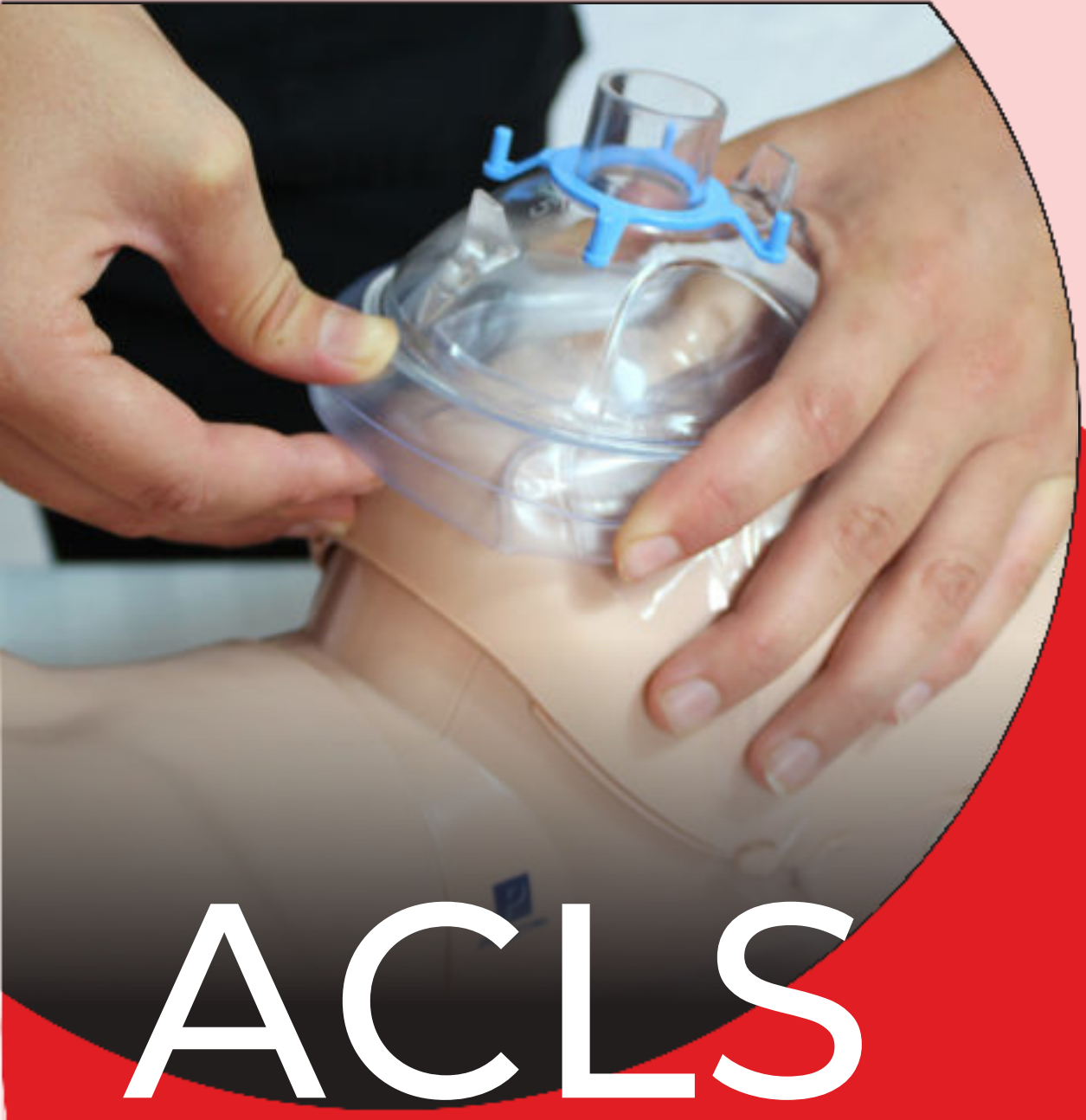


2020 - 2025
Guidelines and Standards

ACLS

Advanced Cardiac Life Support

Provider Handbook

By Dr. Karl Disque

ACLS

Advanced Cardiac Life Support

Provider Handbook

By Dr. Karl Disque

Satori Continuum Publishing
1810 E Sahara Ave. Suite 1507 Las Vegas, NV 89104

Printed in the United States of America

Educational Service Disclaimer

This Provider Handbook is an educational service provided by Satori Continuum Publishing. Use of this service is governed by the terms and conditions provided below. Please read the statements below carefully before accessing or using the service. By accessing or using this service, you agree to be bound by all of the terms and conditions herein.

The material contained in this Provider Handbook does not contain standards that are intended to be applied rigidly and explicitly followed in all cases. A health care professional's judgment must remain central to the selection of diagnostic tests and therapy options of a specific patient's medical condition. Ultimately, all liability associated with the utilization of any of the information presented here rests solely and completely with the health care provider utilizing the service.

Version 2025.01

TABLE *of* CONTENTS

TABLE *of* CONTENTS

CHAPTER 1

INTRODUCTION TO ACLS

The goal of Advanced Cardiovascular Life Support (ACLS) is to achieve the best possible outcome for individuals who are experiencing a life-threatening event. ACLS is a series of evidence-based responses simple enough to be committed to memory and recalled under moments of stress. These ACLS protocols have been developed through research, patient case studies, clinical studies, and opinions of experts in the field. The gold standard in the United States and other countries is the course curriculum published by the International Liaison Committee on Resuscitation (ILCOR).

Previously, the ILCOR published periodic updates to their Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC) guidelines on a five-year cycle, with the most recent update published in 2020. Moving forward, the ILCOR will no longer wait five years between updates; instead, it will maintain the most up-to-date recommendations online at ECCguidelines.heart.org. Health care providers are recommended to supplement the materials presented in this handbook with the guidelines published by the ILCOR and refer to the most current interventions and rationales throughout their study of ACLS.

Refer to the Basic Life Support (BLS) Provider Handbook, also Presented by the Save a Life Initiative, for a more comprehensive review of the BLS Survey. This handbook specifically covers ACLS algorithms and only briefly describes BLS. All ACLS providers are presumed capable of performing BLS correctly. While this handbook covers BLS basics, it is essential that ACLS providers be proficient in BLS first.

While ACLS providers should always be mindful of timeliness, it is important to provide the intervention that most appropriately fits the needs of the individual. Proper utilization of ACLS requires rapid and accurate assessment of the individual's condition. This not only applies to the provider's initial assessment of an individual in distress, but also to the reassessment throughout the course of treatment with ACLS.

ACLS protocols assume that the provider may not have all of the information needed from the individual or all of the resources needed to properly use ACLS in all cases. For example, if a provider is utilizing ACLS on the side of the road, they will not have access to sophisticated devices to measure breathing or arterial blood pressure. Nevertheless, in such situations, ACLS providers have the framework to provide the best possible care in the given circumstances. ACLS algorithms are based on past performances and results in similar life-threatening cases and are intended to achieve the best possible outcome for the individual during emergencies. The foundation of all algorithms involves the systematic approach of the BLS Survey and the ACLS Survey (using steps ABCD) that you will find later in this handbook.

CHAPTER 2

THE INITIAL ASSESSMENT

Determining whether an individual is conscious or unconscious can be done very quickly. If you notice someone in distress, lying down in a public place, or possibly injured, call out to them.

- *Make sure the scene is safe before approaching the individual and conducting the BLS or ACLS Survey.*
- *When encountering an individual who is "down," the first assessment to make is whether they are conscious or unconscious.*

If the individual is unconscious, then start with the BLS Survey *(Figure 20)* and move on to the ACLS Survey *(Figure 9).*

If they are conscious and responsive, obtain consent to provide care and continue assessment and questioning to determine next steps.

CHAPTER 3

BASIC LIFE SUPPORT

The ILCOR has updated the Basic Life Support (BLS) course over the years as new research in cardiac care has become available. Cardiac arrest continues to be a leading cause of death in the United States. BLS guidelines have changed dramatically, and the elements of BLS continue to be some of the most important steps in initial treatment. General concepts of BLS include:

- Quickly starting the Chain of Survival.
- Delivering high-quality chest compressions for adults, children, and infants.
- Knowing where to locate and understanding how to use an Automated External Defibrillator (AED).
- Providing rescue breathing when appropriate.
- Understanding how to perform as a team.
- Knowing how to treat choking.

INITIATING THE CHAIN OF SURVIVAL

Early initiation of BLS has been shown to increase the probability of survival for an individual dealing with cardiac arrest. To increase the odds of surviving a cardiac event, the rescuer should follow the steps in the Adult Chain of Survival *(Figure 1)*.

Adult Chain of Survival

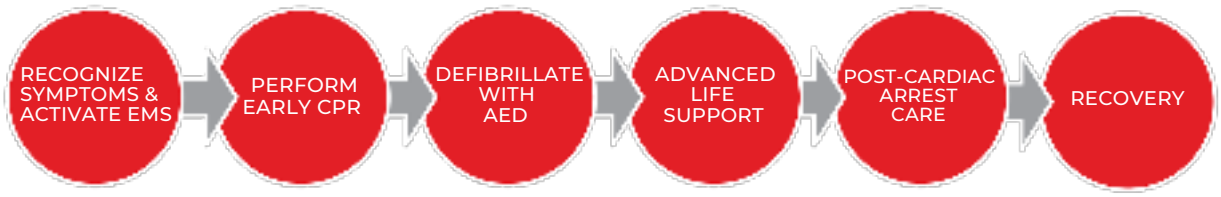


Figure 1

Emergencies in children and infants are not usually caused by the heart. Children and infants most often have breathing problems that trigger cardiac arrest. The first and most important step of the Pediatric Chain of Survival *(Figure 2)* is prevention.

Pediatric Chain of Survival

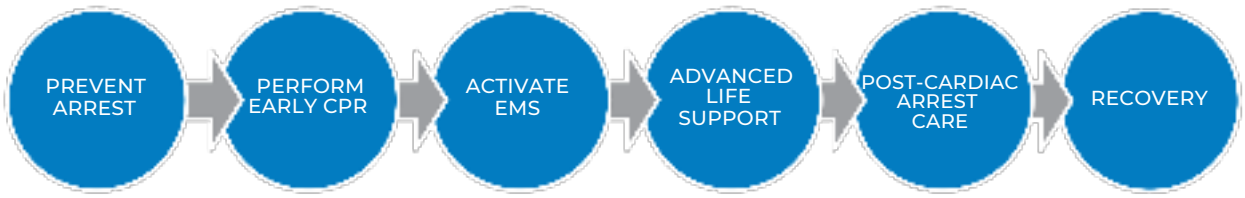


Figure 2

2020 CPR GUIDELINE CHANGES

Approximately every five years the International Liaison Committee on Resuscitation (ILCOR), updates the guidelines for CPR and ECC (Emergency Cardiac Care).

The content contained herein is based on the most recent ILCOR publications on BLS. Recommendations for adult basic life support (BLS) from the 2020 Guidelines for CPR and ECC include the following:

- The importance of early initiation of CPR by lay rescuers has been re-emphasized. The risk of harm to the patient is low if the patient is not in cardiac arrest. Bystanders should not be afraid to start CPR even if they are not sure whether the victim is breathing or in cardiac arrest.
- A sixth link, Recovery, was added to the Chains of Survival for both Pediatric and Adults.
- Care of the patient after return of spontaneous circulation (ROSC) requires close attention to oxygenation, blood pressure control, evaluation for percutaneous coronary intervention, temperature control, and multimodal neuroprognostication.
- Because recovery from cardiac arrest continues long after the initial hospitalization, patients should have formal assessment and support for their physical, cognitive, and psychosocial needs.
- After a resuscitation, debriefing for lay rescuers, EMS providers, and hospital-based healthcare workers may be beneficial to support their mental health and well-being.
- Management of cardiac arrest in pregnancy focuses on maternal resuscitation, with preparation for early perimortem cesarean delivery if necessary to save the infant and improve the chances of successful resuscitation of the mother.

BLS FOR ADULTS

BLS for adults focuses on doing several tasks simultaneously. In many situations, more than one person is available to do CPR. This choreographed method includes performing chest compressions, managing the airway, delivering rescue breaths, and using the AED, all as a team. As a team, your primary objective for CPR is to maximize chest compression time and minimize any pauses. By coordinating efforts, a team of rescuers can save valuable seconds when time lost equals damage to the heart and brain.

Simple Adult BLS Algorithm

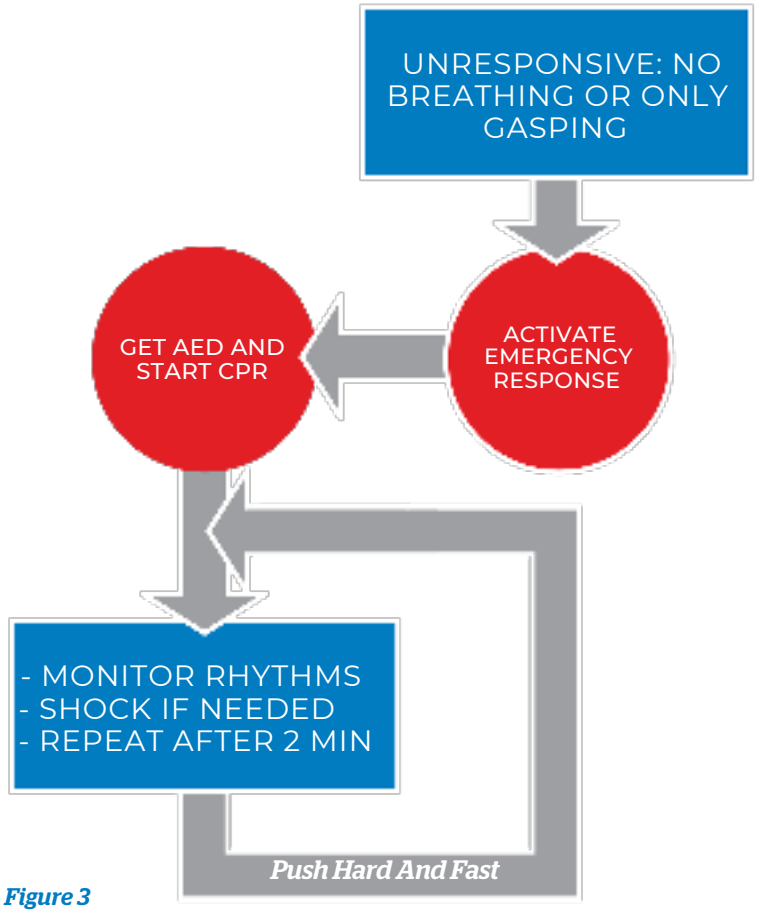


Figure 3

ONE-RESCUER BLS/CPR FOR ADULT

Be Safe

- If inside, watch for dangers such as construction debris, unsecured weapons, violent individuals, electrical hazards.
- If outside, watch out for downed electrical wires, leaking fuel from car accidents, building collapse, or natural disaster/dangerous weather conditions. (Drowning persons should be removed from the water and dried off; they should also be removed from standing water, such as puddles, pools, gutters, etc.).
- Be sure you do not become injured yourself.

Assess the Person

- Tap hard on their shoulder and shout "Hey, are you OK?" Yell their name if you know it.
- Check to see if the person is breathing. (Agonal breathing, which is occasional gasping and is ineffective, does not count as breathing.)

Call EMS

- Send someone for help and to get an AED.
- If alone, call for help while assessing for breathing and pulse. (The ILCOR emphasizes that cell phones are available everywhere now and most have a built-in speakerphone. Call for help without leaving the person.)

CPR

- Check pulse simultaneously with checking for breathing. Do not pause more than 10 seconds to check for breathing and pulse.
- Begin chest compressions and delivering breaths.

Defibrillate

- Turn on the AED upon arrival and attach the pads when directed.
- Listen and perform the steps as directed.

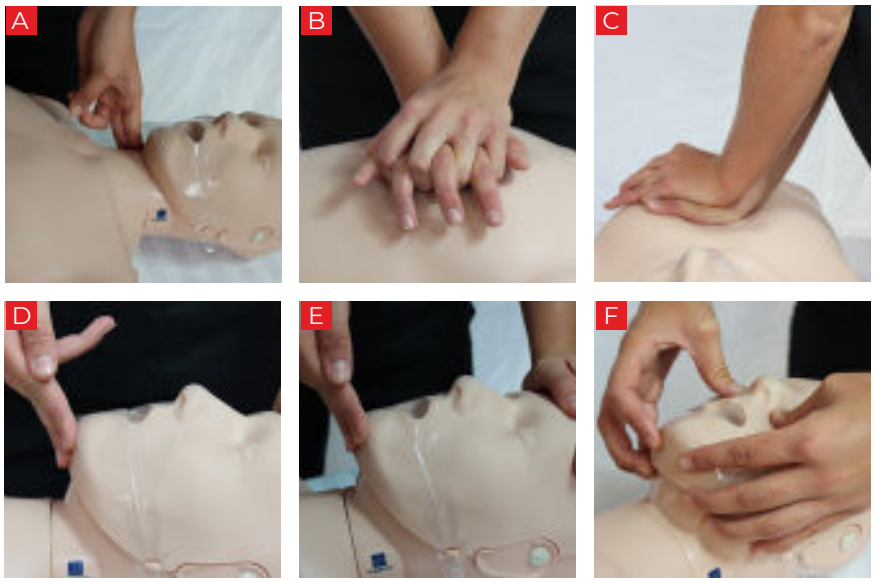


Figure 4

CPR Steps for Adults

1. Check for the carotid pulse on the side of the neck *(Figure 4a)*. Keep in mind not to waste time trying to feel for a pulse; feel for no more than 10 seconds. If you are not sure you feel a pulse, begin CPR with a cycle of 30 chest compressions and two breaths.
2. Use the heel of one hand on the lower half of the sternum in the middle of the chest *(Figure 4b)*.
3. Put your other hand on top of the first hand *(Figure 4b)*.
4. Straighten your arms and press straight down *(Figure 4c)*. Compressions should be 2 to 2.4" (5 to 6 cm) into the person's chest and at a rate of 100 to 120 compressions per minute.
5. Be sure that between each compression you completely stop pressing on the chest and allow the chest wall to return to its natural position. Leaning or resting on the chest between compressions can keep the heart from refilling in between each compression and make CPR less effective.
6. After 30 compressions, stop compressions and open the airway by tilting the head and lifting the chin *(Figure 4d & 4e)*.
    a. Put your hand on the person's forehead and tilt the head back.
    b. Lift the person's jaw by placing your index and middle fingers on the lower jaw; lift up.
7. Give a breath while watching the chest rise. Repeat while giving a second breath. Breaths should be delivered over one second.
8. Resume chest compressions. Switch quickly between compressions and rescue breaths to minimize interruptions in chest compressions.

TWO-RESCUER BLS/CPR FOR ADULTS

Many times there will be a second person available who can act as a rescuer. The ILCOR emphasizes that cell phones are available everywhere now and most have a built-in speakerphone. Direct the second rescuer to call 911 or your local EMS number without leaving the person while you begin CPR. This second rescuer can also find an AED while you stay with the person. When the second rescuer returns, the CPR tasks can be shared:

1. The second rescuer prepares the AED for use.
2. You begin chest compressions and count the compressions out loud.
3. The second rescuer applies the AED pads.
4. The second rescuer opens the person's airway and gives rescue breaths.
5. Switch roles after every five cycles of compressions and breaths. One cycle consists of 30 compressions and two breaths for Adults.
6. Be sure that between each compression you completely stop pressing on the chest and allow the chest wall to return to its natural position. Leaning or resting on the chest between compressions can keep the heart from refilling in between each compression and make CPR less effective. Rescuers who become tired may tend to lean on the chest more during compressions; switching roles helps rescuers perform high-quality compressions.
7. Quickly switch between roles to minimize interruptions in delivering chest compressions.
8. When the AED is connected, minimize interruptions of CPR by switching rescuers while the AED analyzes the heart rhythm. If a shock is indicated, minimize interruptions in CPR. Resume CPR as soon as possible with chest compressions.

Figure 5

ADULT MOUTH-TO-MASK VENTILATION

In one-rescuer CPR, breaths should be supplied using a pocket mask, if available.

