rate
 - Rising or falling blood pressure
 - Deterioration in level of consciousness or mentation
 - Seizure activity
 - Any other subjective concern.
- The focus of the RRT is to intervene immediately to stop the patient's deterioration and to accomplish three major goals:
 - Lower the rate of cardiac arrests that result in mortality
 - Decrease the need for transfers to the ICU
 - Decrease morbidity rates.

UNIT FIVE: ACLS CASES

BLS AND ACLS SURVEYS

The individual or team must always perform the BLS and ACLS surveys before proceeding with the algorithm for the specific arrhythmia or problem (refer to Unit Two for the proper procedure for these surveys).

RESPIRATORY ARREST

In a respiratory emergency, ensure a patent airway and deliver oxygen to maintain an oxygen saturation >94%. If the patient has a pulse and no respiratory effort, provide one breath every 5-6 seconds (10-12 breaths each minute). With an advanced airway, provide one breath every 6 seconds (10 breaths each minute).

For a victim in respiratory arrest, attempt one of the basic airway skills to establish an airway:

- Place the victim in a position to maintain an open airway using the head tilt/chin lift or jaw thrust maneuver. Often, repositioning the respiratory arrest victim is all that is required to improve respirations.
- Mouth-to-mouth ventilation can be used if no barriers are available.
- If there are injuries to the mouth or teeth, use mouth to nose ventilation.
- If a pocket mask or other barrier is available, use mouth to barrier ventilation.
- If an Ambu bag and mask are available, select a mask that covers both the patient's nose and mouth to the chin. If you are using a bag, be sure that oxygen is flowing to the bag and that the bag is intact without leaks. An Ambu bag can also be used with basic and advanced airways.

When using an Ambu bag, avoid excessive ventilation by using only enough volume to make the chest rise. Monitor the victim's oxygen saturation and general condition to determine effectiveness of respiratory interventions. If the victim requires insertion of a basic or advanced airway, ensure that the appropriate equipment is available such as:

- Standard precautions equipment including gloves, mask, and eye protection
- Monitoring devices such as a cardiac monitor, blood pressure monitor, pulse oximetry unit, and carbon dioxide detector
- IV/IO equipment
- Suctioning equipment
- Various types of airways in all sizes
- Oxygen and Ambu bags
- All sizes of ET tubes for advanced airway management
- Laryngoscope
- Syringes to test ET tube balloon
- Adhesive tape.

BASIC AIRWAY MANAGEMENT

OROPHARYNGEAL AIRWAY

The oropharyngeal airway (OPA) should only be used when the victim is NOT conscious. If inserted in a conscious or partially conscious victim, the OPA can cause the victim to gag and vomit. Be sure to select the right airway size to avoid airway obstruction or throat injury.

To insert an OAP airway:

1. Place the victim on his back.
2. Using the thumb and index finger of one hand, insert the fingers in the victim's mouth against his upper and lower teeth.
3. Using a scissors-like motion with your fingers, separate the victim's teeth until his/her mouth opens.
4. Insert the tip of the airway into the victim's mouth on top of the tongue.
5. Point the tip of the airway up toward the roof of the victim's mouth.
6. Carefully, slide the OPA following the curve of the tongue.
7. When the tip of the airway reaches the back of the tongue beyond the soft palate, rotate the airway so the tip of the OPA points toward the victim's throat.
8. Insert the airway until the flared flange is against the victim's lips.
9. If the OPA is the correct size and inserted properly, the victim's tongue will not slide to the back of his throat.
10. If the victim regains consciousness, remove the OPA.

NASOPHARYNGEAL AIRWAY

The nasopharyngeal airway (NPA) is used in a conscious or unconscious victim. Because it is inserted through the nose, the NPA can be used with a victim who has a mouth injury or who has a strong gag reflex.

To insert the NPA:

1. Be sure to measure the NPA by comparing the diameter of the airway with the size of the victim's nostril
2. Proper length of the NPA can be gauged by holding the airway next to the victim's face. An appropriate length of the NPA will measure from the ear lobe to the tip of the nose.
3. Lubricate the NPA with a water-soluble lubricant before attempting insertion.
4. Insert the NPA gently through the victim's largest nostril. If you encounter resistance as you insert the NPA, rotate the airway slightly or attempt to use the other nostril.

ADVANCED AIRWAY MANAGEMENT

When a rescuer is trained and competent in use of an advanced airway, one of these airways can provide better oxygenation. Although learning to insert an advanced airway is beyond the scope of ACLS, every team member should know how to maintain them. When an advanced airway is in place, administer one ventilation every 6 seconds (10 breaths every minute).

- Use a laryngeal mask airway as an alternative to an ET tube since this airway provides comparable oxygenation.
- A laryngeal tube is another advanced airway that can be used instead of bag-mask or ET tube ventilation.
- An esophageal-tracheal tube is another advanced airway that provides oxygenation comparable to an ET tube. Caution should be used when selecting this tube.
- If a team member has been trained, the ET tube may be the best airway to insert during a cardiac arrest. All team members should be trained to:
 - Assemble the equipment necessary for intubation
 - Inflate the cuff after intubation
 - Attach the Ambu bag and give breaths at the appropriate rate
 - Confirm placement by quantitative waveform capnography (if available) **and** by clinical assessment
 - Secure the tube
 - Monitor ET tube placement.
- Only a trained practitioner should actually perform the ET intubation.

Interrupt CPR only long enough to intubate the victim. Once intubated, CPR should NOT be interrupted to deliver breaths. Instead, deliver breaths as the chest recoils between compressions. In any victim with a possible neck injury, a team member should manually stabilize the neck as a cervical collar may interfere with the airway.

SUCTIONING THE AIRWAY

Maintain an open airway by properly suctioning it. Use a wall-mounted device, if available, since this will provide enough power to suction the airway. A rigid Yankauer catheter should only be used to suction the victim's mouth. Use a soft catheter to suction any airway.

To suction an ET tube:

1. If possible, use sterile technique to prevent the possibility of infection.
2. Turn on the suction machine and set vacuum regulator to 80-120 mm Hg if available. Use only enough pressure to effectively suction since hypoxia and damage to respiratory mucosa can occur if suction pressure is too high.
3. Using sterile gloves, pick up the soft suction catheter, and avoid touching it to any non-sterile surfaces. With your opposite hand, pick up the connecting tubing and attach the catheter to it.
4. Without suction, gently insert the catheter into the ET tube until you feel resistance. Pull the catheter back 1-2 centimeters.
5. Apply suction by occluding and opening the control vent on the catheter. Slowly pull the catheter out of the tube as you rotate the catheter between your fingers. **Suctioning time should NEVER exceed 10-15 seconds.**
6. After suctioning, hyper-oxygenate by delivering several deep breaths.
7. Monitor the victim's condition during suctioning observing for cyanosis, airway spasms, cardiac dysrhythmias, and changes in level of consciousness.

VENTRICULAR FIBRILLATION, PULSELESS VENTRICULAR TACHYCARDIA, PEA AND ASYSTOLE

Cardiac arrest is associated with one of the following rhythms:

- Asystole: Often called cardiac standstill or flat line and is the absence of all evidence of electrical activity on the ECG. There are no complexes visible on the monitor. Asystole will not respond to shocks.
- Pulseless electrical activity (PEA): When there are visible complexes on the cardiac monitor but no pulses can be felt, the rhythm is PEA. The goal of treatment for PEA is to identify and treat the underlying cause of the rhythm using the H's and T's. PEA will not respond to shocks.
- Ventricular fibrillation (VF): Characterized by chaotic electrical activity on the monitor, a victim with VF will have no palpable pulses.
- Pulseless ventricular tachycardia (VT): Is usually seen as very wide QRS complexes on the ECG. The victim will be pulseless with this rhythm. Without treatment, VT can quickly deteriorate into VF; consequently, the treatment is the same as for VF.

In cardiac arrest, the victim has no pulse and is unresponsive and not breathing. Once a victim is in cardiac arrest, prognosis for survival is very poor. Therefore, it is critical to intervene BEFORE cardiac arrest occurs.

Once cardiac arrest occurs, the goal of advanced life support is return of spontaneous circulation (ROSC).

Advanced life support includes:

- Determination of whether the cardiac rhythm is shockable
- Provision of vascular access for drug administration (see Routes of Access for Medication Administration)
- Defibrillation
- Medication therapy
- Advanced airway management (although an ET tube is preferred, efficient bag-mask ventilations can be just as effective for short resuscitation efforts).

CARDIAC ARREST: VENTRICULAR FIBRILLATION (VF) WITH CPR AND AED

ADULT BLS/CPR

First, perform the BLS survey introduced in Unit Two and perform the following steps:

1. Secure the scene
2. Assess the victim
3. Activate the emergency response system
4. Use an AED if available, and
5. Perform CPR.

For CPR steps, review Unit Two or a BLS manual. Remember, CPR should be hard (at least 2 inches compression) and fast (100-120 compressions each minute). High-quality CPR can be exhausting. If more than one rescuer is available, be sure to provide relief by alternating rescuer positions every two minutes.

USING THE AUTOMATED EXTERNAL DEFIBRILLATOR

Sudden cardiac death is often caused by VF that causes the cardiac muscle to fibrillate rather than contract in a normal heartbeat. The effective treatment for this arrhythmia is an electric shock by a defibrillator. With the ready availability of the automated external defibrillator (AED), the general public now has a ready way to identify the heart rhythm of a victim and appropriately administer a shock if the victim is in VF. The AED is safe because knowledge of cardiac rhythms is NOT required and a rescuer does not even need experience with the machine. However, previous familiarity with the AED can minimize anxiety when its use is required. All AEDs are similar. To operate an AED, refer to the AED algorithm.

1. Secure the scene and verify the victim is NOT in water
2. Open and turn the AED on
3. Continue CPR until the AED pads are on, the wires are connected (if not connected) and the device is powered. CPR should be stopped only at the moment the device is ready to analyze the rhythm
4. Stop CPR. The effectiveness of shock delivery decreases significantly for every 10 seconds that elapses between compressions and shock delivery, so it is critical to deliver a shock quickly
5. Expose the victim's chest and dry the skin if necessary
6. Open the AED pads and attach the pads to the victim's chest. A hard lump on the victim's chest may indicate an implanted pacemaker. Do not place an AED pad over the lump. Remove any medication patch that is on the chest
7. Instruct all bystanders to move away while the AED analyzes the victim's rhythm. DO NOT TOUCH the victim during this analysis. If you get a message to check the pads, press on each pad to ensure the pads are making full contact. Occasionally, you may have to apply a new set of pads
8. If the AED detects a shockable rhythm, it will verbally tell you to not touch the victim. The AED will advise you to deliver a shock. After announcing "Clear," ensure that no one is in contact with the victim. Press the "Shock" button
9. If the AED does NOT detect a shockable rhythm, it will tell you to resume CPR.