1. Give 30 high-quality chest compressions.
2. Seal the mask against the person's face by placing four fingers of one hand across the top of the mask and the thumb of the other hand along the bottom edge of the mask *(Figure 5a)*.
3. Using the fingers of your hand on the bottom of the mask, open the airway using the head-tilt/chin-lift maneuver. If a cervical injury is suspected, consider alternative methods. *(Figure 5b)*.
4. Press firmly around the edges of the mask and ventilate by delivering a breath over one second as you watch the person's chest rise *(Figure 5c)*.
5. If there is disinterest in providing ventilation (because of an airborne illness suspicion), hands-only CPR would be an equivalent option.

Figure 6

ADULT BAG-MASK VENTILATION IN TWO-RESCUER CPR

If two people are present and a bag-mask device is available, the second rescuer is positioned at the victim's head while the other rescuer performs high-quality chest compressions.

1. Deliver 30 high-quality chest compressions while counting out loud *(Figure 6a)*.
2. The second rescuer holds the bag-mask with one hand using the thumb and index finger in the shape of a "C" on one side of the mask to form a seal between the mask and the face, while the other fingers open the airway by lifting the person's lower jaw *(Figure 6b)*. If possible, keep the mask on the face at all times, only remove if necessary, to reduce gross exhalation exposure to rescuers.
3. The second rescuer gives two breaths over one second each as you watch the person's chest rise *(Figure 6c)*.
4. Practice using the bag valve mask; it is essential to forming a tight seal and delivering effective breaths.

Adult BLS Algorithm

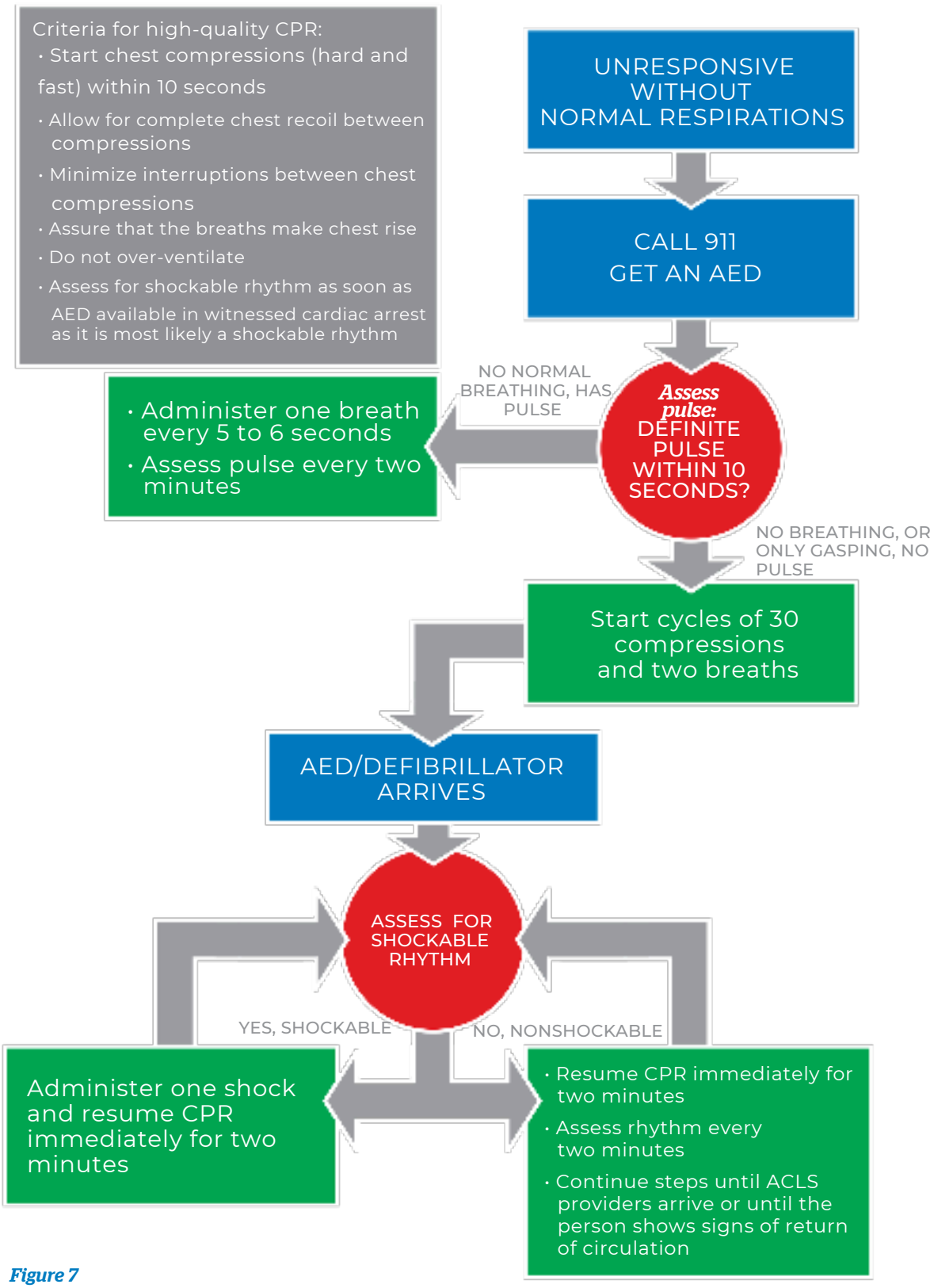


Figure 7

BLS FOR CHILDREN/INFANTS

BLS for children and infants also focuses on doing several tasks simultaneously. In many situations, more than one person is available to do CPR.

This simultaneous and choreographed method includes performing chest compressions, managing the airway, delivering rescue breaths, and using the AED, all as a team. By coordinating efforts, a team of rescuers can save valuable seconds when time lost equals damage to the heart and brain.

ONE-RESCUER BLS/CPR FOR CHILDREN (AGE 1 TO PUBERTY)

Be Safe

- Move the child out of traffic or any unsafe situation.
- Move the child out of water and dry the child. (Drowning children should be removed from the water and dried off; they should also be removed from standing water, such as puddles, pools, gutters, etc.)
- Be sure you do not become injured yourself.

Assess the Child

- Tap hard on their shoulder and talk to them loudly, saying their name.
- Check to see if the child is breathing while simultaneously checking their carotid pulse. (Agonal breathing, which is occasional gasping and is ineffective, does not count as breathing.)
- Keep in mind not to waste time trying to feel for a pulse; feel for at least 5 seconds but no more than 10 seconds. If you are not sure you feel a pulse, begin CPR with a cycle of 30 chest compressions and two breaths.

Call EMS

- Send someone for help and to get an AED.
- If alone, shout for help while assessing for breathing and pulse. (The ILCOR emphasizes that cell phones are available everywhere now and most have a built-in speakerphone. Call for help without leaving the child.)
- If no one answers and you do not have a cell phone available, perform 2 minutes of CPR before taking a moment to find help.

CPR

- Begin CPR with chest compressions and delivering breaths in a ratio of 30:2.

Defibrillate

- Attach the AED when it becomes available. Use pediatric pads for children under the age of 8 and less than 55 pounds (25 kg).
- Listen to the AED and perform the steps as directed.

CPR STEPS FOR CHILDREN

1. Use the heel of one hand on the lower half of the sternum in the middle of the chest.
2. Put your other hand on top of the first hand.
3. Straighten your arms and press straight down. Compressions should be about two inches (5 cm) into the child's chest and at a rate of 100 to 120 compressions per minute.
4. Be sure that between each compression you completely stop pressing on the chest and allow the chest wall to return to its natural position. Leaning or resting on the chest between compressions can keep the heart from refilling in between each compression and make CPR less effective.
5. After 30 compressions, or 15 compressions for two rescuers, stop compressions and open the airway by tilting the head and lifting the chin.
    a. Put your hand on the child's forehead and tilt the head back. Lift the child's jaw by placing your index and middle fingers on the lower jaw; lift up.
    b. If their lips are closed, open the lower lip using your thumb.
6. Give a breath while watching the chest rise. Repeat while giving a second breath. Breaths should be delivered over one second.
7. Resume chest compressions. Switch quickly between compressions and rescue breaths to minimize interruptions in chest compressions.

ONE-RESCUER BLS/CPR FOR INFANT (NEWBORN TO AGE 12 MONTHS)

Be Safe

- Move the infant out of traffic or any unsafe situation.
- Move the infant out of water and dry the infant. (Drowning infants should be removed from the water and dried off; they should also be removed from standing water, such as puddles, pools, gutters, etc.)
- Be sure you do not become injured yourself.

Assess the Infant

- Tap the bottom of the infant's foot and talk to them loudly, saying their name.
- Check to see if the infant is breathing while simultaneously checking their brachial pulse. (Agonal breathing, which is occasional gasping and is ineffective, does not count as breathing.)
- Keep in mind not to waste time trying to feel for a pulse; feel for at least 5 seconds but no more than 10 seconds. If you are not sure you feel a pulse, begin CPR with a cycle of 30 chest compressions and two breaths.

Call EMS

- Send someone for help and to get an AED.
- If alone, shout for help while assessing for breathing and pulse. (The ILCOR emphasizes that cell phones are available everywhere now and most have a built-in speakerphone. Call for help without leaving the infant.)
- If no one answers and you do not have a cell phone available, perform 2 minutes of CPR before taking a moment to find help.

CPR

- Begin CPR with chest compressions and delivering breaths in a ratio of 30:2.

Defibrillate

- Attach the AED when it becomes available. Use pediatric pads for infants and place the pads in an anterior-posterior position if they would overlap on the front of the chest.
- Listen to the AED and perform the steps as directed.

CPR STEPS FOR INFANTS

1. Place 2 or 3 fingers of one hand on the sternum in the middle of the nipple line *(Figure 46)*.

2. Press straight down. Compressions should be 1.5 inches (4 cm) into the infant's chest (or about 1/3 the diameter of the chest) and at a rate of 100 to 120 compressions per minute.

3. Be sure that between each compression you completely stop pressing on the chest and allow the chest wall to return to its natural position. Leaning or resting on the chest between compressions can keep the heart from refilling in between each compression and make CPR less effective.

Figure 46

4. After 30 compressions, or 15 compressions for 2 rescuers, stop compressions and open the airway by tilting the head and lifting the chin.

    a. Put your hand on the infant's forehead and tilt the head back. Lift the infant's jaw by placing your index and middle fingers on the lower jaw; lift up. Aim for a neutral neck position and do not overextend the neck.

    b. If their lips are closed, open the lower lip using your thumb.

5. Give a breath while watching the chest rise. Repeat while giving a second breath. Breaths should be delivered over one second.

6. Resume chest compressions. Switch quickly between compressions and rescue breaths to minimize interruptions in chest compressions.

CHILD/INFANT MOUTH-TO-MASK VENTILATION

Figure 47

In one-rescuer CPR, breaths should be supplied using a pediatric pocket mask, if available.

1. Deliver 30 (or 15 if there are two providers) high-quality chest compressions while counting out loud.
2. Seal the mask against the child's face by placing four fingers of one hand across the top of the mask and the thumb of the other hand along the bottom edge of the mask *(Figure 47)*.
3. Using the fingers of your hand on the bottom of the mask, open the airway using the head-tilt/chin-lift maneuver. (Don't do this if you suspect the child may have a neck injury).
4. Press firmly around the edges of the mask and ventilate by delivering a breath over one second as you watch the child's chest rise.
5. Practice using the pocket mask; it is essential to form a tight seal in delivering effective breaths.

CHILD/INFANT BAG-VALVE-MASK VENTILATION IN TWO-RESCUER CPR

If two people are present and a bag-valve-mask device (BVM) is available, the second rescuer is positioned at the victim's head while the other rescuer performs high-quality chest compressions.

Figure 48

1. Deliver 15 high-quality chest compressions while counting out loud.
2. The second rescuer holds the BVM with one hand using the thumb and index finger in the shape of a "C" on one side of the mask to form a seal between the mask and the face *(Figure 48)*, while the other fingers open the airway by lifting the child's lower jaw.
3. The first rescuer squeezes the bag giving two breaths over one second each. Watch for chest rise.
4. Practice using the BVM; it is essential to form a tight seal in delivering effective breaths.

SELF-ASSESSMENT FOR BLS

1. Which of the following is true regarding BLS?
    a. It is obsolete.
    b. Recent changes prohibit mouth-to-mouth.
    c. It should be mastered prior to ACLS.
    d. It has little impact on survival.

2. What is the first step in the assessment of an individual found "down"?
    a. Check their blood pressure.
    b. Check their heart rate.
    c. Check to see if they are conscious or unconscious.
    d. Check their pupil size.

3. What factor is critical in any emergency situation?
    a. Scene safety
    b. Age of the individual
    c. Resuscitation status
    d. Pregnancy status

4. CPR is initiated on an Adult and the person's pulse returns, but he is not breathing. What ventilation rate should be used for this person?
    a. 6-8 breaths per minute
    b. 10-12 breaths per minute
    c. 18-20 breaths per minute
    d. Depends on his color

5. Arrange the BLS Chain of Survival in the proper order:
    a. Look, listen, and feel
    b. Check responsiveness, call EMS and get AED, defibrillation, and recovery
    c. Check responsiveness, call EMS and get AED, chest compressions, early defibrillation, and recovery
    d. Call for help, shock, check pulse, shock, and transport

6. After activating EMS and sending someone for an AED, which of the following is correct for one-rescuer BLS of an unresponsive individual with no pulse?
    a. Start rescue breathing.
    b. Apply AED pads.
    c. Run to get help.
    d. Begin chest compressions.

ANSWERS

1. C
   ACLS providers are presumed to have mastered BLS skills. CPR is a critical part of resuscitating cardiac arrest victims.
2. C
   When responding to an individual who is “down,” first determine if they are conscious or not.
3. A
   Always assess the safety of the scene in any emergency situation. Do not become injured yourself.
4. B
   Most experts recommend a ventilation rate of 10-12 breaths per minute for adults.
5. C
   The focus is on early CPR and defibrillation.
6. D
   An unresponsive adult without a pulse must receive CPR, and chest compressions should be initiated immediately followed by ventilation.

CHAPTER 4

ADVANCED CARDIAC LIFE SUPPORT

NORMAL HEART ANATOMY AND PHYSIOLOGY

Understanding normal cardiac anatomy and physiology is an important component of performing ACLS. The heart is a hollow muscle composed of four chambers surrounded by thick walls of tissue (septum). The atria are the two upper chambers and the ventricles are the two lower chambers. The left and right halves of the heart work together to pump blood throughout the body. The right atrium (RA) and the right ventricle (RV) pump deoxygenated blood to the lungs where it becomes oxygenated. This oxygen-rich blood returns to the left atrium (LA) and then enters the left ventricle (LV). The LV is the main pump that delivers the newly oxygenated blood to the rest of the body.

Blood leaves the heart through a large vessel known as the aorta. Valves between each pair of connected chambers prevent the backflow of blood. The two atria contract simultaneously, as do the ventricles, making the contractions of the heart go from top to bottom. Each beat begins in the RA. The LV is the largest and thickest-walled of the four chambers, as it is responsible for pumping the newly oxygenated blood to the rest of the body. The sinoatrial (SA) node in the RA creates the electrical activity that acts as the heart's natural pacemaker. This electrical impulse then travels to the atrioventricular (AV) node, which lies between the atria and ventricles *(Figure 8a)*. After pausing there briefly, the electrical impulse moves on to the His – Purkinje system, which acts like wiring to conduct the electrical signal into the LV and RV. This electrical signal causes the heart muscle to contract and pump blood.

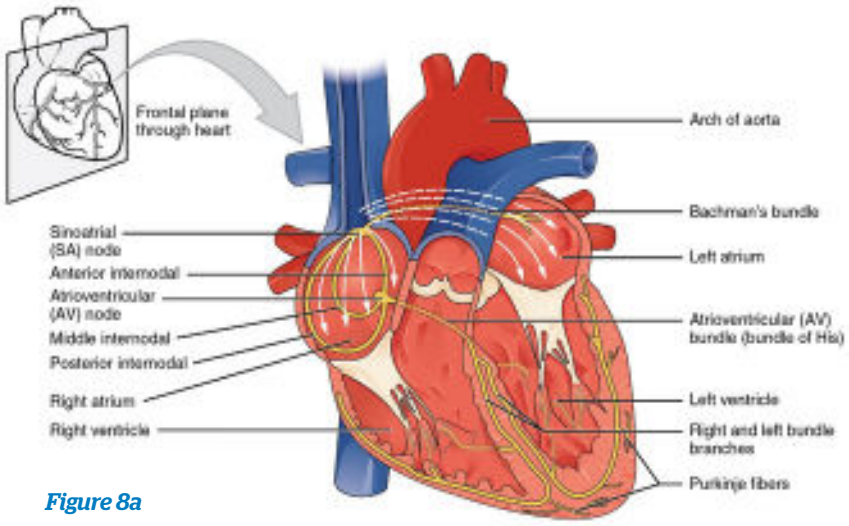


Figure 8a

By understanding the normal electrical function of the heart, it will be easy to understand abnormal functions. When blood enters the atria of the heart, an electrical impulse that is sent out from the SA node conducts through the atria resulting in atrial contraction.

This atrial contraction registers on an electrocardiogram (ECG) strip as the P wave. This impulse then travels to the AV node, which in turn conducts the electrical impulse through the Bundle of His, bundle branches, and Purkinje fibers of the ventricles causing ventricular contraction. The time between the start of atrial contraction and the start of ventricular contraction registers on an ECG strip as the PR interval. The ventricular contraction registers on the ECG strip as the QRS complex. Following ventricular contraction, the ventricles rest and repolarize, which is registered on the ECG strip as the T wave. The atria also repolarize, but this coincides with the QRS complex, and therefore, cannot be observed on the ECG strip. Together a P wave, QRS complex, and T wave at proper intervals are indicative of normal sinus rhythm (NSR) *(Figure 8b, found below)*. Abnormalities that are in the conduction system can cause delays in the transmission of the electrical impulse and are detected on the ECG. These deviations from normal conduction can result in dysrhythmias such as heart blocks, pauses, tachycardias and bradycardias, blocks, and dropped beats. These rhythm disturbances will be covered in more detail further in the handbook.

ACLS RHYTHMS AND INTERPRETATION

Understanding and accurately interpreting ACLS rhythms is critical for health care professionals involved in advanced cardiac life support. Proficiency in this area enables timely identification of life-threatening arrhythmias and guides appropriate interventions, ultimately improving patient outcomes during cardiac emergencies.

IMPORTANCE OF MASTERING ACLS RHYTHMS

- **Rapid Recognition:** Quickly identifying ACLS rhythms such as ventricular fibrillation, ventricular tachycardia, asystole, and pulseless electrical activity is essential for initiating the correct treatment protocols.
- **Effective Intervention:** Knowledge of ACLS rhythms ensures that health care providers can administer the appropriate medications and therapies in accordance with the latest guidelines.
- **Improved Patient Outcomes:** Accurate interpretation of ACLS rhythms contributes to higher survival rates and better neurological outcomes for cardiac event patients.

STEP 1: RECAP THE PQRST PROPERTIES

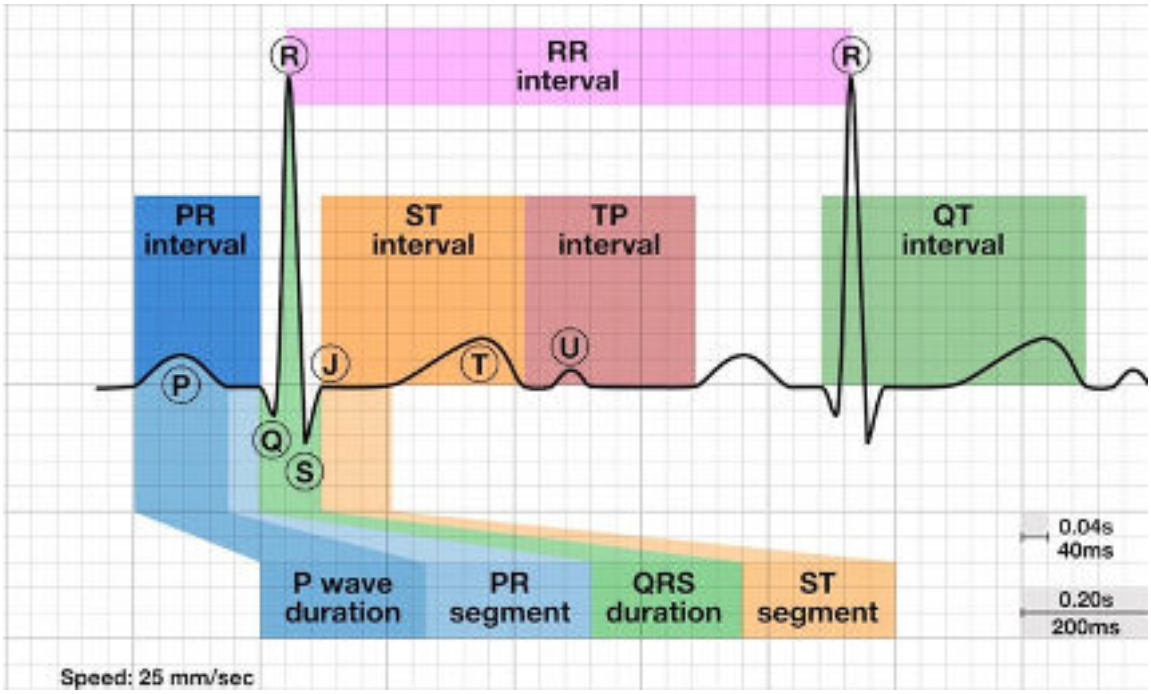


Figure 8b

See the Prototypical ECG Tracing Chart on the following page.

PROTOTYPICAL ECG TRACING	
P-wave	*Electrical activity is traveling through the atria. Synonymous with atrial depolarization. Reflects atrial contraction.*
QRS Complex	*Electrical activity is traveling through the ventricles. Depolarization of the left and right ventricles. Reflects ventricular contraction.*
T-wave	*Synonymous with ventricular repolarization. Reflects the start of ventricular relaxation.*
PR Interval	*Onset of the P-wave to the start of the QRS complex. Reflects conduction through the atrioventricular (AV) node.*
PR Segment	*End of the P-wave to the start of the QRS complex. Reflects time delay between atrial and ventricular activation.*
ST Interval	*Onset of the S-wave to the start of the T-wave. Reflects initial, slow phase of ventricular repolarization.*
ST Segment	*End of the S-wave (J point) to the start of the T-wave. Reflects ventricular repolarization.*
QT Interval	*Onset of the QRS complex to the end of the T-wave. Reflects the period between ventricular depolarization and ventricular repolarization.*
TP Interval	*The TP segment is the portion of the ECG from the end of the T wave to the beginning of the P wave*
RR Interval	*Reflects time elapsed between two successive R-waves of the QRS.*

STEP 2: IDENTIFY THE COMMON CATEGORIES OF ACLS RHYTHMS WITH A FEW EXAMPLES

Sinus rhythms:

- Normal sinus rhythm (NSR)
- Sinus bradycardia
- Sinus tachycardia

Bradyarrhythmia and Conduction Blocks:

- 1st degree AV block
- 2nd degree AV block Type I (Mobitz Type I, Wenckebach's)
- 2nd degree AV block Type II (Mobitz Type II)
- 3rd degree AV block (complete heart block, CHB)

Tachyarrhythmias:

- Supraventricular tachycardia (SVT)
- Wide-complex tachycardias

Pulseless rhythms:

- Pulseless ventricular tachycardia (vTach)
- Ventricular fibrillation (vFib)
- Pulseless electrical activity (PEA)
- Asystole

Atrial Dysrhythmias:

- Atrial flutter
- Atrial fibrillation (aFib)

STEP 3: IDENTIFY THE MOST COMMON ACLS RHYTHMS

Normal Sinus Rhythm (NSR)

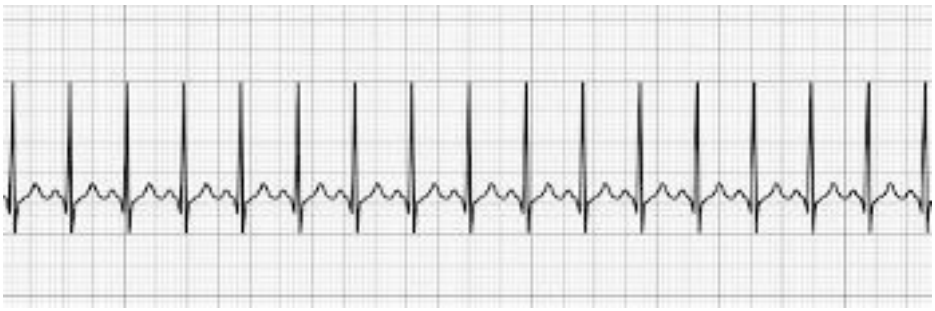
- Normal P-wave
- Normal QRS Complex
- Normal T-wave
- HR: 60-100 BPM (at rest)
- Treatment: None

Sinus Bradycardia

- Normal P-wave
- Normal QRS Complex
- Normal T-wave
- HR: <60 BPM (at rest)
- Treatment (Symptomatic): Atropine, Dopamine (infusion), Epinephrine (infusion)

Sinus Tachycardia

- Normal P-wave
- Normal QRS Complex
- Normal T-wave
- HR: >100 BPM (at rest)
- Treatment: Reverse underlying condition (fever, anxiety, exercise), beta-blockers (metoprolol, sotalol)



1st Degree Heart Block

- Prolonged PR interval due to delay in AV signal transmission
- P-wave may be buried in the preceding T-wave
- Treatment: Transcutaneous pacing (only indicated if prolongation of the PR interval is >400 ms)

2nd Degree AV Block Type I (Mobitz Type I, Wenckebach's)

- Progressive lengthening of the PR interval
- Progression occurs until the QRS complex is dropped
- Treatment: Atropine, Dopamine, Transcutaneous pacing

2nd Degree AV Block Type II (Mobitz Type II)

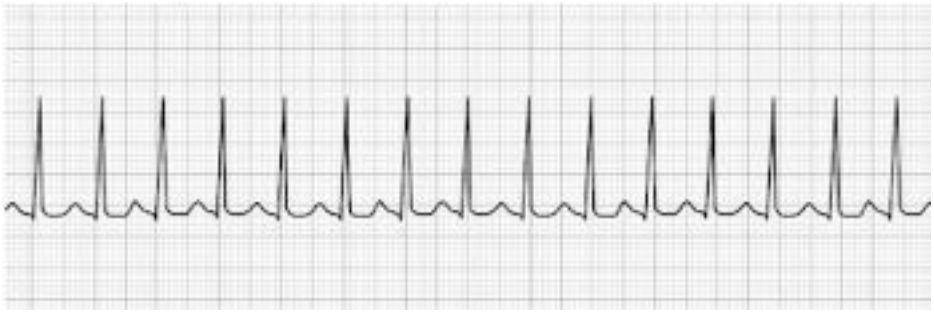
- PR interval is > 0.20 seconds and consistent (not gradually getting longer) but drops a beat, generally on a pattern of 3:1 or 4:1
- Treatment: Transcutaneous pacing

3rd Degree AV Block (complete heart block, CHB)

- No identifiable relationship between the P-wave and QRS waves
- P-P intervals are normal but do not relate to the QRS complex
- Treatment: Transcutaneous pacing

Supraventricular Tachycardia (SVT)

- Profoundly rapid atrial rhythm with narrow QRS complexes
- Occurs when the signal impulse originates over the bundle branches
- HR: 150-250 BPM
- Treatment: Vagal maneuvers, Adenosine, synchronized cardioversion



Atrial Fibrillation (aFib)

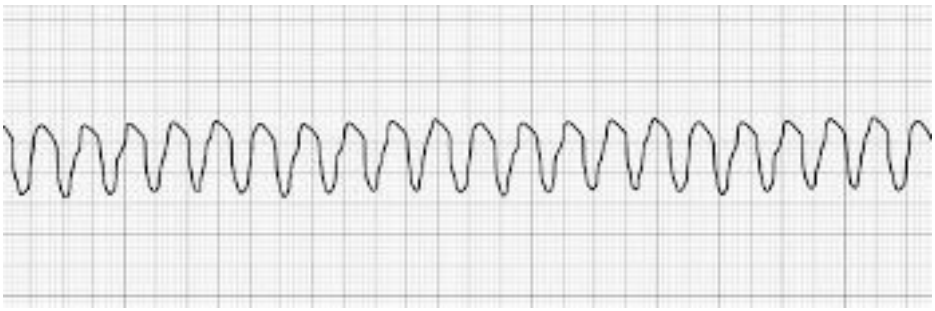
- Uniquely characterized by an absence of P-waves before the QRS complex
- HR: Highly irregular with significant fluctuation
- Treatment: beta-blockers (Metoprolol, Sotalol, etc.), Ca++ channel blockers (Diltiazem, Verapamil, etc.), Digoxin, synchronized cardioversion.

Atrial Flutter

- Uniquely characterized by a saw-toothed flutter appearance
- Toothed fluttering represents multiple P-waves for a single QRS complex
- Treatment: synchronized cardioversion, beta-blockers (Metoprolol, Sotalol, etc.), Ca++ channel blockers (Diltiazem, Verapamil, etc), Digoxin.

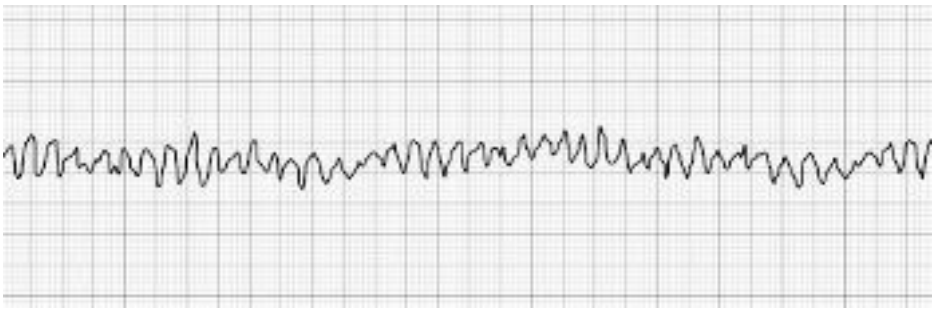
Ventricular Tachycardia (vTach)

- Abnormally-patterned wide QRS complex
- No P-waves
- High likelihood of rapid deterioration to a state of ventricular fibrillation (vFib)
- HR: >100 BPM
- Treatment: Defibrillation



Pulseless Ventricular Fibrillation (vFib)

- Characterized by a chaotic and disorganized wave pattern
- Patient has no palpable pulse
- Treatment: Defibrillation, epinephrine, amiodarone, lidocaine HCl



TIPS FOR ENHANCING ACLS RHYTHM INTERPRETATION SKILLS

- **Regular Practice:** Engage in continuous education and practice ECG interpretation to become more familiar with various ACLS rhythms.
- **Utilize Resources:** Leverage educational materials, such as textbooks, online courses, and simulation tools focused on ACLS rhythms.
- **Stay Updated:** Keep abreast of the latest ACLS guidelines and recommendations to ensure your knowledge of ACLS rhythms is current.

THE ACLS SURVEY (A-B-C-D)

AIRWAY

Monitor and maintain an open airway at all times. The provider must decide if the benefit of adding an advanced airway outweighs the risk of pausing CPR. If the individual's chest is rising without using an advanced airway, continue giving CPR without pausing. However, if you are in a hospital or near trained professionals who can efficiently insert and use the airway, consider pausing CPR for a maximum of 10 seconds.

BREATHING

In cardiac arrest, administer 100% oxygen. Keep blood O2 saturation (sats) greater than or equal to 94 percent as measured by a pulse oximeter. Use quantitative waveform capnography when possible. Normal partial pressure of CO2 is between 35 to 40 mmHg.

High-quality CPR should produce an ETCO2 between 10 to 20 mmHg. If the ETCO2 reading is less than 10 mmHg, confirm the quality of CPR and placement of advanced airway. If still less than 10 mmHg after 20 minutes of CPR for an intubated individual, then you may consider stopping resuscitation attempts.

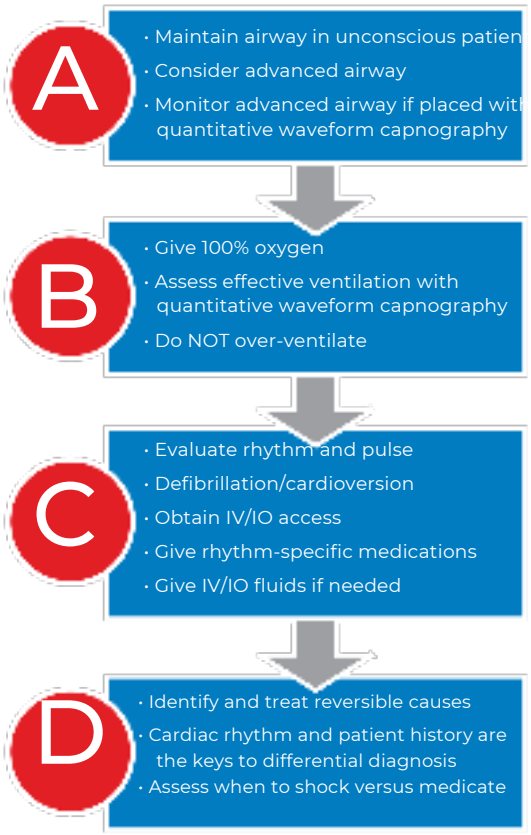


Figure 9

CIRCULATION

Obtain intravenous (IV) access when possible. However, if after two unsuccessful attempts, go straight to intraosseous access (IO). Monitor blood pressure with a blood pressure cuff or intra-arterial line if available. Monitor the heart rhythm using pads and a cardiac monitor. When using an AED, follow the directions (i.e., shock a shockable rhythm). Give fluids when appropriate. Use cardiovascular medications when indicated.

DIFFERENTIAL DIAGNOSIS

Start with the most likely cause of the arrest and then assess for less likely causes. Treat reversible causes and continue CPR as you create a differential diagnosis. Stop only briefly to confirm a diagnosis or to treat reversible causes. Minimizing interruptions in perfusion is key.

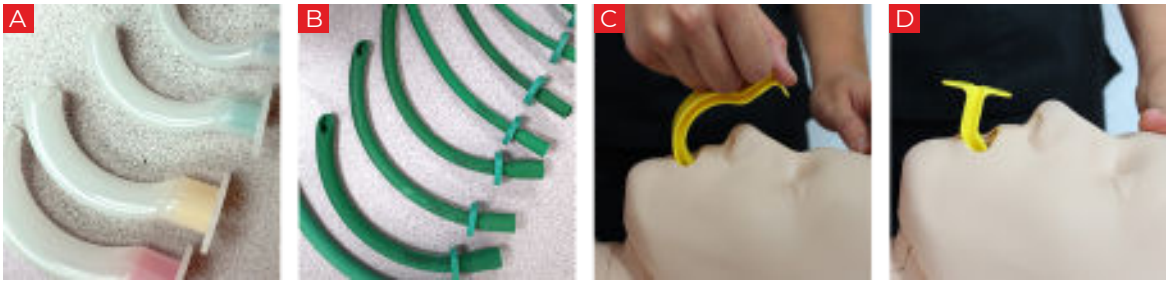


Figure 10

AIRWAY MANAGEMENT

If bag-mask ventilation is adequate, providers may defer insertion of an advanced airway. Health care providers should make the decision as to the appropriateness of placing an advanced airway during the ACLS Survey. The value of securing the airway must be balanced against the need to minimize the interruption in perfusion that results in halting compressions during airway placement.

Basic airway equipment includes the oropharyngeal airway (OPA) and the nasopharyngeal airway (NPA). The primary difference between an OPA *(Figure 10a)* and a NPA *(Figure 10b)* is that an OPA is placed in the mouth *(Figure 10c and 10d)* while an NPA is inserted through the nose. Both airway equipment terminate in the pharynx. The main advantage of an NPA over an OPA is that it can be used in either conscious or unconscious individuals because the device does not stimulate the gag reflex.

Advanced airway equipment includes the laryngeal mask airway, laryngeal tube, esophageal-tracheal tube, and endotracheal tube. Different styles of these supraglottic airways are available. If it is within your scope of practice, you may use advanced airway equipment when appropriate and available.

BASIC AIRWAY ADJUNCTS

OROPHARYNGEAL AIRWAY (OPA)

The OPA is a J-shaped device that fits over the tongue to hold the soft hypopharyngeal structures and the tongue away from the posterior wall of the pharynx. OPA is used in individuals who are at risk for developing airway obstruction from the tongue or from relaxed upper airway muscle. A properly sized and inserted OPA results in proper alignment with the glottis opening.

If efforts to open the airway fail to provide and maintain a clear, unobstructed airway, then use the OPA in unconscious victims. An OPA should not be used in a conscious or semiconscious individual, because it can stimulate gagging, vomiting, and possible aspiration. The key assessment to determine if an OPA can be placed is to check if the individual has an intact cough and gag reflex. If so, do not use an OPA.

NASOPHARYNGEAL AIRWAY (NPA)

The NPA is a soft rubber or plastic uncuffed tube that provides a conduit for airflow between the nares and the pharynx. It is used as an alternative to an OPA in individuals who need a basic airway management adjunct.

- *Only use an OPA in unresponsive individuals with NO cough or gag reflex. Otherwise, an OPA may stimulate vomiting, laryngeal spasm, or aspiration.*
- *An NPA can be used in conscious individuals with intact cough and gag reflex. However, use carefully in individuals with facial trauma due to the risk of displacement.*
- *Keep in mind that the individual is not receiving 100% oxygen while suctioning. Interrupt suctioning and administer oxygen if any deterioration in clinical picture is observed during suctioning.*

Unlike the oral airway, NPAs may be used in conscious or semiconscious individuals (individuals with intact cough and gag reflex). The NPA is indicated when insertion of an OPA is technically difficult or dangerous. NPA placement can be facilitated by the use of a lubricant. Never force placement of the NPA as severe nosebleeds may occur. If it does not fit in one nare, try the other side. Use caution or avoid placing NPAs in individuals with obvious facial fractures.

SUCTIONING

Suctioning is an essential component of maintaining a patent airway. Providers should suction the airway immediately if there are copious secretions, blood, or vomit. Attempts at suctioning should not exceed 10 seconds. To avoid hypoxemia, follow suctioning attempts with a short period of 100% oxygen administration.

Monitor the individual's heart rate, oxygen saturation, and clinical appearance during suctioning. If a change in monitoring parameters is seen, interrupt suctioning and administer oxygen until the heart rate returns to normal and until clinical condition improves. Assist ventilation as warranted.

BASIC AIRWAY TECHNIQUE

INSERTING AN OPA

STEP 1: Clear the mouth of blood and secretions with suction if possible.

STEP 2: Select an airway device that is the correct size for the person.

- Too large of an airway device can damage the throat.
- Too small of an airway device can press the tongue into the airway.

STEP 3: Place the device at the side of the person's face. Choose the device that extends from the corner of the mouth to the earlobe.

STEP 4: Insert the device into the mouth so the point is toward the roof of the mouth or parallel to the teeth.

- Do not press the tongue back into the throat.

STEP 5: Once the device is almost fully inserted, turn it until the tongue is cupped by the interior curve of the device.

INSERTING AN NPA

STEP 1: Select an airway device that is the correct size for the person.

STEP 2: Place the device at the side of the person's face. Choose the device that extends from the tip of the nose to the earlobe. Use the largest diameter device that will fit.

STEP 3: Lubricate the airway with a water-soluble lubricant or anesthetic jelly.

STEP 4: Insert the device slowly, moving straight into the face (not toward the brain).

STEP 5: It should feel snug; do not force the device into the nostril. If it feels stuck, remove it and try the other nostril.