After performing CPR for 2 minutes, the AED will advise you to stop CPR to analyze the rhythm. Repeat this process as needed until the victim regains consciousness or EMS arrives.

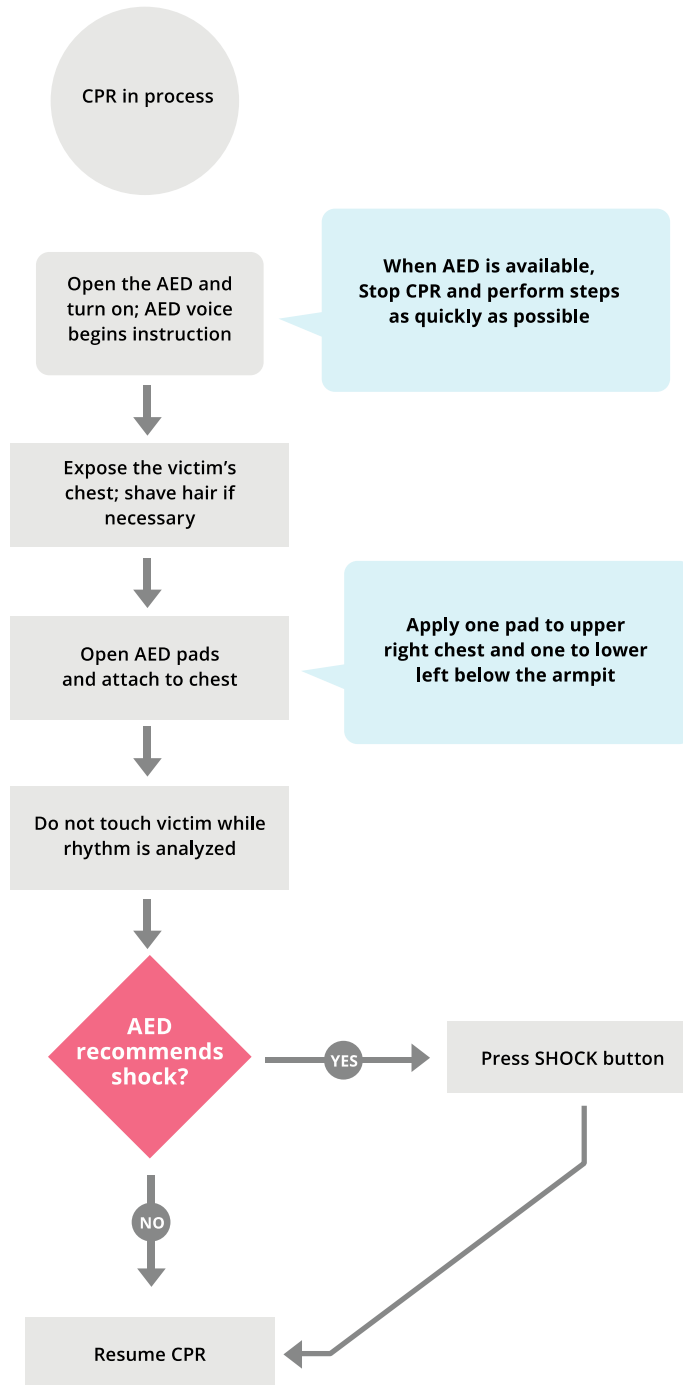


FIGURE 5: AED ALGORITHM

CARDIAC ARREST CASE

The Cardiac Arrest Algorithm is designed to provide high-quality CPR, electrical intervention when appropriate, and medication therapy. This algorithm assumes that CPR is being done and a well-trained team is in place with all required equipment. Immediate intervention in cardiac arrest is critical since it is well documented that success of resuscitation will depend on:

- Length of time between a victim's arrest and beginning of CPR: Outcomes are better with shorter lengths of time
- Provision of high-quality CPR
- Duration of CPR: Prognosis becomes worse as duration of CPR increases
- Early determination and treatment of causes of the arrest.

When BLS interventions are unsuccessful in a cardiac arrest victim, the team will implement the Cardiac Arrest Algorithm. This algorithm is based on whether the rhythm is shockable (VT or VF) or not shockable (PEA or asystole). Figures 6 and 7 (below) represent the separate halves of the Cardiac Arrest Algorithm:

1. Do high-quality CPR, establish an airway and provide oxygen to keep oxygen saturation above 94%, and monitor the victim's heart rhythm and blood pressure.
2. If the patient is in asystole or PEA, go to step 11 and follow the PEA and Asystole Algorithm (Figure 6).
3. If the monitor and assessment indicate pulseless VT or VF, apply defibrillator pads and shock the patient with 120-200 Joules on a biphasic defibrillator or 360 Joules using a monophasic defibrillator (refer to Figure 7: VT and VF Algorithm).
4. Continue CPR and attempt to establish IV or IO access.
5. If the monitor and assessment indicate asystole or PEA, go to step 11 (refer to Figure 6: PEA and Asystole Algorithm).
6. After 2 minutes of CPR, defibrillate again if the victim is still in VT or VF.
7. Give epinephrine 1 mg ASAP and every 3-5 minutes.
8. If the monitor and assessment continue to show VT or VF, shock again.
9. Continue CPR for 2 minutes and give a 300 mg IV bolus of amiodarone. Repeat amiodarone at a dose of 150 mg bolus if needed. If amiodarone is unavailable, substitute lidocaine at 1-1.5 mg/kg IV. If the first dose is not effective, give half doses of lidocaine every 5-10 minutes to a maximum of 3 mg/kg IV.
10. Alternate 2 minutes of CPR with defibrillation for VT or VF.
11. If the monitor and physical assessment indicate the victim is in asystole or PEA, continue CPR and administer epinephrine 1 mg IV as soon as possible and again every 3-5 minutes as needed. Every two minutes, stop CPR in order to evaluate the cardiac rhythm. If PEA or asystole develops into VT or VF (shockable rhythms), defibrillate the victim and refer to the VT and VF Algorithm.
12. H's and T's – Here are several known causes of PEA that can be treated. These causes are known as the H's and T's. As treatment continues, the team leader should continuously evaluate and intervene if any of these underlying causes are identified. Continue to Evaluate, Identify and Intervene on underlying reversible causes (see Table 5).
13. Once identified, treat the cause of the PEA or asystole.
14. If ROSC occurs at any point in the algorithm, proceed to the post-cardiac arrest case.
15. Extracorporeal CPR may be considered in some victims (e.g., reversible cause, awaiting heart transplant) who did not respond to traditional CPR.

Potential Cause	How to Identify	Treatments
Hypovolemia	Rapid heart rate and narrow QRS on ECG; other symptoms of low volume	Infusion of normal saline or Ringer's lactate
Hypoxia	Slow heart rate	Airway management and effective oxygenation
Hydrogen ion excess (acidosis)	Low amplitude QRS on the ECG	Hyperventilation; consider sodium bicarbonate bolus
Hypoglycemia	Bedside glucose testing	IV bolus of dextrose
Hypokalemia	Flat T waves and appearance of a U wave on the ECG	IV Magnesium infusion
Hyperkalemia	Peaked T waves and wide QRS complex on the ECG	Consider calcium chloride, sodium bicarbonate, and an insulin and glucose protocol
Hypothermia	Typically preceded by exposure to a cold environment	Gradual rewarming
Tension pneumothorax	Slow heart rate and narrow QRS complexes on the ECG; difficulty breathing	Thoracostomy or needle decompression
Tamponade - cardiac	Rapid heart rate and narrow QRS complexes on the ECG	Pericardiocentesis
Toxins	Typically will be seen as a prolonged QT interval on the ECG; may see neurological symptoms	Based on the specific toxin
Thrombosis (pulmonary embolus)	Rapid heart rate with narrow QRS complexes on the ECG	Surgical embolectomy or administration of fibrinolytics
Thrombosis (myocardial infarction)	ECG will be abnormal based on the location of the infarction	Dependent on extent and age of MI