- *OPAs too large or too small may obstruct the airway.*
- *NPAs sized incorrectly may enter the esophagus.*
- *Always check for spontaneous respirations after insertion of either device.*

TIPS ON SUCTIONING

- When suctioning the oropharynx, do not insert the catheter too deeply. Extend the catheter to the maximum safe depth and suction as you withdraw.
- When suctioning an endotracheal (ET) tube, keep in mind the tube is within the trachea and that you may be suctioning near the bronchi or lung. Therefore, sterile technique should be used.
- Each suction attempt should be for no longer than 10 seconds. Remember the person will not get oxygen during suctioning.
- Ideally, hyper oxygenate before any suction attempts to eliminate that oxygen loss.
- Monitor vital signs during suctioning and stop suctioning immediately if the person experiences hypoxemia (oxygen sats less than 94%), has a new arrhythmia or becomes cyanotic.

ADVANCED AIRWAY ADJUNCTS

ENDOTRACHEAL TUBE

The endotracheal (ET) tube is an advanced airway alternative. It is a specific type of tracheal tube that is inserted through the mouth or nose. It is the most technically difficult airway to place; however, it is the most secure airway available. Only experienced providers should perform ET intubation. This technique requires the use of a laryngoscope. Fiber optic portable laryngoscopes have a video screen, improve success, and are gaining popularity for field use.

LARYNGEAL MASK AIRWAY

The laryngeal mask airway (LMA) is an advanced airway alternative to ET intubation and provides comparable ventilation. It is acceptable to use the LMA as an alternative to an esophageal-tracheal tube for airway management in cardiac arrest. Experience will allow rapid placement of the LMA device by an ACLS provider.

LARYNGEAL TUBE

The advantages of the laryngeal tube are similar to those of the esophageal-tracheal tube; however, the laryngeal tube is more compact and less complicated to insert. This tube has only one larger balloon to inflate and can be inserted blindly.

- *During CPR, the chest compression to ventilation rate for adults is 30:2.*
- *If advanced airway is placed, do not interrupt chest compressions for breaths. Give one breath every 6 seconds with continuous chest compressions.*

ESOPHAGEAL-TRACHEAL TUBE

The esophageal-tracheal tube (sometimes referred to as a combitube) is an advanced airway alternative to ET intubation. This device provides adequate ventilation comparable to an ET tube. The combitube has two separate balloons that must be inflated and two separate ports. The provider must correctly determine which port to ventilate through to provide adequate oxygenation.

ROUTES OF ACCESS

Historically in ACLS, providers have administered drugs via the intravenous (IV) or the ET route. ET absorption of drugs is poor, and optimal drug dosing is unknown. Therefore, the intraosseous (IO) route is now preferred when IV access is not available. Below are the priorities for vascular access.

INTRAVENOUS ROUTE

A peripheral IV is preferred for drug and fluid administration unless central line access is already available. Central line access is not necessary during most resuscitation attempts, as it may cause interruptions in CPR and complications during insertion. Placing a peripheral line does not require CPR interruption.

If a drug is given via peripheral route of administration, do the following:

1. Intravenously push bolus injection (unless otherwise indicated).
2. Flush with 20 mL of fluid or saline.
3. Raise extremity for 10 to 20 seconds to enhance delivery of drug to circulation.

- *When using peripheral IV route of administration, drugs can take up to two minutes or more to reach central circulation. The effect of medications given may not be seen until even longer. High-quality CPR helps circulate these drugs and is an important part of resuscitation.*
- *Any ACLS drug or fluid that can be administered intravenously can also be given intraosseously.*
- *If possible, administer any medication IV or IO early in any two-minute CPR segment.*

INTRAOSSEOUS ROUTE

Drugs and fluids can be delivered safely and effectively during resuscitation via the IO route if IV access is not available.

IO access can be used for all age groups, can be placed in less than one minute, and has more predictable absorption than the ET route.

PHARMACOLOGICAL TOOLS

Use of any of the ACLS medication in Table 1 should be done within your scope of practice and after thorough study of the actions and side effects. This table only provides a brief reminder for those who are already knowledgeable in the use of these medications. Moreover, Table 1 contains only adult doses, indications, and routes of administration for the most common ACLS drugs.

Doses, Routes, and Uses of Common Drug

DRUG	MAIN ACLS USE	DOSE/IV/IO	NOTES
Adenosine	• *Narrow PSVT/SVT* • *Wide QRS tachycardia, avoid adenosine in irregular wide QRS*	• *6 mg IV bolus, may repeat with 12 mg in 1 to 2 min*	• *Rapid IV push close to the hub, followed by a saline bolus* • *Continuous cardiac monitoring during administration* • *Causes flushing and chest heaviness* • *Ideally, use a 3mL syringe, 3-way stopcock, and a 10mL flush to administer the adenosine efficiently.*
Amiodarone	• *VF/pulseless VT* • *VT with pulse* • *Tachycardia rate control*	• *Conscious VT/VF: 150mg over 10 minutes, followed by a drip* • *Unconscious VF/VT: 300mg, add 150 mg if not effective* • *Max dose: 450mg*	• *Anticipate hypotension, bradycardia, and gastrointestinal toxicity* • *Continuous cardiac monitoring* • *Very long half-life (up to 40 days)* • *Do not use in 2nd or 3rd-degree heart block* • *Do not administer via the ET tube route*
Atropine	• *Symptomatic bradycardia*	• *1 mg IV/IO* • *Max dose: 3 mg*	• *Cardiac and BP monitoring* • *Do not use in glaucoma or tachyarrhythmias* • *Minimum dose 0.5 mg*
	• *Specific toxins/overdose (e.g. organophosphates)*	• *2 to 4 mg IV/IO may be needed*	
Dopamine	• *Shock/CHF* • *Symptomatic bradycardia*	• *5 to 20 mcg/kg/min* • *Titrate to desired blood pressure and/or desired heart rate* • *Max dose: 20mg*	• *Fluid resuscitation first* • *Cardiac and BP monitoring*
Epinephrine	• *Cardiac Arrest*	• *1.0 mg (1:10,000) IV/IO or 1 ampule (1:1,000) in 10ml of normal saline* • *Maintain: 0.1 to 0.5 mcg/kg/min Titrate to desired blood pressure*	• *Continuous cardiac monitoring* • *Note: Distinguish between 1:1,000 and 1:10,000 concentrations* • *Give via central line when possible*
	• *Anaphylaxis*	• *0.3-0.5 mg IM* • *Repeat every five minutes as needed*	
	• *Symptomatic bradycardia/Shock*	• *2 to 10 mcg/min infusion* • *Titrate to response*	
Li do cain e ***(Lidocaine is recommended when Amiodarone is not available)***	• *Cardiac Arrest (VF/VT)*	• *Initial: 1 to 1.5 mg/kg IV loading* • *Second: Half of first dose in 5 to 10 min* • *Maintain: 1 to 4 mg/min*	• *Cardiac and BP monitoring* • *Rapid bolus can cause hypotension and bradycardia* • *Use with caution in renal failure*
	• *Wide complex tachycardia with pulse*	• *Initial: 0.5 to 1.5 mg/kg IV* • *Second: Half of first dose in 5 to 10 min* • *Maintain: 1 to 4 mg/min*	
Magnesium Sulfate	• *Cardiac arrest/ Pulseless torsades*	• *Cardiac Arrest: 1 to 2 gm diluted in 10 mL D5W IVP*	• *Cardiac and BP monitoring* • *Rapid bolus can cause hypotension and bradycardia* • *Use with caution in renal failure* • *Calcium chloride can reverse hypermagnesemia*
	• *Torsades de Pointes with pulse*	• *If not cardiac arrest: 1 to 2 gm IV over 5 to 60 min* • *Maintain: 0.5 to 1 gm/hr IV*	
Procainamide	• *Wide QRS tachycardia* • *Preferred for VT with pulse (stable)*	• *20 to 50 mg/min IV until rhythm improves, hypotension occurs, QRS widens by 50% or MAX dose is given* • *MAX dose: 17 mg/kg* • *Drip: 1 to 2 gm in 250 to 500 mL at 1 to 4 mg/min*	• *Cardiac and BP monitoring* • *Caution with acute MI* • *May reduce dose with renal failure* • *Do not give with amiodarone* • *Do not use in prolonged QT or CHF*
Sotalol	• *Tachyarrhythmia* • *Monomorphic VT* • *3rd line anti-arrhythmic*	• *100 mg (1.5 mg/kg) IV over 5 min*	• *Do not use in prolonged QT*

Table 1

SELF-ASSESSMENT FOR ACLS

1. An individual presents with symptomatic bradycardia. Her heart rate is 32. Which of the following are acceptable therapeutic options?

   a. Atropine
   b. Epinephrine
   c. Dopamine
   d. All of the above

2. Aperson with alcoholism collapses and is found to be in Torsades de Pointes. What intervention is most likely to correct the underlying problem?

   a. Rewarm the individual to correct hypothermia.
   b. Administer magnesium sulfate 1 to 2 gm IV diluted in 10 mL D5W to correct low magnesium.
   c. Administer glucose to correct hypoglycemia.
   d. Administer naloxone to correct narcotic overdose.

3. You have just administered a drug for an individual in supraventricular tachycardia (SVT). She complains of flushing and chest heaviness. Which drug is the most likely cause?

   a. Aspirin
   b. Adenosine
   c. Amiodarone
   d. Amitriptyline

ANSWERS

1. D
   Atropine is the initial treatment for symptomatic bradycardia. If unresponsive, IV dopamine or epinephrine is the next step. Pacing may be effective if other measures fail to improve the rate.

2. B

   Hypomagnesemia or low Mg++ is commonly caused by alcoholism and malnutrition. Administration of IV magnesium may prevent or terminate Torsades de Pointes.

3. B

   Adenosine is the correct choice for SVT treatment and commonly results in reactions such as flushing, dyspnea, chest pressure, and lightheadedness.

CHAPTER 5

PRINCIPLES OF EARLY DEFIBRILLATION

The earlier the defibrillation occurs, the higher the survival rate. When a fatal arrhythmia is present, CPR can provide a small amount of blood flow to the heart and the brain, but it cannot directly restore an organized rhythm. The likelihood of restoring a perfusing rhythm is optimized with immediate CPR and defibrillation. The purpose of defibrillation is to disrupt a chaotic rhythm and allow the heart's normal pacemakers to resume effective electrical activity.

The appropriate energy dose is determined by the design of the defibrillator—monophasic or biphasic. If you are using a monophasic defibrillator, give a single 360 J shock. Use the same energy dose on subsequent shocks. Biphasic defibrillators use a variety of waveforms and have been shown to be more effective for terminating a fatal arrhythmia. When using biphasic defibrillators, providers should use the manufacturer's recommended energy dose. Many biphasic defibrillator manufacturers display the effective energy dose range on the face of the device. If the first shock does not terminate the arrhythmia, it may be reasonable to escalate the energy delivered if the defibrillator allows it.

To minimize interruptions in chest compressions during CPR, continue CPR while the defibrillator is charging. Be sure to clear the individual by ensuring that oxygen is removed, and no one is touching the individual prior to delivering the shock. Immediately after the shock, resume CPR, beginning with chest compressions. Give CPR for two minutes (approximately five cycles). A cycle consists of 30 compressions followed by two breaths for an adult without an advanced airway. Those individuals with an advanced airway device in place can be ventilated at a rate of one breath every 5 to 6 seconds (or 10 to 12 breaths per minute).

KEYS TO USING AN AUTOMATED EXTERNAL DEFIBRILLATOR

If you look around the public places you visit, you are likely to find an Automated External Defibrillator (AED). An AED is both sophisticated and easy to use, providing life-saving power in a user-friendly device which makes it useful for people who have never operated one and for anyone in stressful scenarios. However, proper use of an AED is very important.

Ideally, while CPR is continued, turn on the AED, and then attach the pads to the upper right side and lower left side of the individual's chest *(Figure 11)*. Once the pads are attached correctly, the device will read the heart rhythm. If the pads are not attached appropriately, the device will indicate so with prompts. Once the rhythm is analyzed, the device will direct you to shock the individual if a shock is indicated. A shock depolarizes all heart muscle cells at once, attempting to organize its electrical activity. In other words, the shock is intended to reset the heart's abnormal electrical activity into a normal rhythm.

Figure 11

AED Key Points

- Assure oxygen is NOT flowing across the patient's chest when delivering shock
- Do NOT stop chest compressions for more than 10 seconds when assessing the rhythm
- Stay clear of patient when delivering shock
- Assess pulse after the first two minutes of CPR
- If the end-tidal CO_2 is less than 10 mmHg during CPR, consider adding a vasopressor and improve chest compressions. However, after 20 minutes of CPR for an intubated individual, you may consider stopping resuscitation attempts.

Figure 12

CRITERIA TO APPLY AED

You should use an AED if:

- The individual does not respond to shouting or shaking their shoulders.
- The individual is not breathing or breathing ineffectively.
- The carotid artery pulse cannot be detected.

BASIC AED OPERATION

To use an AED, do the following:

1. Power on the AED.
2. Choose adult or pediatric pads.
3. Attach the pads to bare chest (not over medication patches) and make sure cables are connected. (Dry the chest if necessary.)
4. Place one pad on upper right side and the other on the chest a few inches below the left armpit.
5. Clear the area to allow AED to read rhythm, which may take up to 15 seconds.
6. If the AED states "no shock advised", restart CPR.
7. If the AED indicates a shock is needed, clear the individual, making sure no one is touching them and that the oxygen has been removed. Ensure visually that the individual is clear and shout "CLEAR!"
8. Press the "Shock" button.
9. Immediately resume CPR starting with chest compressions.
10. After two minutes of CPR, the AED with current programming will analyze the rhythm.
11. Continue to follow the AED prompts.

- *If the AED is not working properly, continue CPR. Do not waste excessive time troubleshooting the AED. CPR always comes first, and AEDs are supplemental.*
- *Do not use the AED in water.*
- *AED is not contraindicated in individuals with implanted defibrillator/pacemaker; however, do not place pad directly over the device.*

CHAPTER 6

SYSTEMS OF CARE

The ILCOR guidelines describe Systems of Care as a separate and important part of ACLS provider training. These Systems of Care describe the organization of professionals necessary to achieve the best possible result for a given individual's circumstances. They include an overview of the ways life-saving interventions should be organized to ensure they are delivered efficiently and effectively. Hospitals, EMS staff, and communities that follow comprehensive Systems of Care demonstrate better outcomes for their patients than those who do not.

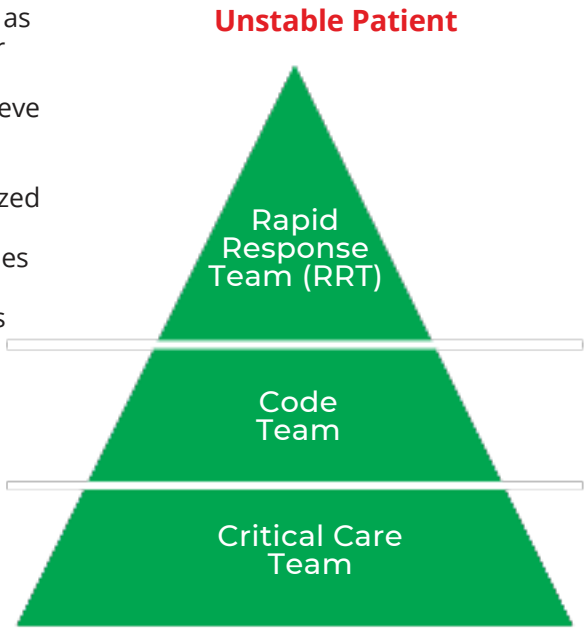


Figure 13

- *Management of life-threatening emergencies requires the integration of a multidisciplinary team that can involve rapid response teams (RRTs), cardiac arrest teams, and intensive care specialists to increase survival rates.*

CARDIOPULMONARY RESUSCITATION

Successful cardiopulmonary resuscitation (CPR) requires the use of it as part of a system of care called the Chain of Survival. As with any chain, it is only as strong as its weakest link. Thus, everyone must strive to make sure each link is strong. For instance, community leaders can work to increase awareness of the signs and symptoms of cardiac arrest and make AEDs available in public places. EMS crews must stay abreast of updates and innovations in resuscitation and hone the skills required to deliver CPR quickly and effectively. Hospitals should be ready to receive patients in cardiac arrest and provide excellent care. Critical care and reperfusion centers should be staffed by experts and equipped with the latest technology. Because recovery from cardiac arrest continues long after the initial hospitalization, patients should have formal assessment and support for their physical, cognitive, and psychosocial needs.

INITIATING THE CHAIN OF SURVIVAL

Early initiation of BLS has been shown to increase the probability of survival for a person dealing with cardiac arrest. To increase the odds of surviving a cardiac event, the rescuer should follow the steps in the Adult Chain of Survival *(Figure 14)*.

Adult Chain of Survival

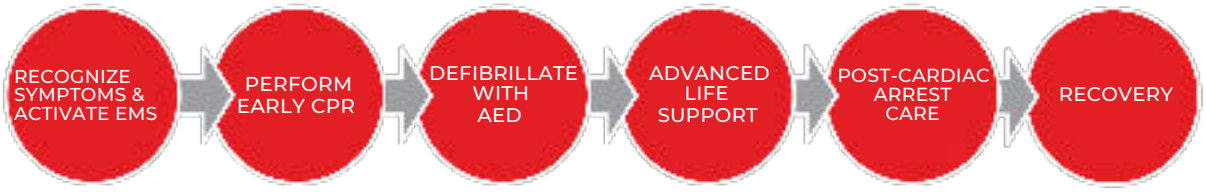


Figure 14

POST-CARDIAC ARREST CARE

Integrated post-cardiac arrest care is the fifth link in the Adult Chain of Survival. The quality of this care is critical to providing resuscitated individuals with the best possible results. When the interventions below are provided, there is an increased likelihood of survival.

Care of the patient after the return of spontaneous circulation (ROSC) requires close attention to oxygenation, blood pressure control, evaluation for percutaneous coronary intervention, temperature control, and multimodal neuroprognostication. Because recovery from cardiac arrest continues long after the initial hospitalization, patients should have formal assessment and support for their physical, cognitive, and psychosocial needs.

After a resuscitation, debriefing for lay rescuers, EMS providers, and hospital-based healthcare workers may be beneficial to support their mental health and well-being.

TEMPERATURE CONTROL

- Recommended for comatose individuals with return of spontaneous circulation after a cardiac arrest event.
- Individuals should be cooled to 89.6 to 99.5 degrees F (32 to 37.5 degrees C) for at least 24 hours.

OPTIMIZATION OF HEMODYNAMICS AND VENTILATION

- 100% oxygen is acceptable for early intervention but not for extended periods of time.
- Oxygen should be titrated, so that individual's pulse oximetry is greater than 94% to avoid oxygen toxicity.
- Do not over ventilate to avoid potential adverse hemodynamic effects.
- Ventilation rates of 10 to 12 breaths per minute to achieve ETCO2 at 35 to 40 mmHg.
- IV fluids and vasoactive medications should be titrated for hemodynamic stability.
- Tight glycemic control for best patient outcome.

PERCUTANEOUS CORONARY INTERVENTION

- Percutaneous coronary intervention (PCI) is preferred over thrombolytics.
- Individual should be taken by EMS directly to a hospital that performs PCI.
- If the individual is delivered to a center that only delivers thrombolytics, they should be transferred to a center that offers PCI if time permits.

NEUROLOGICAL CARE

- Neurologic assessment is key, especially when withdrawing care (i.e., brain death) to decrease false-positive rates. Specialty consultation should be obtained to monitor neurologic signs and symptoms throughout the post-resuscitation period.

ACUTE CORONARY SYNDROME

For individuals with acute coronary syndrome (ACS), proper care starts during the call to EMS. First responders must be aware of and look for signs of ACS. Quick diagnosis and treatment yield the best chance to preserve healthy heart tissue. It is very important that health care providers recognize individuals with potential ACS in order to initiate evaluation, appropriate triage, and time management.

ACS Chain of Survival

Figure 15

GOALS OF ACS TREATMENT

Early EMS communication allows for preparation of emergency department personnel and cardiac catheterization lab and staff. Once the ACS patient arrives at the receiving facility, established protocols should direct care. The shorter the time is until reperfusion, the greater the amount of heart tissue that can be saved, and the more optimal the overall outcome.