TABLE 3: H'S AND T'S AS CAUSES OF PEA

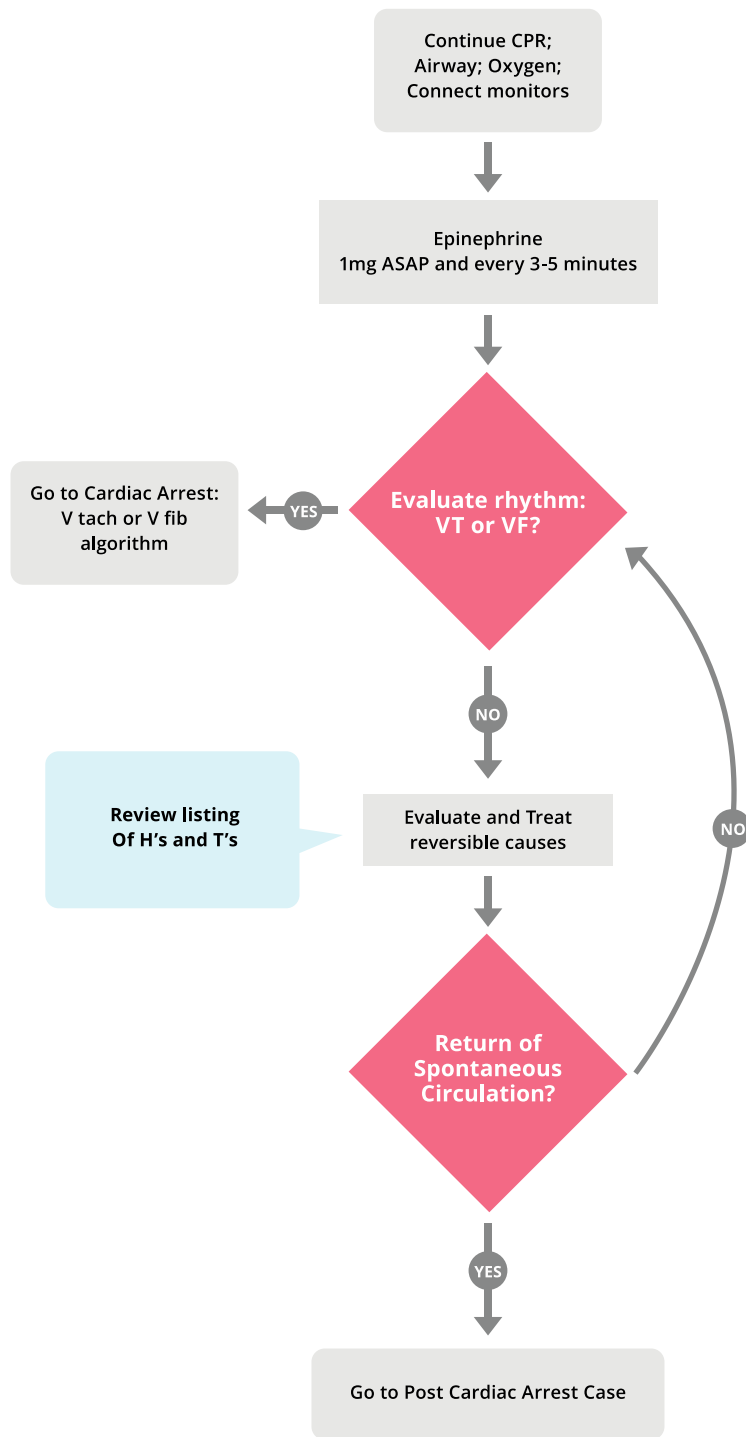


FIGURE 6: CARDIAC ARREST: PEA AND ASYSTOLE ALGORITHM

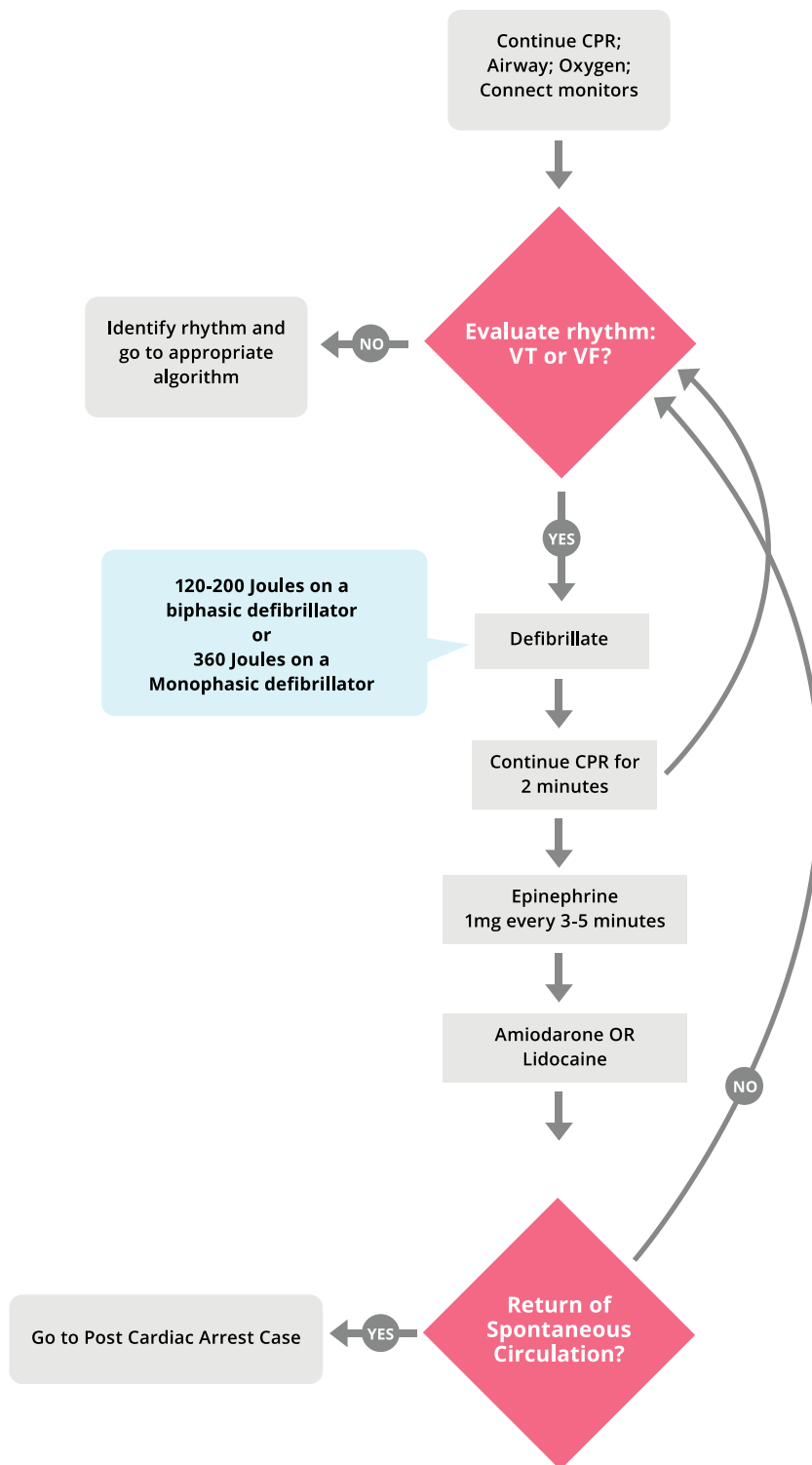


FIGURE 7: CARDIAC ARREST: VT OR VF ALGORITHM

MANUAL DEFIBRILLATION FOR VF OR PULSELESS VT

During the Cardiac Arrest Algorithm, any time the monitor shows a shockable rhythm (VF or pulseless VT), prepare to defibrillate while continuing high-quality CPR. To operate a manual defibrillator:

1. Turn on the machine.
2. Apply conductive gel to paddles or apply adhesive pads to the chest (select the largest pads or paddles available that do not touch each other).
3. If using paddles, press down firmly on the patient's chest.
4. Select dose as in the VT and VF Algorithm (see Figure 7, above).
5. Press the charge button on the defibrillator.
6. When the defibrillator is charged, announce "Clear" and verify that all team members are clear of the bed and victim.
7. Press the shock or discharge buttons.
8. Immediately, continue CPR for 2 minutes and recheck rhythm. If the rhythm is shockable, administer another defibrillation.

ROUTES OF ACCESS FOR MEDICATION ADMINISTRATION

During resuscitation, medication administration will often be needed. The preferred route of administration of medications is:

Route	Indication	Special Notes
Intravenous (IV)	Preferred in most cases if the IV can be established quickly without interrupting CPR	Use a central IV line if it is in place; if medications are given via a peripheral IV, administer 20 mL of IV fluid after each drug
Intraosseous (IO)	Easy to insert when an IV cannot be quickly established; CPR does not have to be interrupted for insertion	Any medication can be given IO; typical sites for insertion include tibia, distal femur or anterior superior iliac crest; should not be used in an injured site or when infection is present near the site
Endotracheal (ET)	Should only be used if an IV or IO cannot be quickly inserted	Dosage of medication should be 2 to 2.5 times the typical IV or IO dosage; only vasopressin, lidocaine, epinephrine, atropine, and naloxone should be given in the ET tube; follow drug administration with normal saline and hyperventilation with Ambu bag.

TABLE 4: ROUTES FOR MEDICATION ADMINISTRATION

INSERTION OF AN IO CATHETER

An IO catheter can be inserted into an adult or child for quick access during resuscitation. The IO catheter should be replaced by an IV as soon as possible. To insert an IO catheter:

1. Use standard precautions.
2. Position and immobilize the extremity.
3. Disinfect the skin at the insertion site.
4. If available, use an IO needle with stylet for insertion.
5. Insert the IO needle using continuing firm pressure and a twisting motion until you feel a sudden decrease in resistance.
6. Remove the stylet and attach a large syringe.
7. Aspirate a combination of blood and bone marrow to confirm IO placement.
8. Blood aspirated from the IO site can be used for lab tests.
9. Start an infusion of normal saline; observe the site for signs of a dislodged catheter.
10. Support the IO needle with gauze and tape the needle flange to the skin.
11. Attach the IV tubing to the needle.
12. After giving any medication via the IO port, flush with sterile saline IV solution.

MONITORING DURING CPR

Quantitative waveform capnography is the most accurate measure of the quality of CPR and airway management during resuscitation. If the PETCO₂ measured by capnography goes below 10 mm Hg during CPR, the team member doing compressions should be directed to increase the depth and rate of compressions. In addition, the placement of the ET tube should be verified. After making those adjustments, a PETCO₂ <10 mm Hg indicates that the prognosis for ROSC is poor. Return of the PETCO₂ to 35-40 mm Hg indicates ROSC. Another indication of ROSC is increased coronary perfusion pressure. Arterial oxygen saturation should be maintained above 30%. If the O₂ saturation falls below this level, the CPR compression rate and depth should be increased.

MEDICATIONS USED DURING CARDIAC ARREST

Administration of epinephrine may improve the victim's chances for ROSC. Give a vasopressor every 3-5 minutes during cardiac arrest. Antiarrhythmics such as amiodarone and lidocaine may increase short-term survival rates (See Unit 6: Commonly Used Medications in Resuscitation for additional information about medications used during ACLS). Lidocaine provides no long-term benefit or harm. Likewise, beta-blockers are not to be routinely used after cardiac arrest. Lidocaine and/or beta-blockers may be considered after ROSC in victims who had a cardiac arrest due pulseless VT or VF.

WHEN TO TERMINATE RESUSCITATION EFFORTS

If the victim fails to respond to ACLS interventions, the team leader must consider terminating treatment. Factors to consider when making the decision to terminate resuscitation efforts include:

- Failure to respond to ACLS interventions.
- Amount of time after collapse before CPR and defibrillation began.
- Any other comorbid disease or conditions.
- Discovery of a “Do Not Resuscitate” order for the victim.
- Length of the resuscitation effort; increased time generally results in poor outcomes.
- Policies of the healthcare facility.
- Low end-tidal carbon dioxide (ETCO₂) after 20 minutes of CPR in intubated victims (e.g., <10 mm Hg by quantitative waveform capnography) along with other items listed above.

POST-CARDIAC ARREST CARE

Treatment for a victim of cardiac arrest must continue post resuscitation in order to optimize the outcomes. The Post-Cardiac Arrest Care Algorithm (see Figure 9: Post-Cardiac Arrest Care Algorithm) includes the following steps:

1. Verify ROSC.
2. Manage the airway and provide a breath every 5-6 seconds. If an advanced airway is in place, provide a breath every 6 seconds. Using quantitative waveform capnography, titrate the oxygen to maintain a PETCO₂ of 35-40 mm Hg. If you do not have access to a waveform capnography machine, titrate oxygen to keep the victim's oxygen saturation between 94% and 99%.
3. Insert and maintain an IV for medication administration. Maintain the blood pressure above 90 mm Hg and/or a mean arterial pressure of 65 mmHg. Avoid hypotension. For a low blood pressure, consider one or more of these treatments:
 - a. Give 1-2 liters of saline or Ringer's lactate IV fluid
 - b. Start an epinephrine IV infusion to keep the systolic pressure >90 mm Hg
 - c. Start a dopamine IV infusion
 - d. Consider norepinephrine for extremely low systolic blood pressure.
4. Evaluate the H's and T's for treatable causes (see Table 5: H's and T's).
5. Track the victim's mental status. For decreased level of consciousness after resuscitation, consider inducing hypothermia.
6. Targeted temperature management (TTM) should be performed in all comatose adult victims who have ROSC after cardiac arrest. The target temperature is between 32°C and 36°C for at least 24 hours. Fever should be actively prevented after patients in TTM return to normothermia (normal temperature). Victims of outside-of-hospital cardiac arrest should not be routinely cooled before they reach the ED.
7. Obtain a 12-lead ECG to determine if the victim has suffered an ST segment elevation myocardial infarction (STEMI) or non-ST segment elevation myocardial infarction (NSTEMI).
8. If STEMI or AMI is suspected, consider percutaneous coronary intervention (PCI) to open the coronary arteries.
9. When myocardial infarction is not suspected or after PCI, transfer the victim to a coronary care unit.

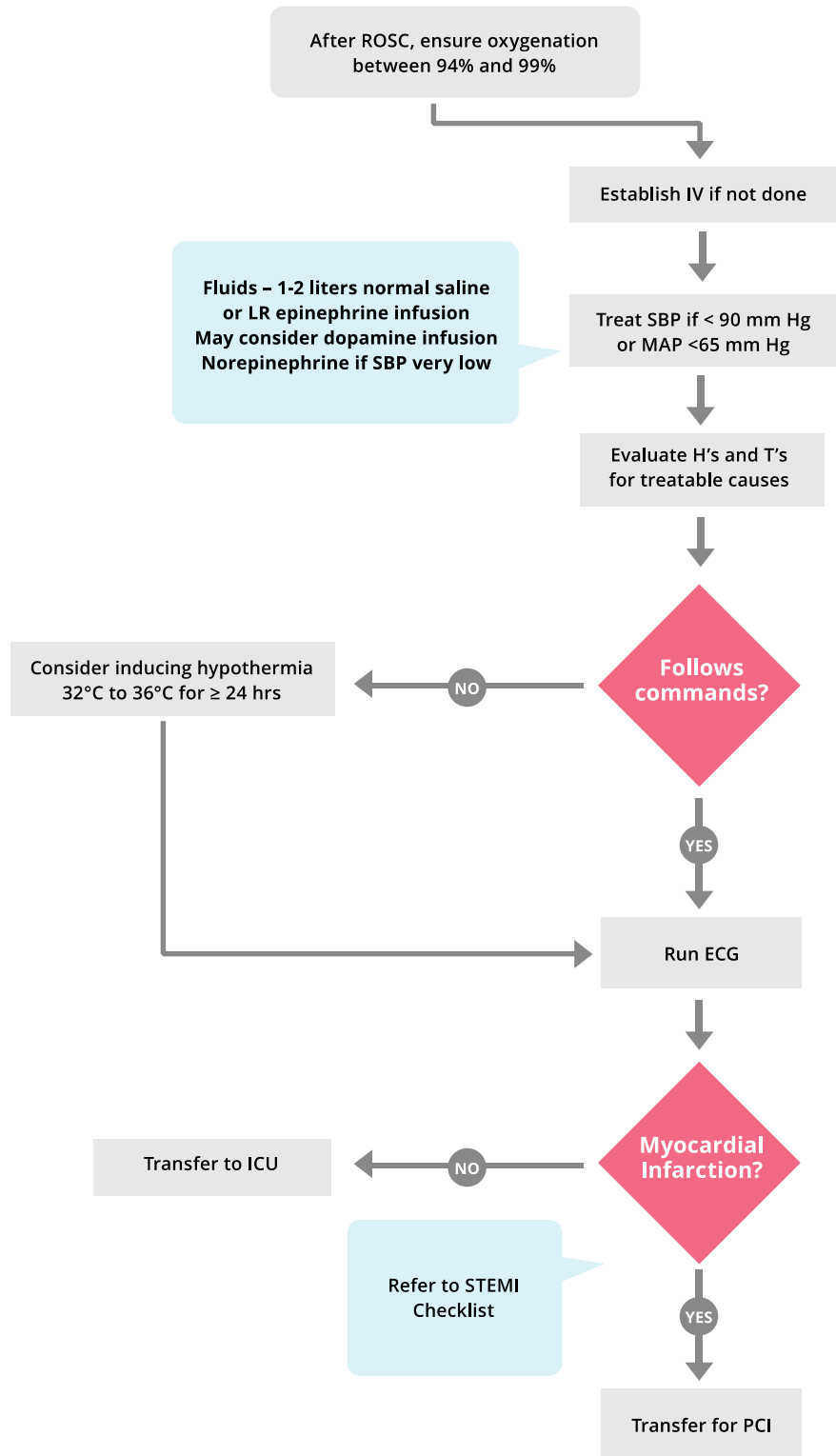


FIGURE 8: POST-CARDIAC ARREST CARE ALGORITHM

ACUTE CORONARY SYNDROME (ACS)

Acute coronary syndrome (ACS) is a range of cardiac diagnoses including ST-segment elevation myocardial infarction (STEMI), non-ST segment elevation myocardial infarction (NSTEMI) or unstable angina. Therapy goals in treatment of ACS include:

- Identification of type of cardiac event to facilitate early reperfusion when appropriate
- Relief of chest pain
- Prevention or treatment of complications (ventricular tachycardia and fibrillation and unstable tachycardia)
- Prevention of major adverse cardiac events (MACE).

ACS ALGORITHM

1. Recognize myocardial infarction signs and symptoms early in the process:
 - a. Chest pain or discomfort radiating to the arm, shoulder or jaw
 - b. Nausea, vomiting and diaphoresis
 - c. Sudden shortness of breath.
2. In the field, activate the emergency management system (EMS):
 - a. Support the airway, breathing and circulation and be prepared to provide CPR
 - b. Administer aspirin
 - c. Administer oxygen to maintain the oxygen saturation at or above 94%. Routine oxygen is not needed for people with normal oxygen levels ($\geq 94\%$)
 - d. Obtain a 12-lead ECG in the field and transmit to the receiving hospital if possible
 - e. Administer a nitroglycerin tablet every 3-5 minutes for ongoing pain
 - f. Administer morphine for pain not controlled by nitroglycerin.
3. In the emergency department (ED):
 - a. Perform a 12-lead ECG if not done
 - b. Insert an IV if not done
 - c. Administer aspirin, nitroglycerin and morphine and monitor for hypotension
 - d. Monitor oxygen saturation and titrate oxygen to keep saturation between 94% and 99%
 - e. Do a quick assessment and history
 - f. Complete the fibrinolytic checklist
 - g. Obtain lab work and chest x-ray
 - h. Based on the ECG, classify the cardiac disease into one of three categories and treat according to the category.
4. Interventional team:
 - a. Coronary angiography should be performed emergently for STEMI. PCI is preferred to fibrinolysis for STEMI. EMS should deliver patient to PCI-equipped facility when practical.
 - b. Emergent coronary angiography is reasonable for unstable, comatose patients with cardiac arrest of a suspected cardiac source, regardless of ST segment elevation or if they are conscious or comatose.
 - c. The earliest time to offer a prognosis about poor neurological outcome in patients not treated with targeted temperature management (TTM) is 72 hours—even longer in TTM.

Category	Symptom Onset	Treatments	Adjunctive Therapy
STEMI	>12 hours earlier	Use the non-STEMI algorithm	Start heparin, beta-blockers and ACE inhibitors
	<12 hours earlier	PCI available within 90 minutes - Do not give fibrinolytics	Consider heparin, beta-blockers and ACE inhibitors if treatment not delayed
		PCI not available within 90 minutes - consider fibrinolytic therapy	Consider heparin, beta-blockers and ACE inhibitors if treatment not delayed
Non-STEMI	Elevated troponin and persistent ST depression or VT or cardiac instability	Consider invasive treatments	Consider heparin, beta-blockers and ACE inhibitors
	Stable	Admit and monitor; consider statin therapy	
Non-diagnostic	Normal ECG	Consider admission for serial cardiac enzymes; If serial enzymes indicate injury, follow the non-STEMI algorithm	Discharge to home after normal imaging and serial enzymes

TABLE 5: ACS CATEGORIZATION

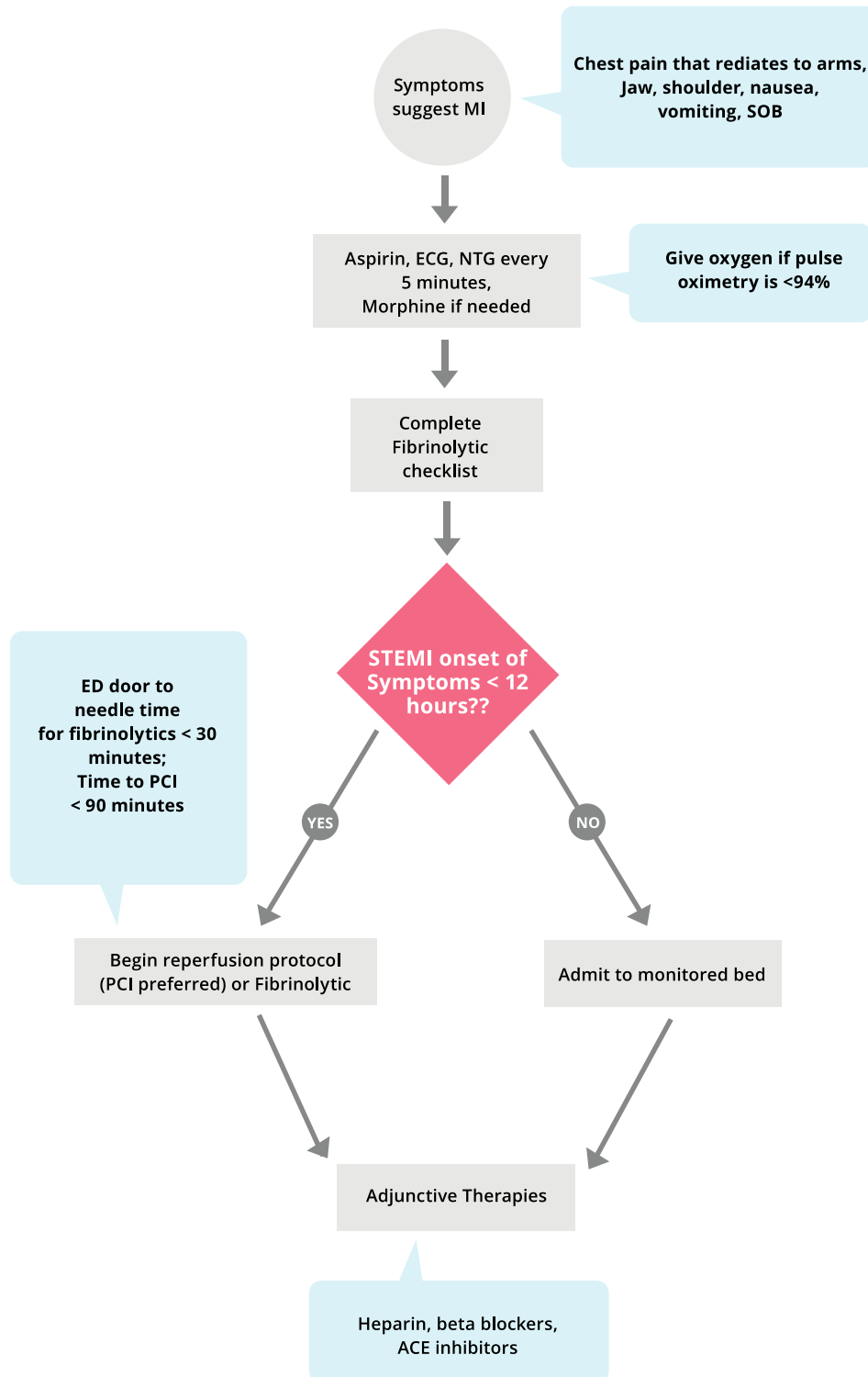


FIGURE 9: ACS ALGORITHM

BRADYCARDIA

In an adult, bradycardia is a rhythm with a rate <50 per minute. Bradycardia is defined as symptomatic when any or all of these symptoms occur:

System	Sign or Symptom
Airway	Normal
Respirations	Distress that may progress to respiratory failure
Blood pressure	Systolic blood pressure decreased
Heart rate	<50 per minute at rest
ECG	P wave and QRS complex variable; P wave and QRS complex may not be associated with each other (called 'AV Dissociation')
Peripheral pulses	Diminished or absent
Capillary refill	Increased capillary refill time
Skin	Pale and cool
Mentation	May be diminished; fatigue; dizziness

TABLE 6: SIGNS & SYMPTOMS OF BRADYCARDIA

Treatment for bradycardia should be based on controlling the symptoms and identifying the cause using the H's and T's (See Table 5: H's and T's).

For bradycardia:

1. Do not delay treatment but look for underlying causes of the bradycardia using the H's and T's (see Table 5).
2. Maintain the airway and monitor cardiac rhythm, blood pressure and oxygen saturation.
3. Insert an IV or IO for medications.
4. If the patient is stable, call for consults.
5. If the patient is symptomatic, administer atropine 0.5 mg IV or IO bolus and repeat the atropine every 3-5 minutes to a total dose of 3 mg:
 - a. If atropine does not relieve the bradycardia, continue evaluating the patient to determine the underlying cause and consider transcutaneous pacing
 - b. Consider an IV/IO dopamine infusion at 2-10 mcg/kg/minute
 - c. Consider an IV/IO epinephrine infusion at 2-10 mcg/kg/minute.

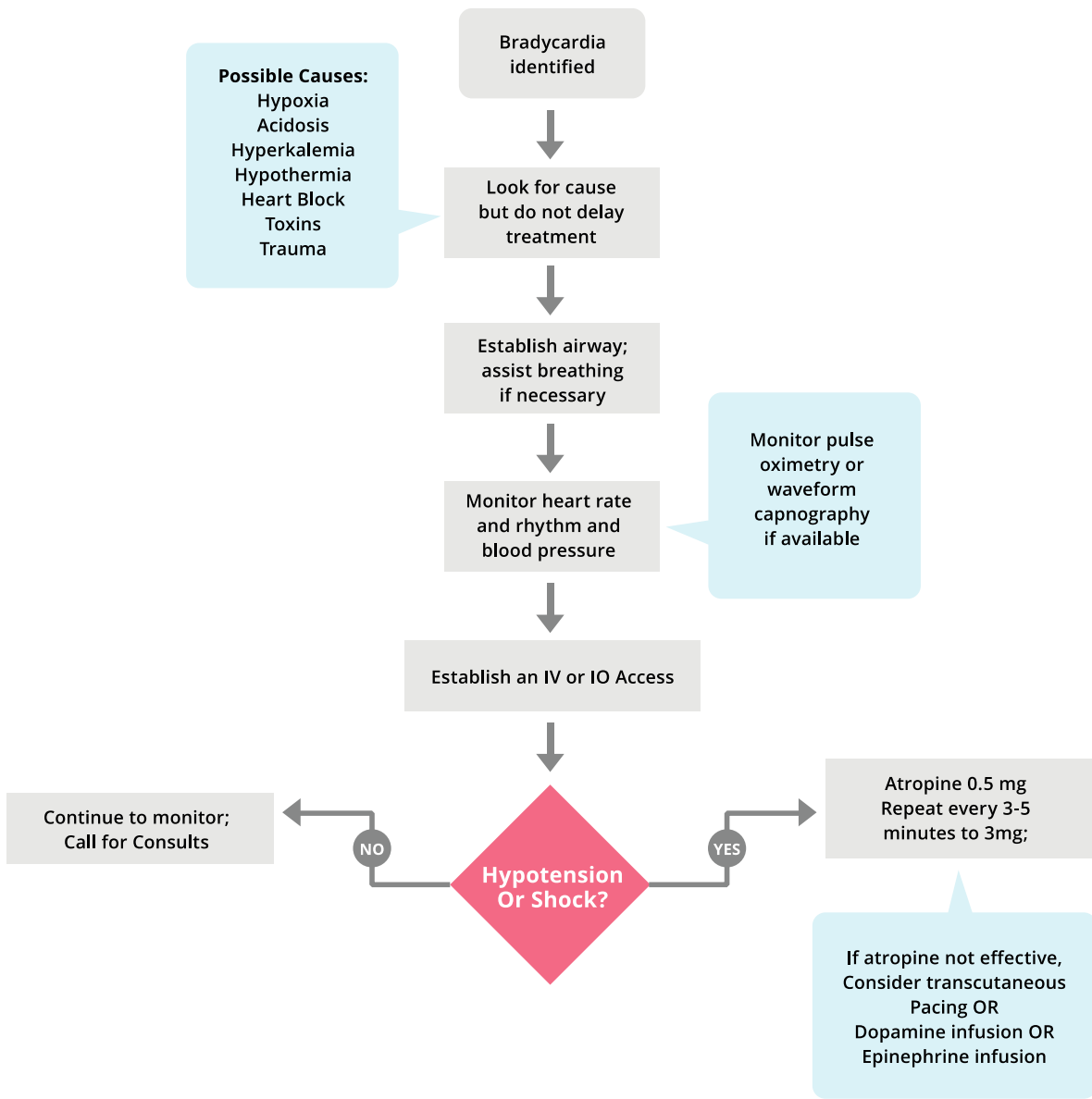


FIGURE 10: BRADYCARDIA ALGORITHM

STABLE AND UNSTABLE TACHYCARDIA

Tachycardia is a faster than normal heart rhythm (greater than 100 beats per minute for an adult) that can quickly deteriorate to cardiac arrest if left untreated. When looking at the ECG, tachycardia can be classified as narrow complex with a QRS less than 0.12 seconds or wide complex when the QRS exceeds 0.12 seconds.

A narrow complex rhythm, sinus tachycardia (ST) is not considered an arrhythmia. Originating above the ventricles of the heart, supraventricular tachycardia (SVT) may have wide or narrow QRS complex. A wide complex rhythm, VT can deteriorate to VF and cardiac arrest so must be treated immediately.

System	Atrial fib/flutter	SVT	VT
Symptom onset	Gradual onset that may be related to fever, dehydration, pain, or blood loss	Sudden onset of palpitations	Abrupt onset
Airway	Normal	Normal	Normal
Respirations	Tachypnea	Tachypnea with possible distress and wheezing	Tachypnea
Blood pressure	Variable	Systolic blood pressure usually decreased	Variable
Heart rate	Rate <150/minute that increases depending on activity	Rate >150/minute that is unaffected by activity	Typically >120 beats per minute and regular
ECG	QRS complex width <0.12 seconds; P waves and PR interval normal; R-R intervals variable	QRS complex width > or < 0.12 seconds; P waves absent or abnormal; R-R may be normal	QRS complex width >0.12 seconds; P waves may not be present; QRS complexes may be uniform or variable
Peripheral pulses	Normal	Weak	Weak
Capillary refill	Normal	Increased capillary refill time	Increased capillary refill time
Skin	Pale and cool	Diaphoretic and cool; color usually pale, gray or bluish	Pale and cool
Mentation	Fatigue and dizziness if rhythm persists	Decreased mentation with dizziness	Decreased mentation with dizziness
Treatment	If unstable, proceed to immediate synchronized cardioversion If stable, may attempt vagal maneuvers, carotid massage, or medications (adenosine, amiodarone, or procainamide)		

TABLE 7: SIGNS AND SYMPTOMS OF TACHYCARDIA

TACHYCARDIA ALGORITHM

For the tachycardic patient:

1. Identify and treat the cause of the dysrhythmia.
2. Monitor cardiac rhythm, blood pressure and oxygenation.
3. Determine if the patient is stable or unstable. Unstable tachycardia = hypotension, chest pain, symptoms of shock and possible decreased mentation.
4. For unstable tachycardia, perform immediate synchronized cardioversion:
 - a. If the QRS is *narrow* and *regular*, cardiovert with 50-100 Joules
 - b. If the QRS is *narrow* and *irregular*, cardiovert with 120-200 Joules
 - c. If the QRS is *wide* and *regular*, cardiovert with 100 Joules
 - d. If the QRS is *wide* and *irregular*, turn off the synchronization and defibrillate immediately.
5. For stable tachycardia and a prolonged QRS complex (>0.12 seconds), go to Step 7.
6. For stable tachycardia with a normal or narrow QRS complex (≤ 0.12 seconds), consider performing vagal maneuvers.
7. Establish an IV or IO to administer medications.
8. Consider giving adenosine 6 mg IV bolus; give a second double dose (12 mg) if needed.
9. If adenosine does not terminate the tachycardia, consider procainamide 20-50 mg IV (maximum dose = 17 mg/kg IV). Start a maintenance infusion of procainamide at 1-4 mg/minutes. Instead of procainamide, you may consider giving amiodarone 150 mg IV over 10 minutes with second dose for any recurrent VT. Start a maintenance infusion of amiodarone at 1 mg/min IV.

PERFORM SYNCHRONIZED CARIOVERSION

If the defibrillator has a synchronization mode, attempt to cardiovert the unstable patient with a tachycardic rhythm:

- Apply the pads
- Switch to synchronized mode
- Dial in the appropriate dose
- Charge the machine
- Ensure that no one is touching the patient or bed
- Press the buttons; the shock will be synchronized with the ECG. Therefore, the shock may not be delivered immediately. Keep clear of the bed and patient until the shock is delivered
- For continued tachycardia, ensure that the machine is still in synchronized mode, increase the dose, and repeat synchronized cardioversion.