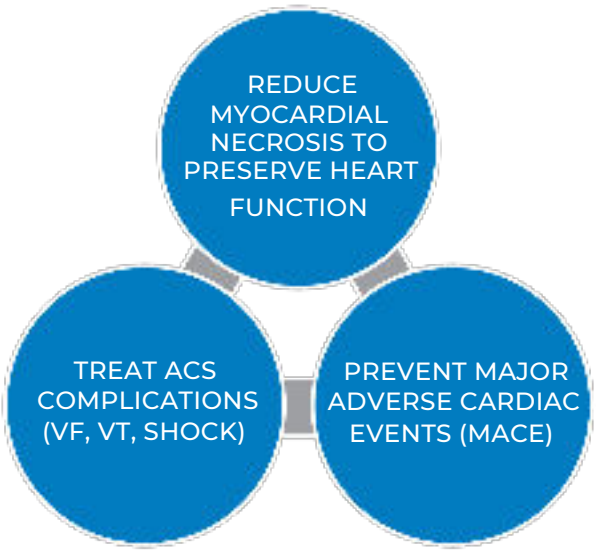


Figure 16

Major adverse cardiac events (MACE) include death and non-fatal myocardial infarction. Life-threatening complications of ACS include ventricular fibrillation, pulseless ventricular tachycardia, bradyarrhythmias, cardiogenic shock, and pulmonary edema. EMS should have the capacity to perform ECGs on scene and on the way to the hospital. The receiving hospital should be made aware of possible ACS, especially ST-elevation myocardial infarction elevation (STEMI) and non-ST-elevation myocardial infarction (NSTEMI).

ACUTE STROKE

Outcomes for individuals with stroke have improved significantly due to the implementation of the Acute Stroke System of Care. The community is better equipped to recognize stroke as a "brain attack," and there is greater awareness of the importance of medical care within three hours of symptom onset because you will have the opportunity to reverse said symptoms with the fibrinolytic. Likewise, EMS systems have been enhanced to transport individuals to regional stroke care centers that are equipped to administer fibrinolytics.

Stroke Chain of Survival

Figure 17

FAST Acronym

The FAST acronym is based on the Cincinnati Pre-Hospital Stroke Scale and is used to evaluate when someone is having a stroke.

Face	*Grimace or drooping on one side*
Arms	*Weakness drift or paralysis on the same side*
Speech	*Slurred or incomprehensible*
Time	*Time of activity and time to call 911*

Table 2

The 8 D's of Stroke Care (Table 3) highlight the major steps of diagnosis and treatment of stroke and key points at which delays can occur.

GOALS OF ACUTE ISCHEMIC STROKE CARE

The overall goal of stroke care is to minimize brain injury and optimize the individual's recovery. Preferential transport to stroke-capable centers has been shown to improve outcomes. Stroke centers are equipped with resources often not available at smaller community hospitals. The presence of specialists, including neurologists and stroke care specialists, multidisciplinary teams experienced in stroke care, advanced imaging modalities, and other therapeutic options make transport to stroke centers the most suitable option. The goal of the stroke team, the emergency physician, or other experts should be to assess the individual with suspected stroke and get to the CT scanner within ten minutes.

The 8 D's of Stroke Care

DETECTION	*Rapid recognition of stroke symptoms*
DISPATCH	*Early activation and dispatch of EMS*
DELIVERY	*Rapid EMS identification, management, and transport*
DOOR	*Adhere to all door to delivery times, such as door to needle in < 60 minutes, etc.*
DATA	*Rapid triage, evaluation, and management in ED*
DECISION	*Stroke expertise and therapy selection*
DRUG	*Fibrinolytic therapy, intra-arterial strategies*
DISPOSITION	*Rapid admission to the stroke unit or critical care unit*

Table 3

ACUTE STROKE

The ILCOR guidelines for ACLS highlight the importance of effective team dynamics during resuscitation. In the community (outside a health care facility), the first rescuer on the scene may be performing CPR alone. However, a Code Blue in a hospital may bring dozens of responders/providers to a patient's room. It is important to quickly and efficiently organize team members to effectively participate in ACLS. The ILCOR suggests a team structure with each provider assuming a specific role during the resuscitation; this consists of a team leader and several team members. *(Table 4)*

TEAM LEADER	TEAM MEMBER	GOOD TEAM DYNAMICS
• Organize the group • Monitor performance • Be able to perform all skills • Direct team members • Provide critique of group performance after the resuscitation effort	• Understand their role • Understand others' roles too • Be willing, able, and skilled to perform the role • Understand the ACLS sequences • Be committed to the success	• Clear roles and responsibilities • Knowing limitations • Constructive Interventions • Knowledge Sharing • Summarizing and reevaluating • Closed-loop communication • Clear messages • Mutual respect

Table 4

Clear communication between team leaders and team members is essential.

It is important to know your own clinical limitations. Resuscitation is the time for implementing acquired skills, not trying new ones. Only take on tasks you can perform successfully. Clearly state when you need help and call for help early in the care of the individual. Resuscitation demands mutual respect, knowledge sharing, constructive criticism, and follow-up discussion (debriefing) after the event.

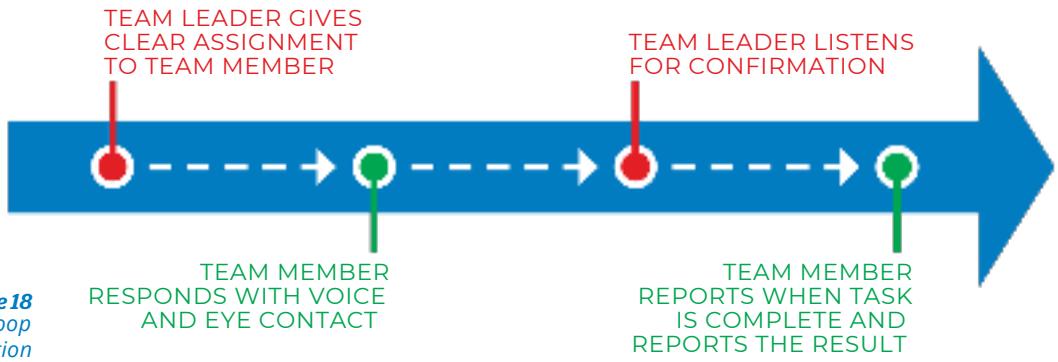


Figure 18 *Closed-Loop Communication*

EDUCATION, IMPLEMENTATION, TEAMS

Only about 20% of the individuals who have a cardiac arrest inside a hospital will survive. This statistic prompted the development of a Cardiac Arrest System of Care. Four out of five individuals with cardiopulmonary arrest have changes in vital signs prior to the arrest. Therefore, most individuals who eventually have a cardiac arrest showed signs of impending cardiac arrest. Survival rates could be improved if individuals are identified and treated with ACLS protocols sooner.

Originally, specialized groups of responders within a hospital, called Cardiac Arrest Teams, attended to a patient with recognized cardiac arrest. These teams responded to a Code Blue after someone presumably recognized an active cardiac arrest and sought help. Many believed Cardiac Arrest Teams would improve survival rates, but the results were disappointing. Studies show that survival rates were the same in hospitals with Cardiac Arrest Teams as in those without a team. As a result, hospitals are replacing Cardiac Arrest Teams with Rapid Response Teams (RRTs) or Medical Emergency Teams (METs). Anyone can call for the RRT/ MET if there is any concern by the patient, a health care provider, or a family member.

Rather than waiting for loss of consciousness and full cardiopulmonary arrest, RRTs/METs closely monitor patients in order to treat them before the cardiac arrest occurs. These teams combine the efforts of nurses, physicians, and family members to detect an impending cardiac arrest.

RRT/MET ALERT CRITERIA

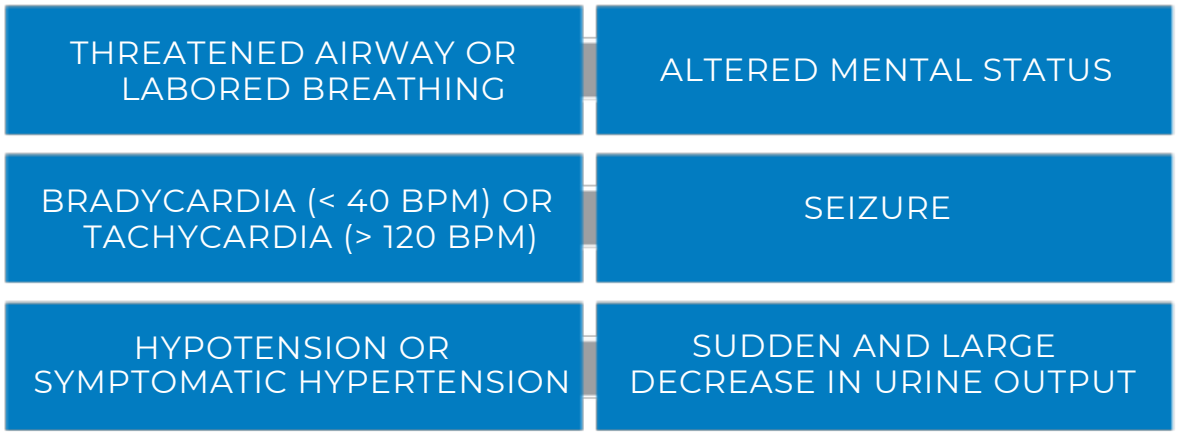


Figure 19

When hospitals implement RRTs/METs, there are fewer cardiac arrests, fewer ICU transfers, improved survival rates, and shorter lengths of inpatient stay.

SELF-ASSESSMENT FOR SYSTEMS OF CARE

1. What is the longest a rescuer should pause to check for a pulse?

    a. 20 seconds
    b. 10 seconds
    c. 5 seconds
    d. Less than two seconds

2. Select the proper pairing regarding CPR for an adult:

    a. Chest compressions 60 to 80/minute; 2 inches deep (5cm)
    b. Chest compressions 80/minute; 1.5 inches deep (4cm)
    c. Chest compressions 100/minute; 3 inches deep (8cm)
    d. Chest compression 100 to 120 per minute; 2 to 2.4 inches deep (5-6cm)

3. What is the role of the second rescuer during a cardiac arrest scenario?

    a. Summon help.
    b. Retrieve AED.
    c. Perform ventilations.
    d. All of the above

ANSWERS

1. B
   Pulse checks are limited to no more than 10 seconds. If you are unsure whether a pulse is present, begin CPR.
2. D
   Chest compression 100 to 120 per minute; 2 to 2.4 inches deep (5-6cm).
3. D
   Take advantage of any bystander and enlist their help based on their skill level.

CHAPTER 7

ACLS CASES

RESPIRATORY ARREST

Individuals with ineffective breathing patterns are considered to be in respiratory arrest and require immediate attention. There are many causes of respiratory arrest, including but not limited to cardiac arrest and cardiogenic shock. Resuscitate individuals in apparent respiratory arrest following BLS or ACLS protocols.

Respiratory arrest is an emergent condition in which the individual is either not breathing or is breathing ineffectively.

If someone is breathing ineffectively, it can be agonal or gasping respirations, which can often go unrecognized.

BLS Survey for Adults

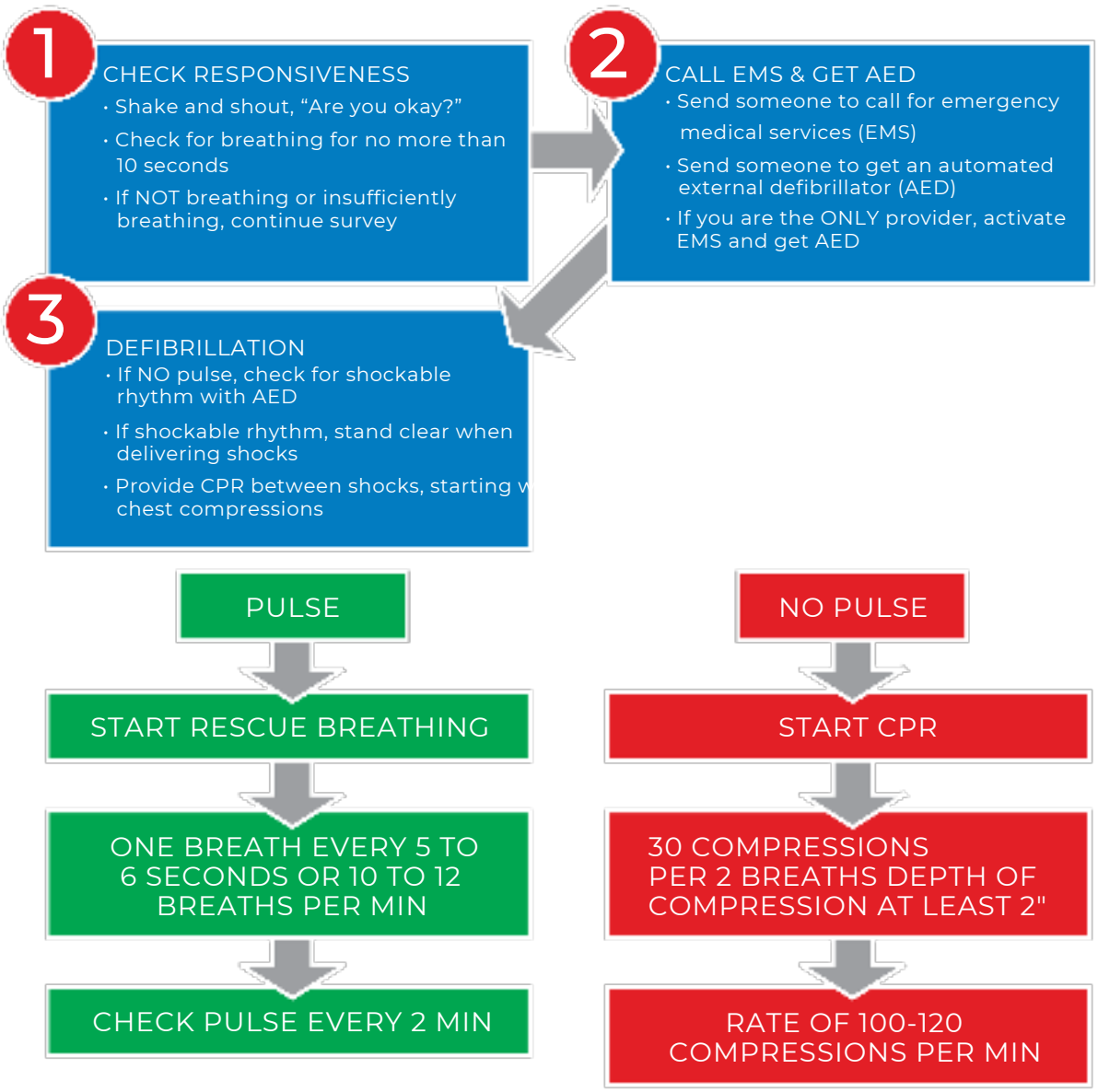


Figure 20

ACLS Survey

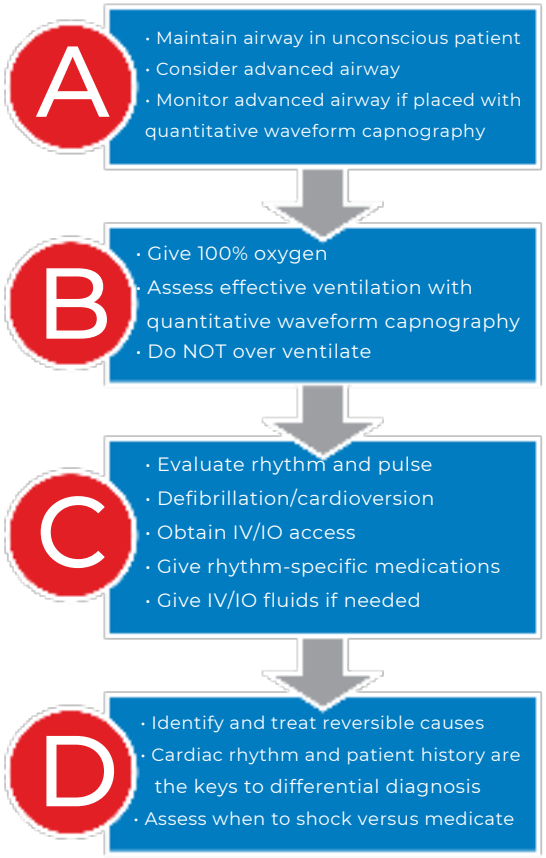


Figure 21

TYPES OF AIRWAYS

ADVANCED	BASIC
ESOPHOGEAL TUBE	MOUTH-TO-MOUTH/NOSE
ET	BAG-MASK VENTILATION
LARYNGEAL TUBE	OPA
LMA	NPA

Table 5

In Table 5, the airways listed in the left column are considered advanced airways, while those in the right column are basic airways. Although OPAs and NPAs are considered to be basic airways, they require proper placement by an experienced provider. Advanced airway placement requires specialized training which is beyond the scope of ACLS certification. However, all ACLS providers should be familiar with the proper management of advanced airways in order to be part of an effective life support team.

CPR is performed with the individual lying on their back; gravity will cause the jaw, the tongue, and the tissues of the throat to fall back and obstruct the airway. The airway rarely remains open in an unconscious individual without external support.

The first step in any airway intervention is to open the airway. This is accomplished by lifting the chin upward while tilting the forehead back *(Figure 22)*. The goal is to create a straighter path from the nose to the trachea.

Figure 22

Do not over ventilate (i.e., give too many breaths per minute or too large volume per breath). Both can increase intrathoracic pressure, decrease venous return to heart, diminish cardiac output, as well as predispose individuals to vomit and aspirate gastrointestinal contents.

PULSELESS VENTRICULAR TACHYCARDIA AND VENTRICULAR FIBRILLATION

Pulseless ventricular tachycardia (VT) and Ventricular fibrillation (VF) are life-threatening cardiac rhythms that result in ineffective ventricular contractions. The ventricular motion of VF is not synchronized with atrial contractions. VT or VTach *(Figure 24)* is a condition in which the ventricles contract more than 100 times per minute. VF or VFib *(Figure 23)* is a rapid quivering of the ventricular walls that prevents them from pumping. The emergency condition, pulseless VT, occurs when ventricular contraction is so rapid that there is no time for the heart to refill, resulting in an undetectable pulse. In both cases, individuals are not receiving adequate blood flow to the tissues. Despite being different pathological phenomena and having different ECG rhythms, the ACLS management of pulseless VT and VF are essentially the same. Pulseless VT and resuscitation for VF starts with the BLS Survey.

An AED reads and analyzes the rhythm and determines if a shock is needed. The AED is programmed to only prompt the user to defibrillate pulseless VT and VF rhythms. The machine does not know if the individual has a pulse or not. This is the primary reason you should not use an AED in someone with a palpable pulse. ACLS responses to pulseless VT and VF within a hospital will likely be conducted using a cardiac monitor and a manual defibrillator. Thus, the ACLS provider must read and analyze the rhythm. Shocks should only be delivered for pulseless VT and VF. Likewise, antiarrhythmic drugs and drugs to support blood pressure may be used.

RULES FOR VENTRICULAR FIBRILLATION (VF)

Figure 23

Table 6

REGULARITY	*There is no regular shape of the QRS complex because all electrical activity is disorganized.*
RATE	*The rate appears rapid, but the disorganized electrical activity prevents the heart from pumping.*
P WAVE	*There are no P waves present.*
PR INTERVAL	*There are no PR intervals present.*
QRS COMPLEX	*The ventricle complex varies.*

RULES FOR VENTRICULAR TACHYCARDIA (REGULAR/RAPID WIDE COMPLEX TACHYCARDIA)

Figure 24

REGULARITY	*R-R intervals are usual, but not always, regular.*
RATE	*The atrial rate cannot be determined. Ventricular rate is usually between 150 and 250 beats per minute.*
P WAVE	*QRS complexes are not preceded by P waves. There are occasionally P waves in the strip, but they are not associated with the ventricular rhythm.*
PR INTERVAL	*There are no PR intervals present.*
QRS COMPLEX	*QRS complex measures more than 0.12 seconds. The QRS will usually be wide and bizarre. It is usually difficult to see a separation between the QRS complex and the T wave.*

Table 7

RULES FOR TORSADES DE POINTES (IRREGULAR WIDE COMPLEX TACHYCARDIA)

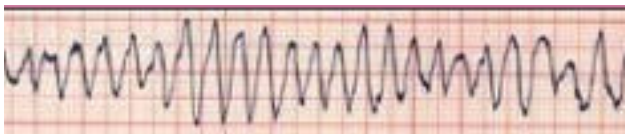


Figure 25

REGULARITY	*There is no regularity.*
RATE	*The atrial rate cannot be determined. Ventricular rate is usually between 150 and 250 beats per minute.*
P WAVE	*There are no P waves present.*
PR INTERVAL	*There are no PR intervals present.*
QRS COMPLEX	*The ventricle complex varies.*

Table 8

VF and pulseless VT are both shockable rhythms. The AED cannot tell if the individual has a pulse or not.