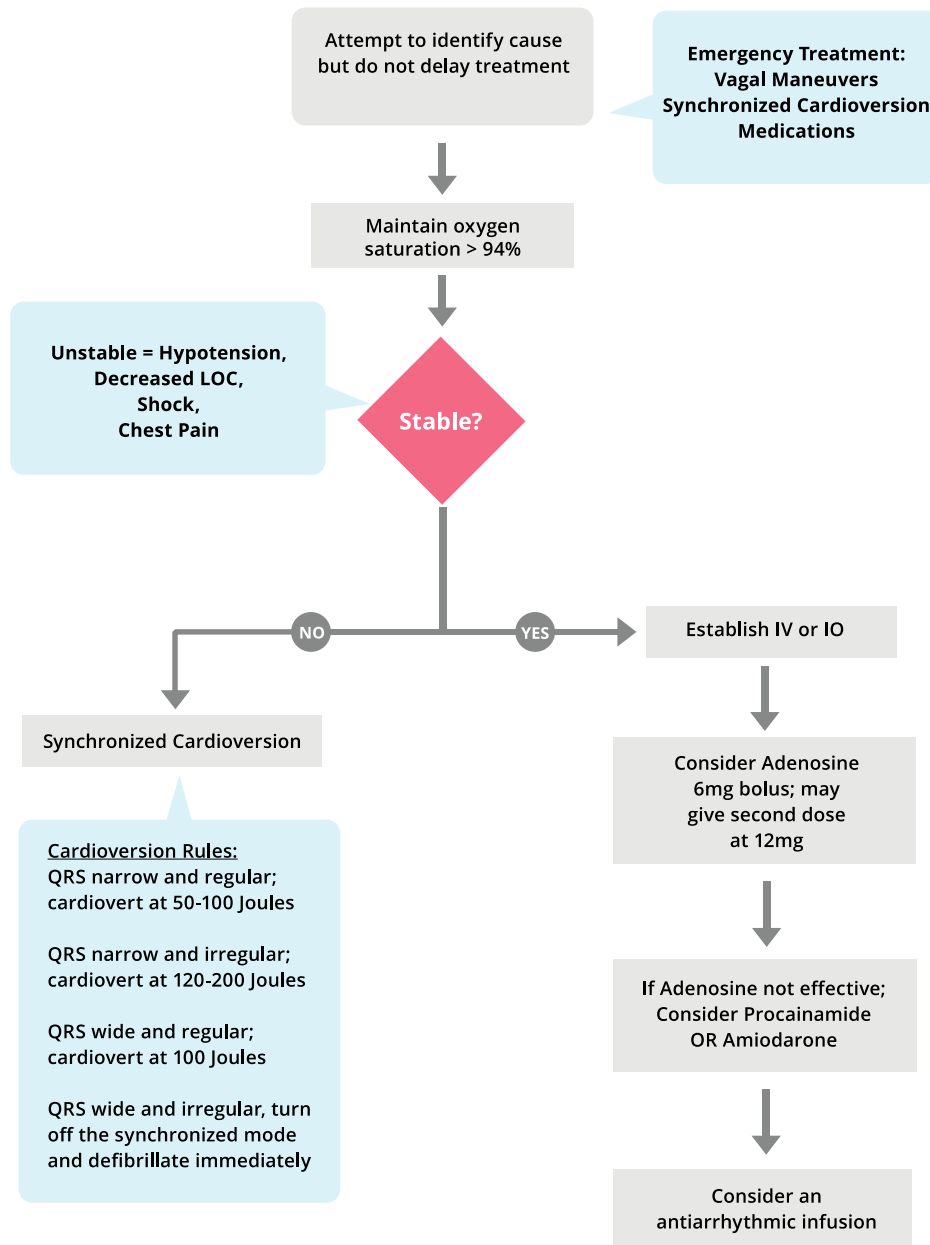


FIGURE 11: TACHYCARDIA ALGORITHM

OPIOID OVERDOSE ALGORITHM

Unresponsive victims who have a known or suspected opioid overdose should be given intranasal or intramuscular naloxone. Opioids are drugs such as heroin, methadone, and morphine. Naloxone is an opioid receptor antagonist (blocker) that can reverse the effects of excessive opioids. Intranasal (2 mg) or intramuscular (0.4 mg) naloxone should be administered to anyone in respiratory distress/arrest that is likely or definitely due to the effects of opioids. Do not delay EMS activation to administer naloxone, but also do not delay naloxone administration to activate EMS. Naloxone has a short half-life (does not last very long in the body). A repeat dose of naloxone can be given after 4 minutes if the victim starts to lose consciousness again or again experiences respiratory distress/arrest.

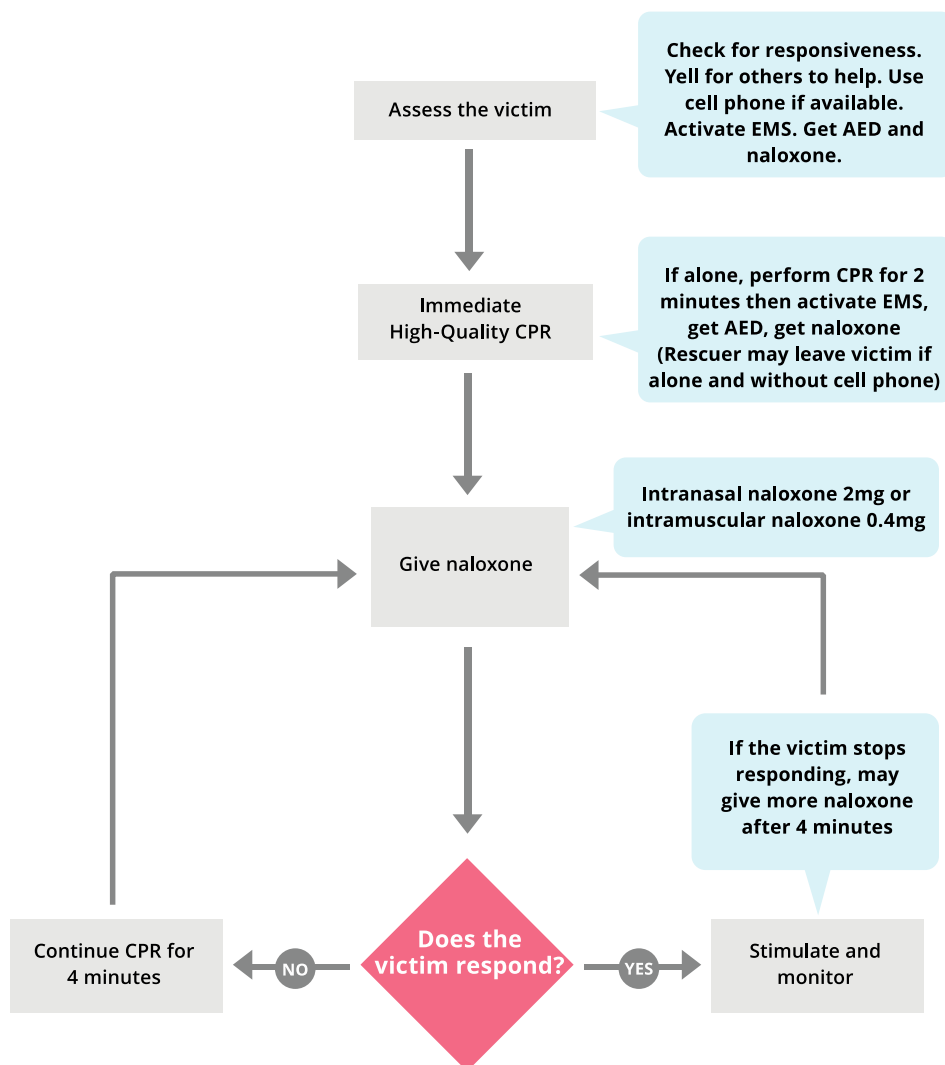


FIGURE 12: SUSPECTED OPIOID OVERDOSE ALGORITHM

ACUTE STROKE

An acute stroke can be classified as ischemic or hemorrhagic. Artery occlusion in the brain causes an ischemic stroke, while a ruptured blood vessel in the brain causes a hemorrhagic stroke. Acute stroke is covered in ACLS because, as with cardiac problems, time is critical in stroke treatment. If treatment is provided within three hours of symptom onset, an ischemic stroke can usually be treated using fibrinolytic therapy. Brain injury due to stroke can be minimized by early stroke care. Therefore, as with cardiac care, there is a stroke chain of survival.

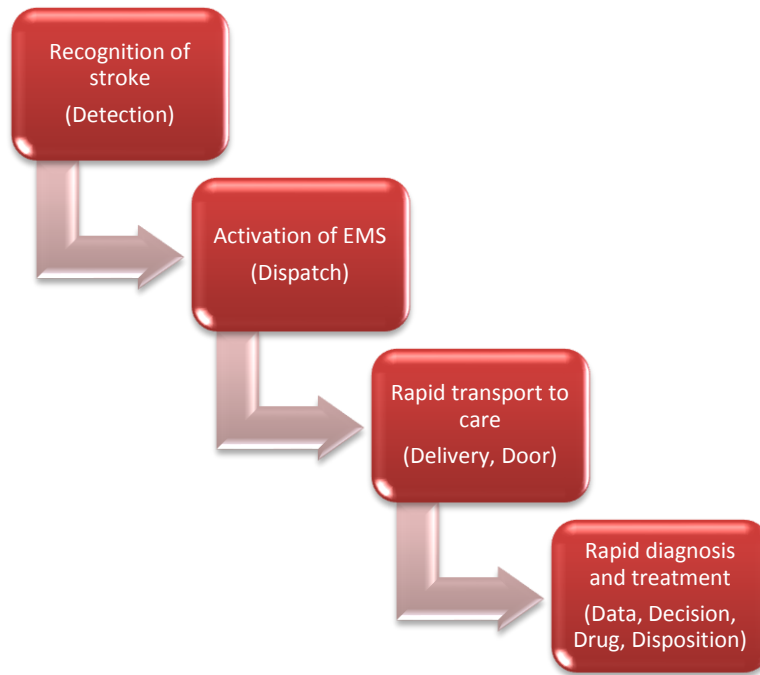


FIGURE 13: STROKE CHAIN OF SURVIVAL

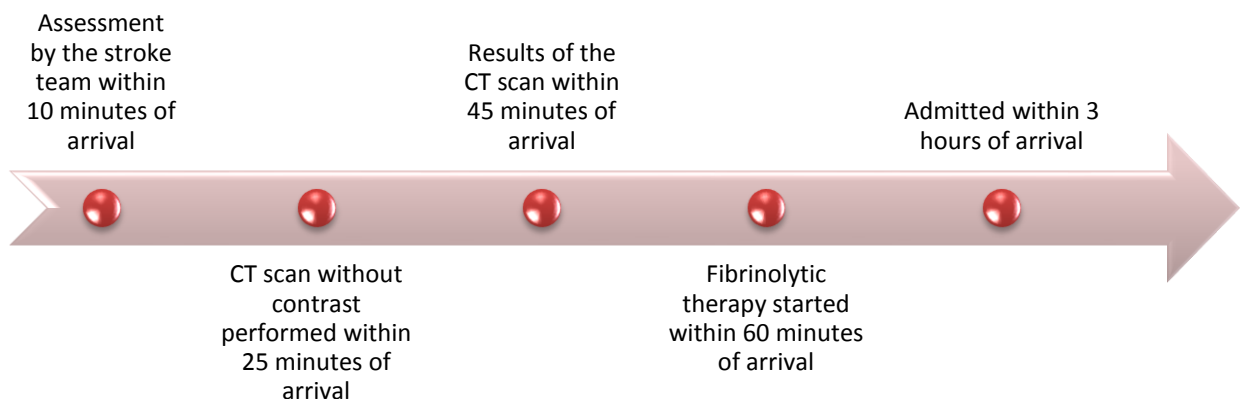


FIGURE 14: TIMELINE FOR TREATMENT OF STROKE

SUSPECTED STROKE ALGORITHM

The Stroke Algorithm emphasizes rapid assessment, identification, and intervention to minimize effects of stroke.

1. Educate the public about signs and symptoms of stroke:
 - a. Sudden weakness of one side of the face or body
 - b. Sudden confusion
 - c. Garbled speech
 - d. Sudden trouble seeing out of one or both eyes
 - e. Difficulty walking with evidence of deficit with balance or coordination
 - f. Sudden severe headache.
2. After identification of possible stroke, activate the emergency response system (ERS).
3. EMS assessment and treatments:
 - a. Rapid stroke assessment
 - i. Facial droop on one side
 - ii. Inability to keep one arm from drifting when extended in front of patient
 - iii. Garbled or inappropriate speech
 - b. Maintain the airway and O₂ saturation at >94%
 - c. Determine how long patient has been symptomatic
 - d. Alert the hospital so stroke team will be in the emergency department (ED).
4. Transport to ED of a hospital with a stroke center if available.
5. On arrival to the ED:
 - a. Continually monitor respiratory status and vital signs
 - b. Maintain oxygen saturation at >94%
 - c. If not already done, establish an IV site and send blood to the lab
 - d. Test blood sugar and treat hypoglycemia with IV glucose bolus
 - e. Assess neurological status
 - f. If stroke is suspected, consult the stroke team (if available) or neurologist
 - g. Complete a brain CT scan
 - h. Monitor cardiac rhythm and run initial ECG (if not done by EMS).
6. When the stroke team or neurologist arrives, conduct a comprehensive neurological exam using a tool such as the NIH Stroke Scale.
7. The stroke team or neurologist will consult with the radiologist to interpret the CT scan of the brain:
 - a. If the CT scan reveals a hemorrhagic stroke, admit patient to the stroke or neurological unit and consult a neurosurgeon for definitive treatment. Do **NOT** give fibrinolytics
 - b. If the CT scan reveals an ischemic stroke, review the criteria for fibrinolytic treatment:
 - i. Patient must be older than 18 years
 - ii. Diagnosis should be ischemic stroke
 - iii. Onset of symptoms must be less than 3 hours before arrival to the ED
 - iv. The stroke team or neurologist will verify that the patient is a candidate for fibrinolytic therapy. Exclusion criteria may include:
 - Stroke or head trauma in the previous 3 months
 - Subarachnoid hemorrhage at any time in the past
 - Uncorrected blood glucose under 50 mg/dL
 - Any active bleeding disorders

- Any active bleeding during the assessment
 - Systolic blood pressure over 185 mm Hg or diastolic blood pressure over 110 mm Hg.
 - v. Relative contraindications exist for any patient with a history of seizures, a major surgery in the previous two weeks, a gastrointestinal bleeding incident within the past three weeks, or an acute myocardial infarction in the last three months. If any of these conditions exist, the stroke team and neurologist should decide with the patient and family whether the benefits of fibrinolytic therapy outweigh the risks.
 - c. If the team determines that the patient should NOT receive fibrinolytic therapy, administer aspirin and admit to the neurological or stroke unit for monitoring.
 - d. If the team determines that the patient CAN receive fibrinolytic therapy, the stroke team will discuss risks and benefits with the patient's family.
- 8. Administer fibrinolytic therapy and provide associated care:
 - a. Admit the patient to the neurological or stroke unit
 - b. Maintain the airway
 - c. Monitor level of consciousness and vital signs
 - d. Maintain blood glucose between 55 and 185 mg/dL by administering insulin or glucose
 - e. Monitor for complications of fibrinolytic administration.

UNIT SIX: COMMONLY USED MEDICATIONS IN RESUSCITATION

Types, uses and dosages of drugs change very quickly. For this reason, it is critical that a qualified medical person with up-to-date knowledge of medications be primarily responsible for ordering medications during resuscitation. All members of a resuscitation team should be familiar with the most commonly used drugs, which are listed in the “ACLS Resuscitation Medications” (Table 8, below). NOTE: Doses and uses are based on AHA recommendations. Anyone that administers these drugs should be aware of and competent in the use of these medications. These drugs should only be administered by licensed medical professionals.

Drug	Type of Drug	Uses	Recommended Dosage	Side Effects	Other Notes
Adenosine	Antiarrhythmic	Supraventricular tachycardia	1st dose = 6 mg rapid IV push followed by saline bolus 2nd dose = 12 mg rapid IV push in 1-2 minutes	Headache, dizziness, metallic taste, dyspnea, hypotension, bradycardia or palpitations, nausea, flushing, sweating	Cardiac monitoring during administration; Administer through central line if available; flush with saline following administration; give very rapidly Do not use in 2nd or 3rd degree heart block
Amiodarone	Antiarrhythmic	Unstable ventricular tachycardia (VT) with pulses; ventricular fibrillation (VF); VT without pulse and unresponsive to shock	300 mg rapid bolus with 2nd dose of 150 mg if necessary to a maximum of 2.2 grams over 24 hours	Headache, dizziness, tremors, ataxia; syncope, significant hypotension, bradycardia, CHF, torsades de pointes, nausea, vomiting, diarrhea, rash, skin discoloration, hair loss,	Monitor ECG and BP; Use with caution in patients with a perfusing rhythm, hepatic failure; Do not use in 2nd or 3rd degree heart block

				flushing, coagulation abnormalities	
Atropine	Anticholinergic	Symptomatic bradycardia; toxic poisonings and overdoses	Bradycardia: 0.5 mg IV every 3- 5 minutes with 3 mg max dose; may be given by ET tube Toxins/overdose: 2-4 mg may be needed until symptoms reverse	Headache, dizziness, confusion, anxiety, flushing, blurred vision, photophobia, pupil dilation, dry mouth, tachycardia, hypotension, hypertension, nausea, vomiting, constipation, urinary retention, painful urination, rash, dry skin	Monitor ECG, oxygen, and BP; Administer before intubation if bradycardia is present; Contraindicated in glaucoma and tachyarrhythmias Doses lower than 0.5mg should not be given since this may result in worsening of bradycardia
Dopamine	Catecholamine vasopressor, inotrope	Can be given in bradycardia after atropine; can be given for Systolic BP <100 mm Hg with signs of shock	2 to 20 mcg/kg/ minute infusion titrated to response	Headache, dyspnea, palpitations, PVCs, SVT, VT, nausea/ vomiting, acute renal failure	Monitor ECG and BP; If hypovolemic, give fluid boluses first; avoid high infusion rates; Do not mix in alkaline solutions or with sodium bicarbonate

Epinephrine	Catecholamine vasopressor, Inotrope	Cardiac arrest; anaphylaxis; symptomatic bradycardia after atropine; shock when pacing and atropine are not effective	Cardiac arrest: 1.0 mg (1:10000) IV or 2-2.5 mg (1:1000) per ET tube every 3-5 minutes; follow with 0.1-0.5 mcg/kg/minute infusion titrated to response Symptomatic bradycardia or shock: 2-10 mcg/minute infusion titrated to response	Tremors, anxiety, headaches, dizziness, confusion, SVT, VT, hallucinations, dyspnea, palpitations, chest pain, hypertension, nausea, vomiting, hyperglycemia, hypokalemia, vasoconstriction	Available in 1:1000 and 1:10000 concentrations so be aware of which concentration is being used; Monitor BP, oxygen, and ECG; Administer via central line if possible to avoid the danger of tissue necrosis Do not give in cocaine induced VT
Lidocaine	Antiarrhythmic	Cardiac arrest from VF or VT Wide complex tachycardia	Cardiac Arrest: 1-1.5 mg/kg IV bolus; may repeat twice at half dose in 5-10 minutes to total of 3 mg/kg; followed with infusion of 1-4 mg per minute infusion Wide complex tachycardia with pulse: 0.5-1.5 mg/kg IV; may repeat twice at half dose in 5-10 minutes to total of 3 mg/kg; followed	Seizures, heart block, bradycardia, dyspnea, respiratory depression, nausea, vomiting, headache, dizziness, tremor, drowsiness, tinnitus, blurred vision, hypotension, rash	Monitor ECG and BP; May cause seizures; Do not give for wide complex bradycardia Do not use prophylactically in acute MI