PULSELESS ELECTRICAL ACTIVITY AND ASYSTOLE

Pulseless electrical activity (PEA) and asystole are related to cardiac rhythms in that they are both life-threatening and unshockable cardiac rhythms. Asystole is a flat-line ECG *(Figure 26)*. There may be subtle movement away from baseline (drifting flat-line), but there is no perceptible cardiac electrical activity. Always ensure that a reading of asystole is not a user or technical error. Make sure pads have good contact with the individual, leads are connected, gain is set appropriately, and the power is on. PEA is one of many waveforms by ECG (including sinus rhythm) without a detectable pulse. PEA may include any pulseless waveform with the exception of VF, VT, or asystole *(Figure 27)*.

Hypovolemia and hypoxia are the two most common causes of PEA. They are also the most easily reversible and should be at the top of any differential diagnosis.

If the individual has return of spontaneous circulation (ROSC), proceed to post-cardiac arrest care.

RULES FOR PEA AND ASYSTOLE

A flatline ECG reveals no electrical activity and is reserved for asystole, whereas PEA reveals organized or semi-organized electrical activity in the absence of a palpable pulse.

Figure 26

ORGANIZED OR SEMI-ORGANIZED	*Any rhythm without a pulse.*
RATE	*Any rate or no rate.*
P WAVE	*Possible P wave or none detectable.*
PR INTERVAL	*Possible PR wave or none detectable.*
QRS COMPLEX	*Possible QRS complex or none detectable.*

ASYSTOLE REGULARITY	*The rhythm will be a nearly flat line.*
RATE	*There is no rate.*
P WAVE	*There are no P waves present.*
PR INTERVAL	*PR interval is unable to be measured due to no P waves being present.*
QRS COMPLEX	*There are no QRS complexes present.*

Table 9

Figure 27

REVERSIBLE CAUSES

Table 10

REVERSIBLE CAUSES OF CARDIAC ARREST	
THE H'S	THE T'S
Hypovolemia	*Tension pneumothorax*
Hypoxia	*Tamponade*
H+ (acidosis)	*Toxins*
Hypo/Hyperkalemia	*Thrombosis (coronary)*
Hypoglycemia	*Thrombosis (pulmonary)*
Hypothermia	*Trauma (unrecognized)*

- *Always verify that a reading of asystole is not equipment failure. Make sure pads make good contact with the individual, all cables are connected, gain is set appropriately, and the power is on.*
- *Hypovolemia and hypoxia are easily reversed and are the two most common causes of PEA.*

STANDARD DOSE EPINEPHRINE IS VASOPRESSOR OF CHOICE

Epinephrine is still the best choice according to 2020 guidelines. Of sixteen observational studies on timing in the recent systematic review, all found an association between earlier epinephrine and ROSC for patients with nonshockable rhythms, although improvements in survival were not universally seen.

For patients with shockable rhythm, the literature

supports
prioritizing defibrillation and CPR initially and giving epinephrine if initial attempts with CPR and defibrillation are not successful.

ACLS ADULT CARDIAC ARREST ALGORITHM

Effective cardiac arrest management improves patient survival rates and neurological outcomes. The ACLS adult cardiac arrest algorithm provides health care professionals with a structured approach to resuscitation efforts during these critical events. Understanding and implementing this algorithm is essential for anyone involved in advanced cardiac life support.

IMPORTANCE OF THE ACLS ADULT CARDIAC ARREST ALGORITHM

The ACLS adult cardiac arrest algorithm is designed to guide clinicians through a systematic process during a cardiac arrest scenario. It emphasizes the importance of high-quality CPR, early defibrillation, and the identification and treatment of reversible causes. By adhering to this algorithm, health care providers can ensure they deliver the most effective interventions at the right time.

Adult Cardiac Arrest Algorithm

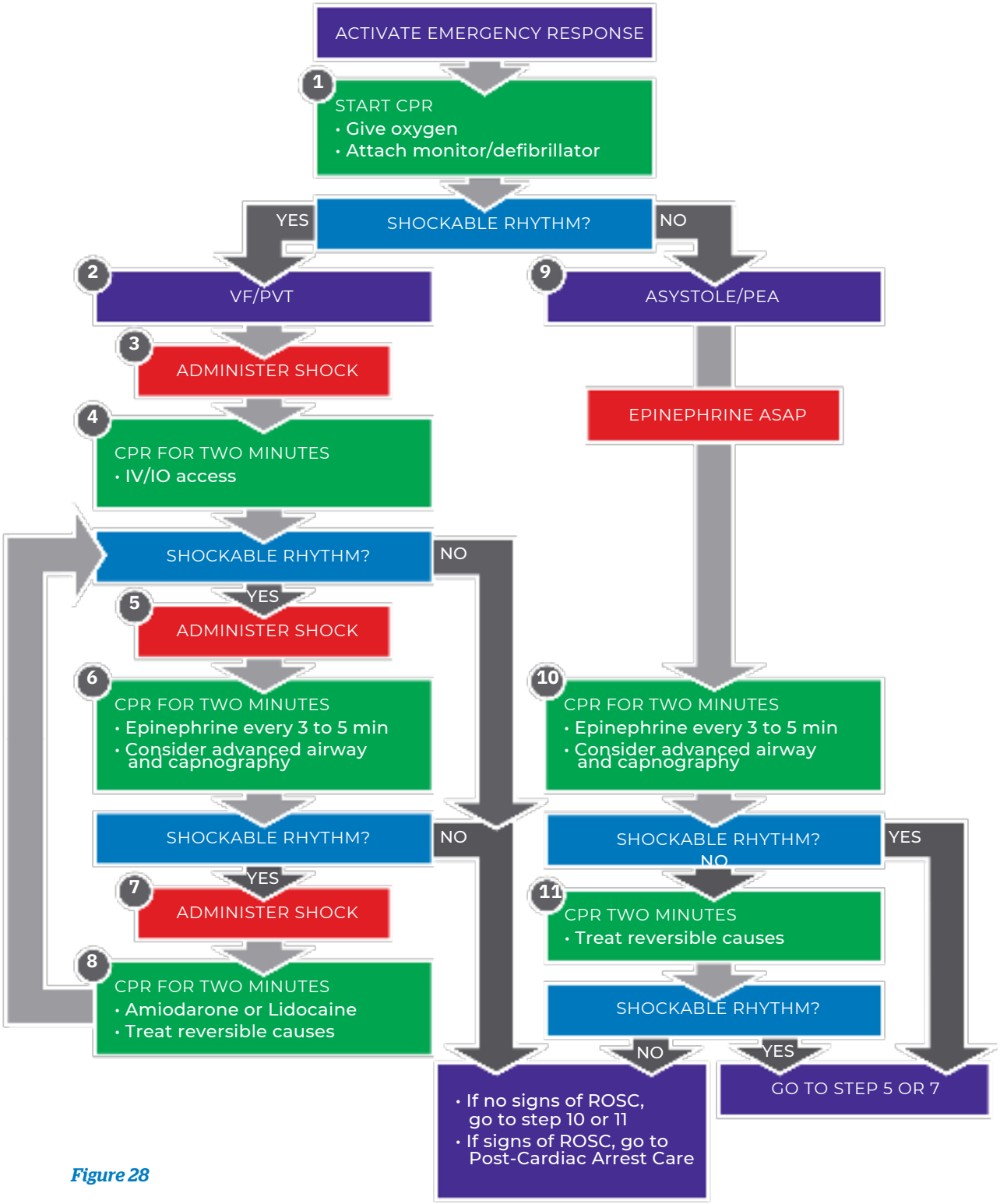


Figure 28

KEY COMPONENTS

While the specific steps are detailed in the existing content, it's important to highlight the overarching components that make the ACLS adult cardiac arrest algorithm effective:

- **High-Quality CPR:** Maintaining optimal chest compression depth and rate, minimizing interruptions, and ensuring full chest recoil.
- **Early Defibrillation:** Prompt recognition of shockable rhythms and immediate defibrillation can significantly improve survival chances.
- **Advanced Airway Management:** Securing the airway to ensure adequate oxygenation and ventilation.
- **Medication Administration:** Appropriate use of medications like epinephrine and amiodarone, according to the algorithm.
- **Reversible Causes:** Identifying and addressing underlying causes (the H's and T's) that may have led to the cardiac arrest.

ADULT CARDIAC ARREST

CPR Quality

- Push hard (2-2.4" (5-6 cm)) and fast (100-120 bpm) and allow chest recoil
- Minimize interruptions
- Do not over ventilate
- If no advanced airway, 30:2 compression to ventilation ratio
- Quantitative waveform capnography
  - If ETCO2 <10 mmHg, attempt to improve CPR quality

Shock Energy

- Biphasic: Biphasic delivery of energy during defibrillation has been shown to be more effective than older monophasic waveforms. Follow manufacturer recommendation (e.g., initial dose of 120 to 200 J); if unknown, use the maximum dose available. Second and subsequent doses should be equivalent and higher doses should be considered.
- Monophasic: 360 J

Return of Spontaneous Circulation

- Return of pulse and blood pressure
- Sudden sustained increase in PETCO2 (typically ≥ 40 mmHg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Advanced Airway

- Supraglottic advanced airway or ET intubation
- Absolute placement confirmation:

1. Negative Epigastric Auscultation
2. Positive Bilateral Chest Auscultation
3. Vocal Cord Visualization
4. Quantitative ETCO2

- 10 breaths per minute with continuous chest compressions

Drug Therapy

- Epinephrine IV/IO Dose: 1 mg, administer as soon as possible then every 3 to 5 minutes after
- Amiodarone IV/IO Dose: first dose is 300 mg bolus, second dose is 150 mg
- Lidocaine: 1st dose: 1-1.5 mg/kg, second dose: 0.5-0.75 mg/kg

Reversible Causes

- Hypovolemia
- Hypoxia
- H+(acidosis)
- Hypothermia
- Hypo-/hyperkalemia
- Hypoglycemia
- Tamponade, cardiac
- Toxins
- Tension pneumothorax
- Thrombosis, pulmonary or coronary
- Trauma

ENHANCING RESUSITATION EFFORTS

Implementing the ACLS adult cardiac arrest algorithm effectively requires teamwork, clear communication, and regular practice. Health care professionals should continue education and simulation training to improve these life-saving skills.

Team Dynamics and Communication

- **Role Assignment:** Clearly define team member roles during resuscitation.
- **Closed-Loop Communication:** Confirm orders and interventions to prevent errors.
- **Leadership:** Effective team leaders guide resuscitation efforts smoothly, ensuring adherence to the ACLS adult cardiac arrest algorithm.

POST-CARDIAC ARREST CARE

If an individual has a return of spontaneous circulation (ROSC), start post-cardiac arrest care immediately. The initial BLS/ACLS processes are meant to save an individual's life, while post-cardiac arrest care is meant to optimize ventilation and circulation, preserve heart and brain tissue/function, and to maintain recommended blood glucose levels. Pay close attention to oxygenation, blood pressure control, need for percutaneous coronary intervention, and ideal temperature management. The 2020 ILCOR Guidelines recommend formal assessment and support for an individual's continued physical, cognitive, and psychosocial needs because recovery from a cardiac arrest event continues long after the initial hospitalization. Be sure to remember to address the mental health needs of the First Responders also, and schedule a debriefing for lay rescuers, EMS providers, and hospital-based healthcare workers after a resuscitation event.

VOMIT - AN ACRONYM TO DESCRIBE POST-CARDIAC ARREST CARE

- **V**ital signs- Especially checking blood pressure.
- **O**xygen- Do they need to be intubated at all, or do they need a type of oxygen apparatus?
- **M**yocardial infarction- Do they need to get to a chest pain center?
- **I**v- Do they need IV fluids? Do they need a drip?
- **T**emperature Control- Only if they are still unresponsive.

AIRWAY MANAGEMENT

- Early placement of advanced airway as needed
- Manage respiratory parameters:
  - Keep 10 breaths per minute
  - Pulse Ox goal 92-98%
  - Titrate to PaCO2 35-45 mm Hg
  - Waveform capnography (capnometry) to confirm ETT placement

BLOOD PRESSURE SUPPORT AND VASOPRESSORS

- Obtain early ECG.
- Consider blood pressure support in any individual with systolic blood pressure less than 90 mmHg or mean arterial pressure (MAP) less than 65.
- Unless contraindicated, 1 to 2 liters of IV saline or Lactated Ringer's is the first intervention.
- When blood pressure is very low, consider vasopressors (commonly referred to as "pressors"). Vasopressors and inotropes are medications used to create vasoconstriction or increase cardiac contractility, respectively. Consider using the following:
  - Dopamine and norepinephrine are the pressors of choice for individuals who are not in cardiac arrest.
  - Vasopressin and phenylephrine are the second agents to be added.
  - Epinephrine is generally reserved for severe hypotension or as a last-line agent.
- Titrate the infusion rate to maintain the desired blood pressure.

The Post–Cardiac Arrest Care Algorithm *(Figure 29)* was updated to emphasize the need to prevent hyperoxia, hypoxemia, and hypotension.

TEMPERATURE CONTROL

Temperature control is the only documented intervention that improves/enhances brain recovery after cardiac arrest. Induced temperature control can be performed in unresponsive individuals and should be continued for at least 24 hours. The goal of induced temperature control is to maintain a core body temperature between 89.6 to 99.5 degrees F (32 to 37.5 degrees C) for at least 24 hours by using a cooling device with a feedback loop. Device manufacturers have developed several innovative technologies that improve the ability to affect and manage temperature control in the post-arrest individual. Temperature control should be induced and monitored by trained professionals. Induced temperature control should not affect the decision to perform percutaneous coronary intervention (PCI), because concurrent PCI and temperature control are reported to be feasible and safe.

ACLS ADULT POST CARDIAC ARREST CARE ALGORITHM

Effective management following the return of spontaneous circulation (ROSC) is crucial for improving the survival and neurological outcomes of patients who have experienced cardiac arrest. Understanding and implementing the ACLS adult post-cardiac arrest care algorithm is essential for health care professionals involved in resuscitation and critical care. This guide provides an overview of the key aspects of the ACLS adult post-cardiac arrest care algorithm, enhancing your ability to deliver optimal care during this critical phase.

IMPORTANCE OF THE ACLS ADULT POST CARDIAC ARREST CARE ALGORITHM

The ACLS adult post-cardiac arrest care algorithm is a systematic approach designed to stabilize patients after ROSC, minimize brain injury, and prevent the recurrence of cardiac arrest. It emphasizes:

- **Optimizing Hemodynamic Stability:** Maintaining adequate blood pressure and cardiac output.
- **Ensuring Adequate Oxygenation and Ventilation:** Preventing hypoxia and hyperoxia.
- **Controlling Temperature:** Implementing targeted temperature management (TTM) to improve neurological outcomes.
- **Monitoring and Treating Underlying Causes:** Identifying and managing precipitating factors.

By adhering to the ACLS adult post-cardiac arrest care algorithm, healthcare providers can significantly improve patient outcomes and reduce the risk of complications.

Adult Immediate Post-Cardiac Arrest Care Algorithm

VENTILATION/ OXYGENATION:

Avoid excessive ventilation. Start at 10 to 12 breaths per minute and titrate to target PaCO2 of 35 to 45 mmHg.

DOSES/DETAILS

IV Bolus:

1 to 2 liters normal saline or Lactated Ringer's.

Epinephrine IV Infusion:

0.1 to 0.5 mcg/kg per minute

Dopamine IV Infusion:

5 to 10 mcg/kg per minute

Norepinephrine IV Infusion:

0.1 to 0.5 mcg/kg per minute

REVERSIBLE CAUSES:

- Hypovolemia
- Hypoxia
- H+ (acidosis)
- Hypothermia
- Hypo-/hyperkalemia
- Tamponade, cardiac
- Toxins
- Tension pneumothorax
- Thrombosis, pulmonary, or coronary

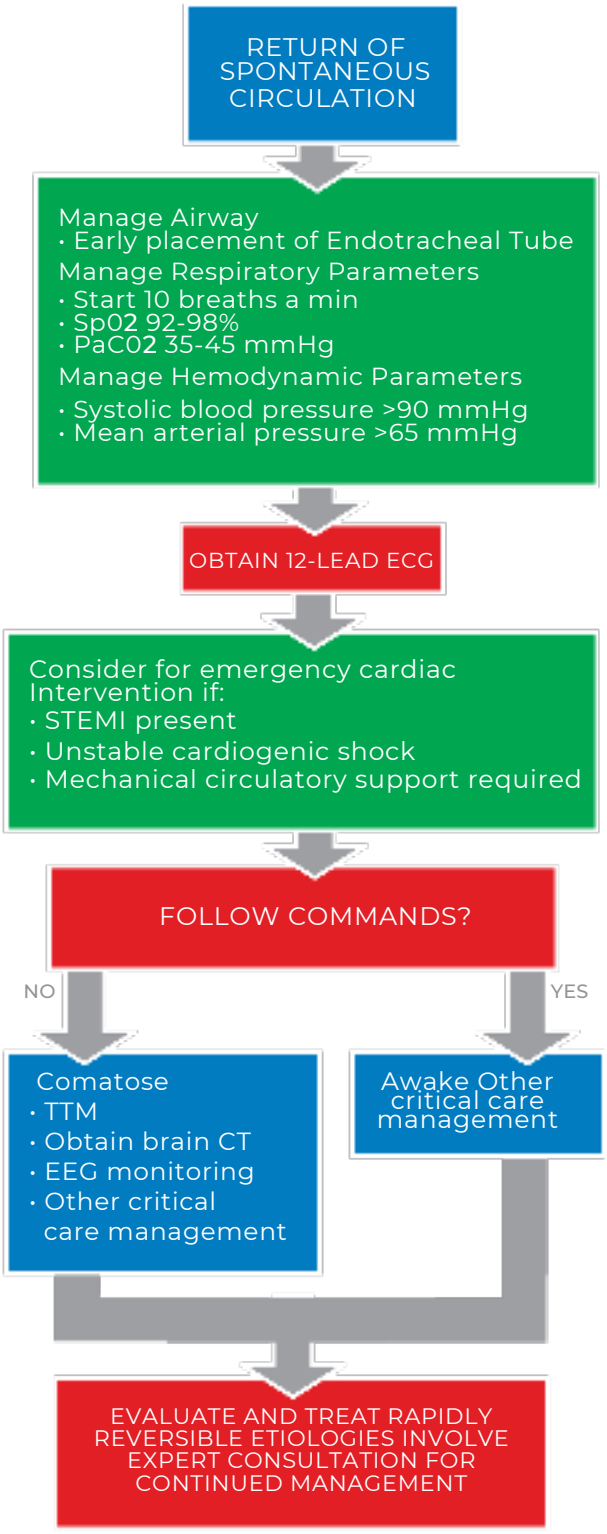


Figure 29

KEY COMPONENTS OF THE ACLS ADULT POST CARDIAC ARREST CARE ALGORITHM

1. Airway and Breathing

- **Secure the Airway:** Consider endotracheal intubation if not already performed.
- **Optimize Ventilation:** Aim for an oxygen saturation of 94-99%. Avoid excessive ventilation; target a respiratory rate to achieve a $PaCO_2$ of 35-45 mm Hg.
- **Continuous Monitoring:** Use waveform capnography to confirm proper endotracheal tube placement and monitor ventilation.

2. Circulation

- **Blood Pressure Management:** Maintain a systolic blood pressure ≥90 mm Hg or mean arterial pressure (MAP) ≥65 mm Hg using fluids and vasopressors as needed.
- **IV/IO Access:** Ensure reliable intravenous or intraosseous access for medication administration.
- **12-Lead ECG:** Obtain an assessment for STEMI or other arrhythmias requiring intervention.

3. Temperature Control

- **Temperature Control:** Initiate TTM for comatose patients by cooling to 32-37.5°C for at least 24 hours.
- **Monitoring:** Continuously monitor core temperature using esophageal or bladder.

4. Neurological Assessment

- **Glasgow Coma Scale (GCS):** Regularly assess neurological status.
- **Pupil Response:** Check for reactive pupils.
- **Consider Neurology Consultation:** For persistent coma or seizures.

5. Laboratory and Diagnostic Tests

- **Blood Tests:** Check electrolytes, glucose, and other pertinent labs.
- **Chest x-ray:** Evaluate for pulmonary complications or confirm tube placements.
- **Echocardiogram:** Assess cardiac function if indicated.

6. Treat Underlying Causes

- **Identify Precipitating Factors:** Use the H's and T's mnemonic to consider reversible causes such as hypoxia, hypovolemia, thrombosis, toxins, tension pneumothorax, etc.
- **Coronary Reperfusion:** For patients with STEMI or suspected myocardial infarction, proceed with reperfusion therapy as appropriate.

RULES FOR SINUS BRADYCARDIA

Figure 30

REGULARITY	*R-R intervals are regular, overall rhythm is regular.*
RATE	*The rate is less than 60 bpm, but usually more than 40 bpm.*
P WAVE	*There is one P wave in front of every QRS. The P waves appear uniform.*
PR INTERVAL	*Measures between 0.12 and 0.20 seconds in duration. PR interval is consistent.*
QRS COMPLEX	*Measures less than 0.12 seconds.*

RULES FOR FIRST DEGREE HEART BLOCK

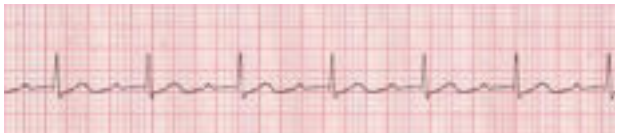


Figure 31

REGULARITY	*R-R intervals are regular, overall rhythm is regular.*
RATE	*The rate depends on the underlying rhythm.*
P WAVE	*There is one P wave in front of every QRS. The P waves appear uniform.*
PR INTERVAL	*Measures more than 0.20 seconds in duration. PR interval is consistent.*
QRS COMPLEX	*Measures less than 0.12 seconds.*

Table 11 & 12

RULES FOR 2ND DEGREE TYPE I AV BLOCK (WENCKEBACH/MOBITZ I)

Figure 32

REGULARITY	*R-R interval is irregular, but there is usually a pattern to it. The R-R interval gets longer as the PR interval gets longer.*
RATE	*The ventricular rate is usually slightly lower than the atrial rate due to some atrial beats not being conducted. The atrial rate is usually normal.*
P WAVE	*P waves are upright and uniform. Most complexes will have a P wave in front of them; however, there will be some P waves that do not have a QRS complex.*
PR INTERVAL	*PR interval gets progressively longer until there is a dropped QRS complex.*
QRS COMPLEX	*Measures less than 0.12 seconds.*

RULES FOR 2ND DEGREE TYPE II AV BLOCK (MOBITZ II)

Figure 33

REGULARITY	*If there is a consistent conduction ratio, then the R-R interval will be regular. If the conduction ratio is not constant, the R-R interval will be irregular.*
RATE	*The atrial rate is normal. The ventricular rate is slower, usually 1/2 to 1/3 slower than the atrial rate.*
P WAVE	*P waves are upright and uniform. There is not a QRS following every P wave.*
PR INTERVAL	*PR interval can only be measured on conducted beats, and it is usually constant across the strip. It may or may not be longer than a normal PR interval (0.12 seconds).*
QRS COMPLEX	*Measures less than 0.12 seconds.*

Table 13 & 14

RULES FOR 3RD DEGREE AV BLOCK (COMPLETE HEART BLOCK)

Figure 34

Table 15

REGULARITY	*R-R interval is regular. P-P interval is also regular. The atrial rate is regular and normally 60 to 100.*
RATE	*Rate of QRS complexes is dependent on the focus. If the focus is ventricular, the rate will be 20 to 40. If the focus is junctional, the rate will be 40 to 60.*
P WAVE	*P waves are upright and uniform. There is not a QRS following every P wave.*
PR INTERVAL	*PR interval can only be measured on conducted beats, and it is usually constant across the strip. It may or may not be longer than a normal PR interval (0.12 seconds).*
QRS COMPLEX	*Interval may be normal but is more likely to be prolonged.*

SYMPTOMATIC BRADYCARDIA

Bradycardia is defined as a heart rate of less than 60 beats per minute. While any heart rate less than 60 beats per minute is considered bradycardia, not every individual with bradycardia is symptomatic or having a pathological event. Individuals in excellent physical shape often have sinus bradycardia. Symptomatic bradycardia may cause a number of signs and symptoms including low blood pressure, pulmonary edema and congestion, abnormal rhythm, chest discomfort, shortness of breath, lightheadedness, and/or confusion. Symptomatic bradycardia should be treated with the ACLS Survey. If bradycardia is asymptomatic but occurs with an arrhythmia listed below, obtain a consultation from a cardiologist experienced in treating rhythm disorders.

SYMPTOMS OF BRADYCARDIA

- Shortness of breath
- Altered mental status
- Pulmonary edema/congestion
- Weakness/dizziness/lightheadedness

SYMPTOMATIC BRADYCARDIA REVIEW

Sinus Bradycardia

- Normal rhythm with slow rate

First Degree AV Block

- PR interval is longer than 0.20 seconds

Type I Second Degree AV Block

- PR interval increases in length until QRS complex is dropped

Type II Second Degree AV Block

- Constant PR intervals (may be prolonged) before a random QRS is dropped

Third Degree AV Block

- Pwaves and QRS complex are not coordinated with each other

ACLS BRADYCARDIA ALGORITHM

Understanding and effectively applying the ACLS bradycardia algorithm is essential for health care professionals managing patients with symptomatic bradycardia with a pulse. Prompt recognition and intervention can prevent the progression to more severe cardiac events. This guide provides an overview of the key aspects of the ACLS bradycardia algorithm, incorporating critical dosing details to enhance your ability to respond effectively during emergencies.

IMPORTANCE OF ACLS BRADYCARDIA ALGORITHM

The ACLS bradycardia algorithm is a systematic approach designed to assist clinicians in:

- **Accurate Assessment:** Determining the severity of the patient's bradycardia with pulse and its impact on hemodynamic stability.
- **Identifying Underlying Causes:** Recognizing reversible factors contributing to the bradycardia.
- **Appropriate Intervention:** Implementing treatments based on the patient's condition, including specific medication dosages and pacing when necessary.

By adhering to the ACLS bradycardia algorithm, health care providers can improve patient outcomes and reduce the risk of deterioration to cardiac arrest.

Adult Bradycardia with Pulse Algorithm

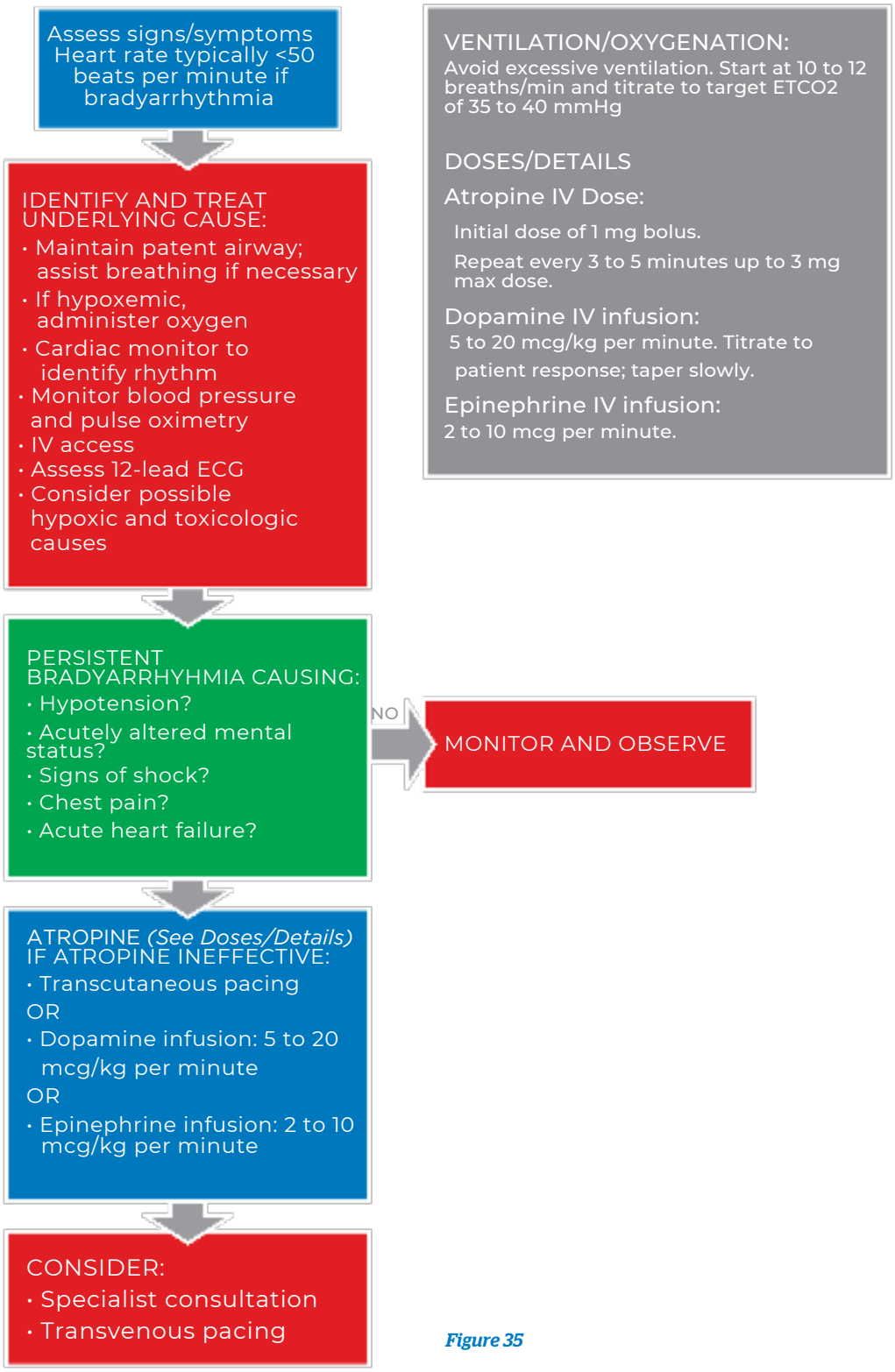


Figure 35

KEY STEPS OF THE ACLS BRADYCARDIA ALGORITHM

1. Assess and Monitor the Patient

- **Airway and Breathing:** Ensure the airway is open and the patient is breathing adequately; provide oxygen if needed.
- **Circulation:** Monitor blood pressure, heart rate, and oxygen saturation.
- **Vital Signs:** Obtain a complete set of vital signs, including level of consciousness.
- **Establish IV Access:** Prepare for medication administration.
- **12-Lead ECG:** obtain an ECG and identify the type of bradycardia.

2. Evaluate for Signs of Poor Perfusion

- **Symptoms of Unstable Bradycardia with Pulse:**
  - Hypotension
  - Altered mental status
  - Signs of shock
  - Chest pain
  - Acute heart failure

3. Identify and Treat Underlying Causes

Consider possible contributing factors to bradycardia (remember the H's and T's):

- Hypoxia
- Hypothermia
- Hypovolemia
- Hyper/Hypokalemia
- Toxins
- Tamponade (cardiac)
- Tension pneumothorax
- Thrombosis (coronary or pulmonary)

4. Implement Appropriate Interventions

If the Patient is Symptomatic (Unstable Bradycardia with Pulse)

First-line Medication: Atropine

- **Atropine IV Dose:**
  - **First Dose:** 0.5 mg bolus
  - **Repeat:** Every 3-5 minutes as needed
  - **Maximum Total Dose:** 3 mg

If Atropine is Ineffective

Proceed to one of the following:

- **Transcutaneous Pacing**
- **Dopamine Infusion**
- **Dopamine IV Infusion Dose:**
  - 2-20 mcg/kg per minute
  - Titrate to patient response
  - Taper slowly as needed

Epinephrine Infusion

- **Epinephrine IV Infusion Dose:**
  - 2-10 mcg per minute
  - Titrate to patient response

5. Consider Expert Consultation

If the patient does not respond to initial treatments or if the management plan is uncertain, seek expert consultation.

6. Prepare for Transvenous Pacing

If the patient remains unstable despite medications and transcutaneous pacing, prepare for transvenous pacing.

Doses and Details

Atropine IV Dose
- Initial Dose: 0.5 mg IV bolus
- Repeat: Every 3-5 minutes as needed
- Maximum Total Dose: 3 mg

Dopamine IV Infusion
- Dose Range: 2-20 mcg/kg per minute
- Administration: Titrate to patient response; taper slowly

Epinephrine IV Infusion
- Dose Range: 2-10 mcg per minute
- Administration: Titrate to patient response

Transcutaneous Pacing
- Procedure: Apply pacing pads and begin pacing at the lowest effective energy level.

Monitoring: Observe patient comfort and adjust settings as necessary.

For Stable Patients with Wide QRS Complexes

Antiarrhythmic Infusions:

Procainamide IV Dose:

- Loading Dose: 20 to 50 mg per minute until arrhythmia is suppressed, hypotension ensues, QRS duration increases by >50%, or a maximum dose of 17 mg/kg is reached.
- Maintenance Infusion: 1 to 4 mg per minute.
- Precautions: Avoid if prolonged QT interval or congestive heart failure is present.

Amiodarone IV Dose:

- Initial Dose: 150 mg over 10 minutes. Repeat as needed if ventricular tachycardia recurs.
- Maintenance Infusion: 1 mg per minute for the first six hours.

Sotalol IV Dose:

- Dose: 100 mg (1.5 mg/kg) over five minutes.
- Precautions: Avoid if prolonged QT interval is present.
- Expert Consultation: Consider seeking specialist input for complex arrhythmias.

7. Reassessment and Monitoring

- Continuous Monitoring: Observe ECG, blood pressure, and patient symptoms.
- Evaluate Response: Adjust treatment based on patient response to interventions.

Prepare for Escalation: Be ready to initiate advanced interventions if the patient's condition worsens.

TACHYCARDIA

Tachycardia is a heart rate of greater than 100 beats per minute. When the heart beats too quickly, there is a shortened relaxation phase. This causes two main problems: the ventricles are unable to fill completely, causing cardiac output to decrease; and the coronary arteries receive less blood, causing supply to the heart to decrease.

- Tachycardia is classified as stable or unstable.
- Heart rates greater than or equal to 150 beats per minute usually cause symptoms.
- Unstable tachycardia always requires prompt attention.
- Stable tachycardia can become unstable.

SYMPTOMS OF TACHYCARDIA

- Hypotension
- Sweating
- Pulmonary edema/congestion
- Jugular venous distension
- Chest pain/discomfort
- Shortness of breath
- Weakness/dizziness/lightheadedness
- Altered mental state

SYMPTOMATIC TACHYCARDIA WITH HEART RATE > 150 BPM

1. **If the individual is unstable, provide immediate synchronized cardioversion.**
   - Is the individual's tachycardia producing hemodynamic instability and serious symptoms?
   - Are the symptoms (i.e., pain and distress of acute myocardial infarction (AMI)) producing the tachycardia?

2. **Assess the individual's hemodynamic status and begin treatment by establishing IV, giving supplementary oxygen and monitoring the heart.**
   - Heart rate of 100 to 130 bpm is usually the result of underlying process and often represents sinus tachycardia. In sinus tachycardia, the goal is to identify and treat the underlying systemic cause.
   - Heart rate greater than 150 bpm may be symptomatic; the higher the rate, the more likely the symptoms are due to the tachycardia.

3. **Assess the QRS Complex.**

If at any point you become uncertain or uncomfortable during the treatment of a stable patient, seek expert consultation.

Adenosine may cause bronchospasm; therefore, adenosine should be given with caution to patients with asthma.

Synchronized cardioversion is appropriate for treating wide complex tachycardia of unknown type. Prepare for synchronized cardioversion as soon as a wide complex tachycardia is detected.

REGULAR NARROW COMPLEX TACHYCARDIA (PROBABLE SVT)

- Attempt vagal maneuvers.
- Obtain 12-lead ECG; consider expert consultation.
- Adenosine 6 mg rapid IVP; if no conversion, give 12 mg IVP (second dose); may attempt 12 mg once.

IRREGULAR NARROW COMPLEX TACHYCARDIA (PROBABLE A-FIB)

- Obtain 12-lead ECG; consider expert consultation.
- Control rate with diltiazem 15 to 20 mg (0.25 mg/kg) IV over two minutes or beta-blockers.

REGULAR WIDE COMPLEX TACHYCARDIA (PROBABLE VT)

- Obtain 12-lead ECG; consider expert consultation.
- Convert rhythm using amiodarone 150 mg IV over 10 minutes.
- Perform elective cardioversion.

IRREGULAR WIDE COMPLEX TACHYCARDIA

- Obtain 12-lead ECG; consider expert consultation.
- Consider anti-arrhythmic.
- If Torsades de Pointes, give magnesium sulfate 1 to 2 gm IV; may follow with 0.5 to 1 gm over 60 minutes.

STABLE AND UNSTABLE TACHYCARDIA

RULES FOR SINUS TACHYCARDIA

Figure 36

REGULARITY	*R-R intervals are regular, overall rhythm is regular.*
RATE	*The rate is over 100 bpm but usually less than 150 bpm.*
P WAVE	*There is one P wave in front of every QRS. The P waves appear uniform.*
PR INTERVAL	*Measures between 0.12-0.20 seconds in duration. PR interval is consistent.*
QRS COMPLEX	*Measures less than 0.12 seconds.*

Table 16

RULES FOR ATRIAL FLUTTER

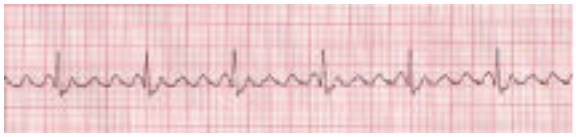


Figure 37

REGULARITY	*The atrial rate is regular. The ventricular rate will usually be regular, but only if the AV node conducts the impulses in a consistent manner. Otherwise, the ventricular rate will be irregular.*
RATE	*The atrial rate is normally between 250 to 350. Ventricular rate depends on conduction through the AV node to the ventricles.*
P WAVE	*The P waves will be well defined and have a "sawtooth" pattern to them.*
PR INTERVAL	*Due to the unusual configuration of P waves, the interval is not measured with atrial flutter.*
QRS COMPLEX	*QRS measures less than 0.12 seconds.*

RULES FOR ATRIAL FIBRILLATION (A-FIB) IRREGULAR NARROW COMPLEX TACHYCARDIA

Figure 38

REGULARITY	*The R-R intervals are irregular; therefore, overall rhythm is irregularly irregular. The ventricles conduct from different atrial foci causing the irregularity.*
RATE	*Atrial rate usually exceeds 350. If the ventricular rate is between 60 and 100 bpm, this is known as "controlled" A-Fib. If the ventricular rate is more than 100, it is considered A-Fib with Rapid Ventricular Response (RVR), also known as uncontrolled A-Fib.*
P WAVE	*Due to the atria firing so rapidly from multiple foci, there are no obvious P waves in the rhythm. The baseline appears chaotic because the atria are fibrillating, therefore no P waves are produced.*
PR INTERVAL	*Because there are no P waves, PR interval cannot be measured.*
QRS COMPLEX	*QRS measures less than 0.12 seconds.*

Table 17 & 18

ADULT TACHYCARDIA WITH A PULSE ALGORITHM

Understanding and effectively applying adult tachycardia with a pulse algorithm is essential for healthcare professionals managing patients with tachyarrhythmias. Prompt recognition and intervention can prevent the progression of more severe arrhythmias or cardiac arrest. This guide provides an overview of the key aspects of adult tachycardia with a pulse algorithm, incorporating critical dosing details to enhance your ability to respond effectively during emergencies.