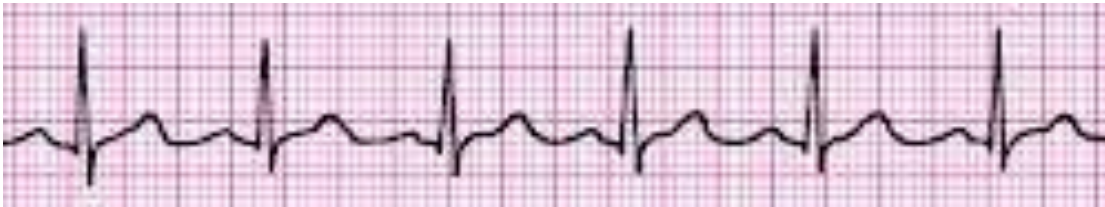
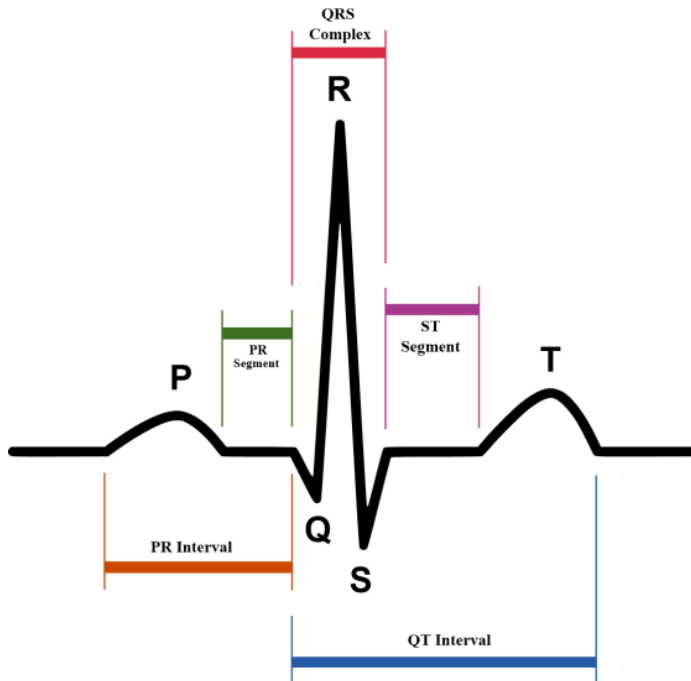
			with infusion of 1-4 mg per minute infusion		
Magnesium sulfate	Electrolyte; bronchodilator	Torsades de pointes; hypomagnesemia; digitalis toxicity	Cardiac arrest due to hypomagnesemia or torsades: 1-2 gram IV bolus Torsades with a pulse: 1-2 gram IV over 5-60 minutes followed by infusion at 0.5-1 gram per hour IV	Confusion, sedation, weakness, respiratory depression, hypotension, heart block, bradycardia, cardiac arrest, nausea, vomiting, muscle cramping, flushing, sweating	Monitor ECG, oxygen and BP; Rapid bolus may cause hypotension and bradycardia; Calcium chloride is the antidote to reverse hypermagnesemia
Oxygen	Elemental gas	Hypoxia, respiratory distress or failure, shock, trauma, cardiac arrest	In resuscitation, administer at 100% via high flow system and titrate to response to maintain oxygen saturation >94%	Headache, dry nose, mouth, possible airway obstruction if secretions become dry	Monitor oxygen saturation; Insufficient flow rates may cause carbon dioxide retention
Vasopressin	Antidiuretic hormone analogue	As alternative to epinephrine for VF/asystole/PEA Shock	Cardiac arrest: 40 units IV as replacement for 2nd or 3rd dose of epinephrine Shock: IV infusion of 0.02-0.04 units/minute	Fever; dizziness; arrhythmia; chest pain; hypertension; nausea; vomiting; abdominal cramping and pain; hives	Monitor BP and distal pulses; Watch for signs of water intoxication; Deliver through central line if possible to avoid tissue necrosis from IV extravasation

TABLE 8: ACLS RESUSCITATION MEDICATIONS

UNIT SEVEN: RHYTHM RECOGNITION

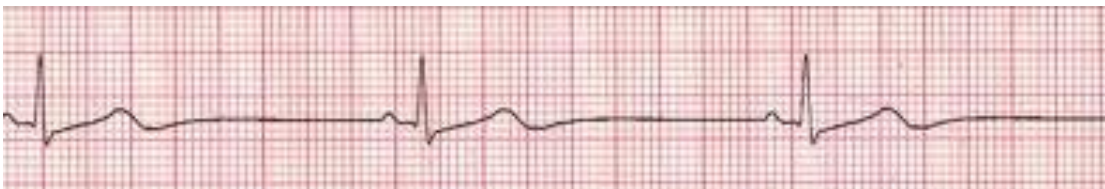
SINUS RHYTHM

A sinus rhythm is regular with normal P, Q-R-S, T deflections and intervals. Rate = 60-100 at rest.



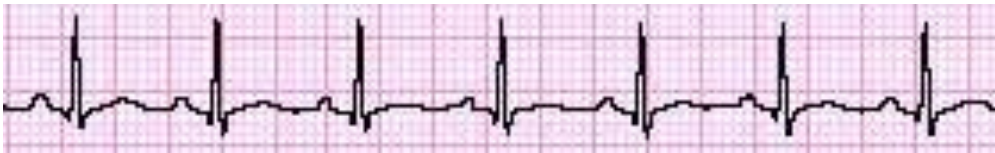
SINUS BRADYCARDIA

Sinus bradycardia is a sinus rhythm with a rate less than 60 per minute in an adult.



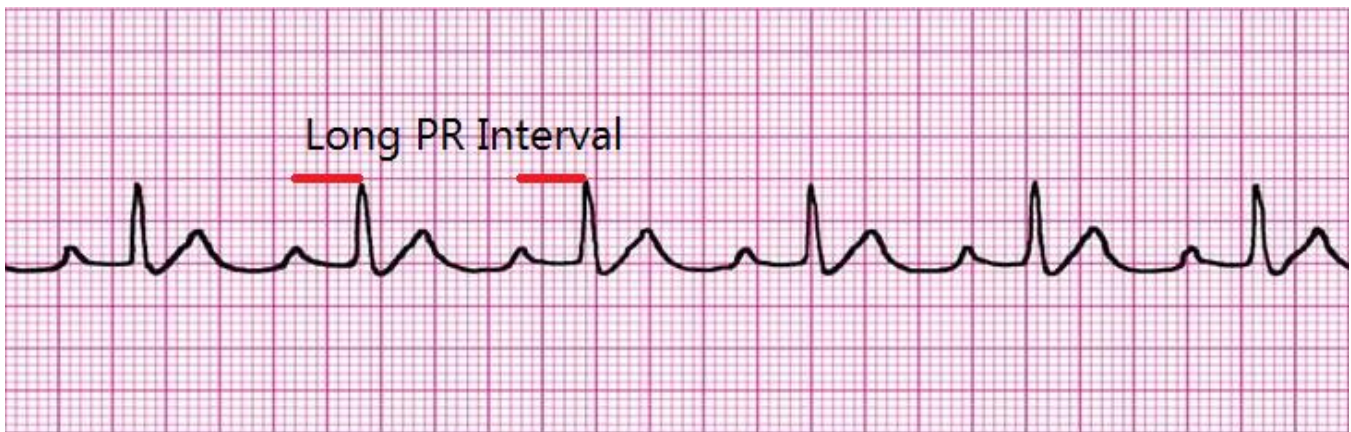
SINUS TACHYCARDIA

Sinus tachycardia is a sinus rhythm with a rate greater than 100 per minute in an adult. Note that the p waves are still present.



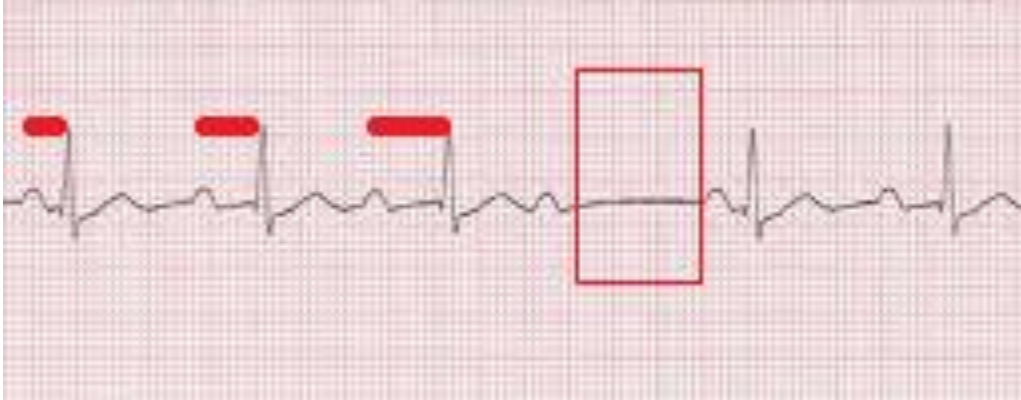
SINUS RHYTHM WITH 1ST DEGREE HEART BLOCK

Sinus rhythm with 1st degree heart block is a sinus rhythm with a prolonged PR interval >0.20 seconds due to a delay in transmission from the atria to the ventricles.



2ND DEGREE AV HEART BLOCK

A 2nd degree AV block is usually classified as Mobitz Type I (Wenckebach) or Mobitz Type II. A Mobitz Type I heart block is characterized by progressive lengthening of the PR interval until a QRS complex is dropped.

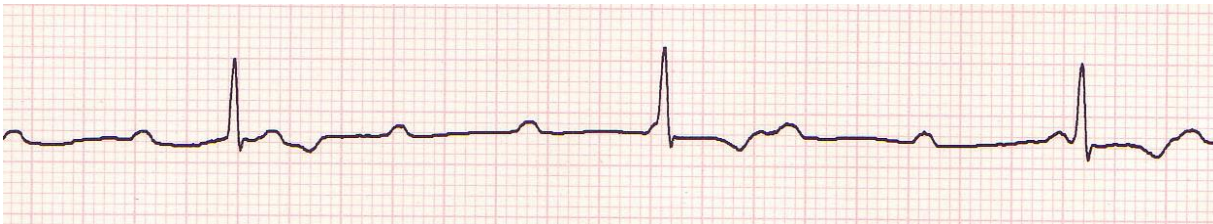


A Mobitz Type II heart block is characterized by an intermittent dropped QRS that is not in a Mobitz Type I pattern. The Mobitz Type II block must be evaluated since it can rapidly progress to a complete heart block.



3RD DEGREE HEART BLOCK

A 3rd degree heart block (sometimes called a complete heart block) is a rhythm in which there is no relationship between the P and QRS waves. In this case, the P to P intervals are regular but have no relationship to the QRS complexes on the ECG.



SUPRAVENTRICULAR TACHYCARDIA (SVT)

Supraventricular tachycardia (SVT) is an extremely fast atrial rhythm with narrow QRS complexes when the impulse originates above the bundle branches (above the ventricles).



ATRIAL FIBRILLATION (AF)

Atrial fibrillation (AF) is a very common arrhythmia. This rhythm is characterized by no waves before the QRS complex and a very irregular heart rate.



ATRIAL FLUTTER

Atrial flutter is a supraventricular arrhythmia that is characterized by a "saw-toothed" flutter appearance on the ECG that represent multiple P waves for each QRS complex.



ASYSTOLE

Asystole is also commonly known as a "flat line" where there is no electrical activity seen on the cardiac monitor. Not responsive to electrical defibrillation.



PULSELESS ELECTRICAL ACTIVITY

Can be virtually any organized ECG rhythm in a patient who is unresponsive and lacks a palpable pulse. Thus, one cannot learn a PEA rhythm. It should not be confused, however, with specific pulseless scenarios listed previously.

VENTRICULAR TACHYCARDIA (VT)

Ventricular tachycardia (VT) is characterized by bizarre widened QRS complexes, no P waves and a heart rate that usually exceeds 100 beats per minute. VT may quickly degenerate to Ventricular fibrillation and death. VT may be responsive to electrical defibrillation.



VENTRICULAR FIBRILLATION (VF)

Ventricular fibrillation (VF) is characterized by a chaotic wave pattern and no pulse. VF may be responsive to electrical defibrillation.