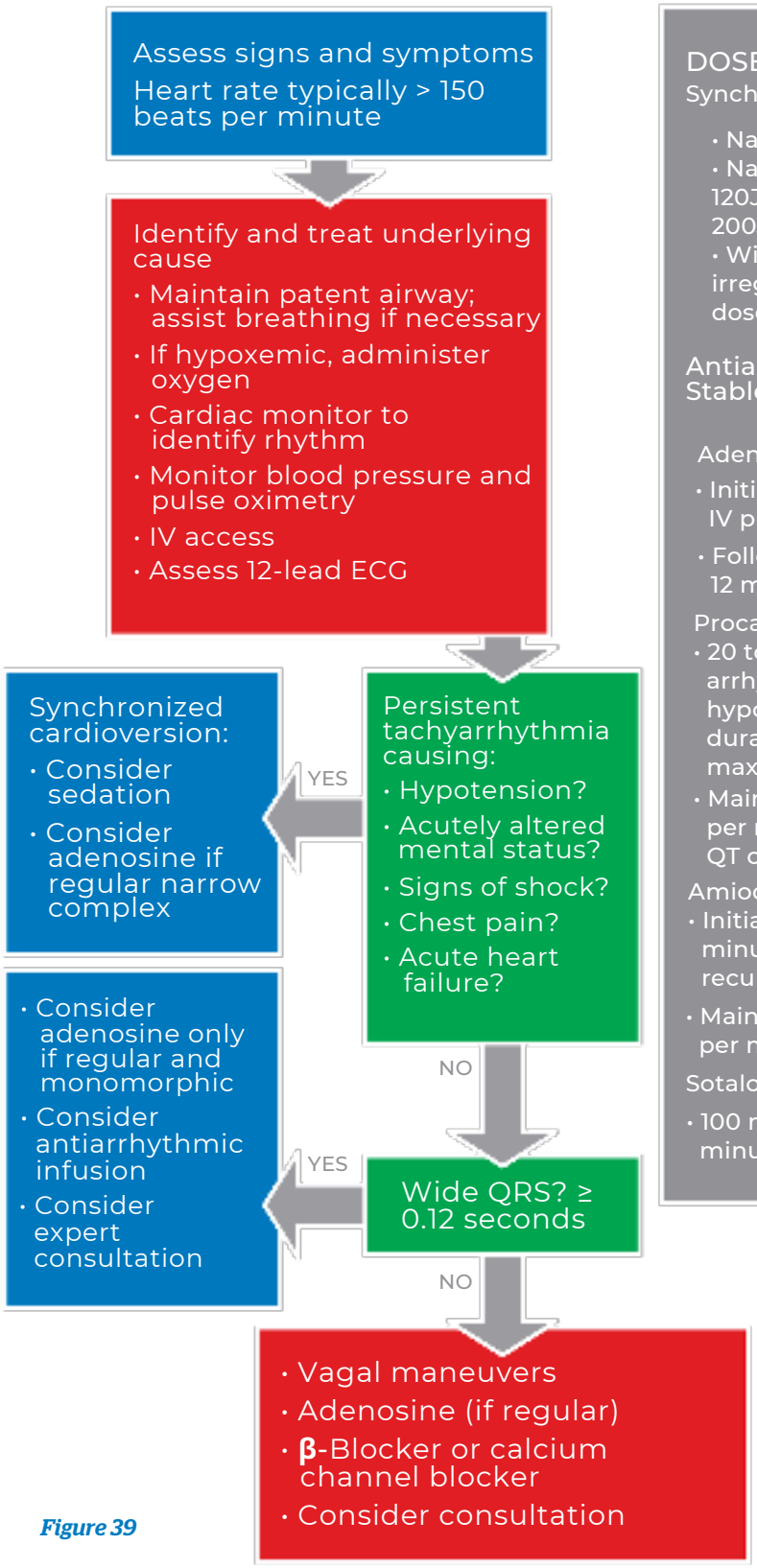
IMPORTANCE OF ADULT TACHYCARDIA WITH A PULSE ALGORITHM

The adult tachycardia with a pulse algorithm is a systematic approach designed to assist clinicians in:

- **Accurate Assessment:** Determining the hemodynamic stability of the patient.
- **Rhythm Identification:** Differentiating between narrow and wide QRS complexes.
- **Appropriate Intervention:** Implementing treatments based on the type of tachycardia and the patient's condition, including specific dosages for medications and cardioversion.

By adhering to adult tachycardia with a pulse algorithm, health care providers can improve patient outcomes and reduce the risk of progression to life-threatening conditions.

Adult Tachycardia with Pulse Algorithm



DOSES/DETAILS

Synchronized Cardioversion Joules:

- Narrow regular: 50 to 100J
- Narrow irregular: Biphasic 120J to 200J OR Monophasic 200J
- Wide regular: 100J • Wide irregular: Use defibrillation dose (NOT synchronized)

Antiarrhythmic Infusions for Stable Wide QRS Tachycardia:

Adenosine IV Dose:

- Initial dose of 6 mg rapid IV push; follow with NS flush
- Follow with second dose of 12 mg if required

Procainamide IV Dose:

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

Amiodarone IV Dose:

- Initial dose: 150 mg over 10 minutes. Repeat as needed if VT recurs
- Maintenance infusion: 1 mg per minute for first six hours

Sotalol IV Dose:

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

Figure 39

KEY STEPS OF THE ADULT TACHYCARDIA WITH A PULSE ALGORITHM

1. Assess and Monitor the Patient

- **Airway and Breathing:** Ensure the airway is open and the patient is breathing adequately; provide oxygen if needed.
- **Circulation:** Monitor blood pressure, heart rate, and oxygen saturation.
- **Vital Signs:** Obtain a complete set of vital signs, including level of consciousness.
- **Establish IV Access:** Prepare for medication administration.

2. Evaluate for Hemodynamic Stability

- **Signs of Instability:**
  - Hypotension
  - Altered mental status
  - Signs of shock
  - Chest pain
  - Acute heart failure
- **Unstable Patients:** Immediate synchronized cardioversion is indicated per the adult tachycardia with a pulse algorithm.

3. Identify the Type of Tachycardia

- **ECG Analysis:** Obtain a 12-lead ECG to analyze the rhythm.
- **QRS Complex Width:**
  - Narrow QRS (<0.12 sec): Likely indicating a supraventricular tachycardia (SVT).
  - Wide QRS (≥0.12 sec): This could indicate ventricular tachycardia or SVT with aberrancy.

4. Management Based on QRS Width and Rhythm Regularity

For Unstable Patients

Immediate Synchronized Cardioversion:

Energy Dosages:
- **Narrow Regular:** 50 to 100 Joules (J)
- **Narrow Irregular:**
  - Biphasic: 120 to 200 J
  - Monophasic: 200 J
- **Wide Regular:** 100 J
- **Wide Irregular:** Treat with defibrillation dose (unsynchronized shocks), as synchronization is not possible

For Stable Patients with Narrow QRS Complexes

Regular Rhythm:
- **Vagal Maneuvers:** Stimulate the vagus nerve to slow heart rate.
- **Adenosine Administration:**
  - First Dose: 6 mg rapid IV push followed by normal saline flush.
  - Second Dose: 12 mg if required.

Irregular Rhythm:
- **Rate Control:** Consider beta-blockers or calcium channel blockers.

ACUTE CORONARY SYNDROME

Acute coronary syndrome (ACS) is a collection of clinical presentations including unstable angina, non-ST-elevation myocardial infarction (NSTEMI) and ST-elevation myocardial infarction (STEMI). ACS is classically recognized by one or more of the following symptoms: crushing chest pain, shortness of breath, pain that radiates to the jaw, arm or shoulder, sweating, and/or nausea or vomiting. It is important to note that not all individuals with ACS will present with these classic findings, particularly women and individuals with diabetes mellitus. It is impossible to determine a specific cardiac event from the ACS symptoms; therefore, ACS symptoms are managed in the same way.

Every individual with these symptoms should be evaluated immediately. If an individual appears to be unconscious, begin with the BLS Survey and follow the appropriate pathway for advanced care. If the individual is conscious, proceed with the pathway below.

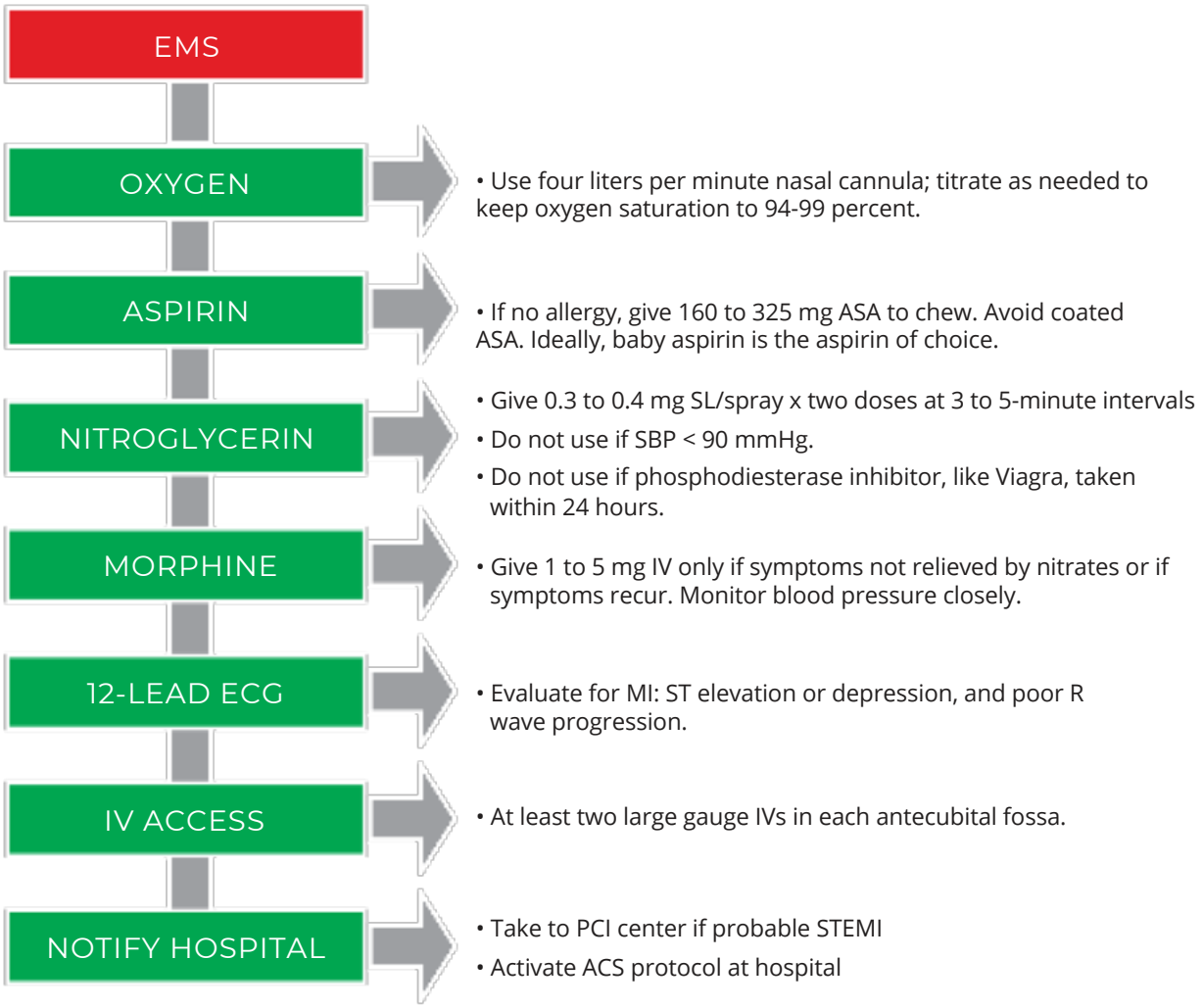


Figure 40

ACUTE CORONARY SYNDROME ALGORITHM

Understanding and effectively applying the ACLS acute coronary syndrome algorithm is essential for health care professionals managing patients with acute coronary syndromes (ACS). Prompt recognition and intervention can significantly improve patient outcomes by minimizing heart muscle damage and preventing complications. This guide provides an overview of the key aspects of the ACLS acute coronary syndrome algorithm, enhancing your ability to respond effectively during critical situations.

IMPORTANCE OF THE ACLS ACUTE CORONARY SYNDROME ALGORITHM

The ACLS acute coronary syndrome algorithm is a systematic approach designed to assist clinicians in rapidly identifying and treating patients experiencing ACS, which includes conditions like unstable angina, non-ST-elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI). It emphasizes:

- **Early Recognition:** Prompt identification of ACS signs and symptoms.
- **Timely Intervention:** Rapidly initiating appropriate therapies to restore blood flow and reduce cardiac damage.
- **Coordinated Care:** Streamlining communication and procedures among health care teams to provide optimal patient care.

By adhering to the ACLS acute coronary syndrome algorithm, health care providers can improve patient survival rates and reduce the risk of long-term complications.

Adult Coronary Syndrome Algorithm

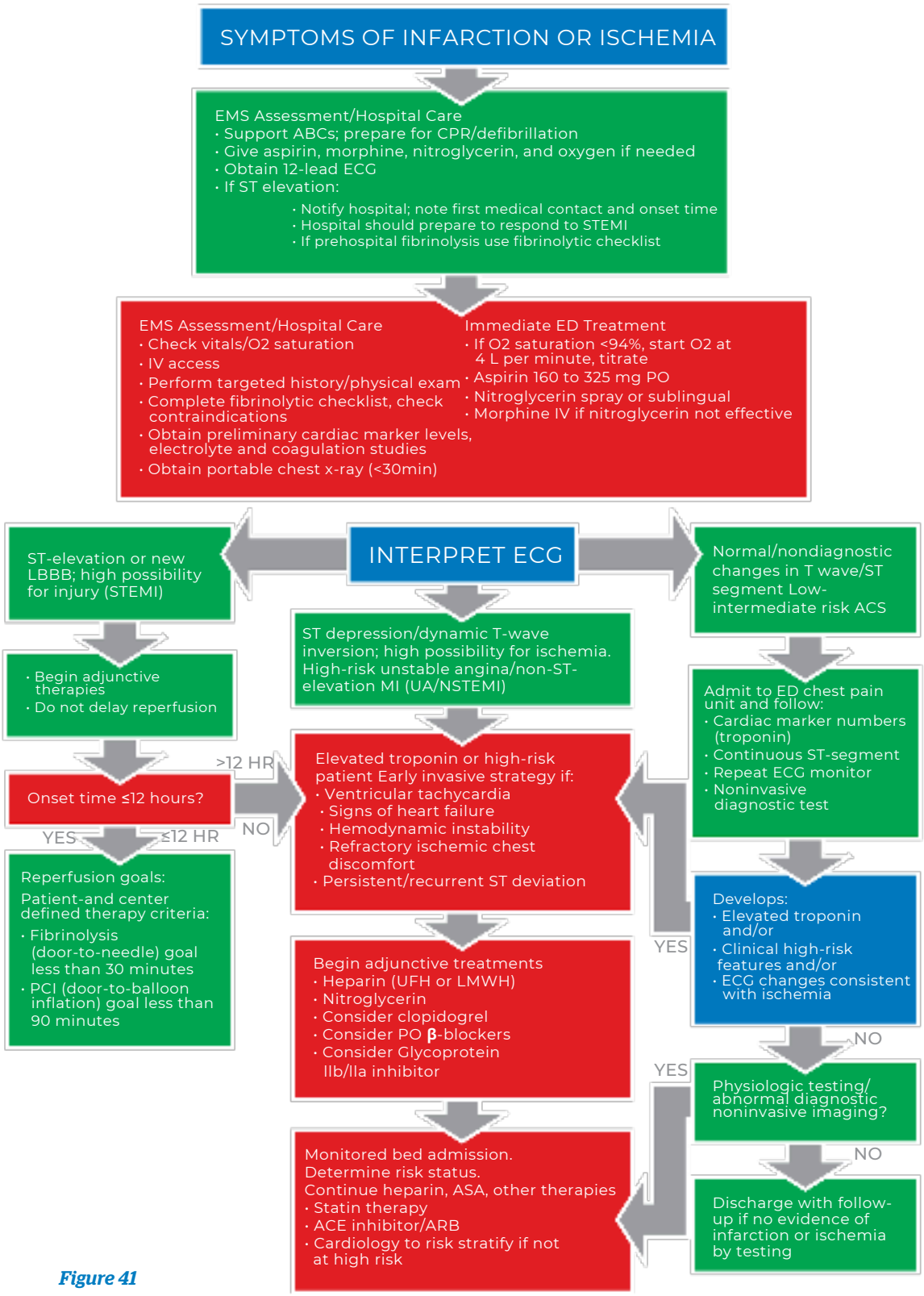


Figure 41

KEY STEPS OF THE ACLS ACUTE CORONARY SYNDROME ALGORITHM

1. Immediate Assessment and Recognition

- **Identify ACS Signs:** Common symptoms include chest pain or discomfort, shortness of breath, nausea, lightheadedness, and pain in the arms, back, neck, jaw, or stomach.
- **Activate Emergency Response:** If ACS is suspected, initiate the emergency response system and prepare for advanced cardiac life support.

2. Initial Stabilization

- **Monitor Vital Signs:** Check airway, breathing, and circulation.
- **Oxygen Administration:** Provide supplemental oxygen if oxygen saturation is below 90% or the patient is in respiratory distress.
- **Obtain a 12-Lead ECG:** Perform an electrocardiogram within 10 minutes of arrival to assess for ischemic changes.
- **Establish IV Access:** Secure venous access for medication administration.
- **Blood Tests:** Order cardiac biomarkers, electrolyte levels, and coagulation studies.

3. Immediate Interventions

- **Aspirin Administration:** Give 160-325 mg of non-enteric-coated aspirin to chew unless contraindicated.
- **Nitroglycerin:** If the patient is experiencing ongoing chest discomfort and is hemodynamically stable, administer sublingual nitroglycerin every 5 minutes for up to three doses.
- **Morphine:** Consider morphine for chest pain, being unresponsive to nitroglycerin, and being cautious of potential hypotension or respiratory depression.

4. Risk Stratification

- **Interpret ECG Results:**
  - **STEMI:** ST-segment elevation indicating complete coronary artery occlusion.
  - **NSTEMI/Unstable Angina:** ST-segment depression or T-wave inversion.

5. Reperfusion Strategy for STEMI

- **Prompt Reperfusion Therapy:**
  - **Percutaneous Coronary Intervention (PCI):** Preferred method if it can be performed within 90 minutes.
  - **Fibrinolytic Therapy:** If PCI is unavailable within the recommended time frame, consider fibrinolytic therapy within 30 minutes of hospital arrival.

6. Adjunctive Therapies

- **Antiplatelet Agents:** Such as clopidogrel to prevent further clot formation.
- **Anticoagulants:** Such as heparin to inhibit new thrombus development.
- **Beta-Blockers:** To reduce myocardial oxygen demand unless contraindicated.

7. Ongoing Management and Monitoring

- **Continuous ECG Monitoring:** Detects arrhythmias or ischemic changes.
- **Vital Signs:** Regularly monitor blood pressure, heart rate, and oxygen saturation.
- **Assess for Complications:** Be vigilant for signs of heart failure, arrhythmias, or cardiogenic shock.

ACUTE STROKE

Stroke is a condition in which normal blood flow to the brain is interrupted. Strokes can occur in two variations: ischemic and hemorrhagic. In ischemic stroke, a clot lodges in one of the brain's blood vessels, blocking blood flow through the blood vessel. In hemorrhagic stroke, a blood vessel in the brain ruptures, spilling blood into the brain tissue. Ischemic stroke and hemorrhagic stroke account for 87% and 13% of the total incidents, respectively. In general, the symptoms of ischemic and hemorrhagic strokes are similar. However, the treatments are very different.

SYMPTOMS OF STROKE

- Weakness in the arm and leg or face
- Vision problems
- Confusion
- Nausea or vomiting
- Trouble speaking or forming the correct words
- Problems walking or moving
- Severe headache (hemorrhagic)

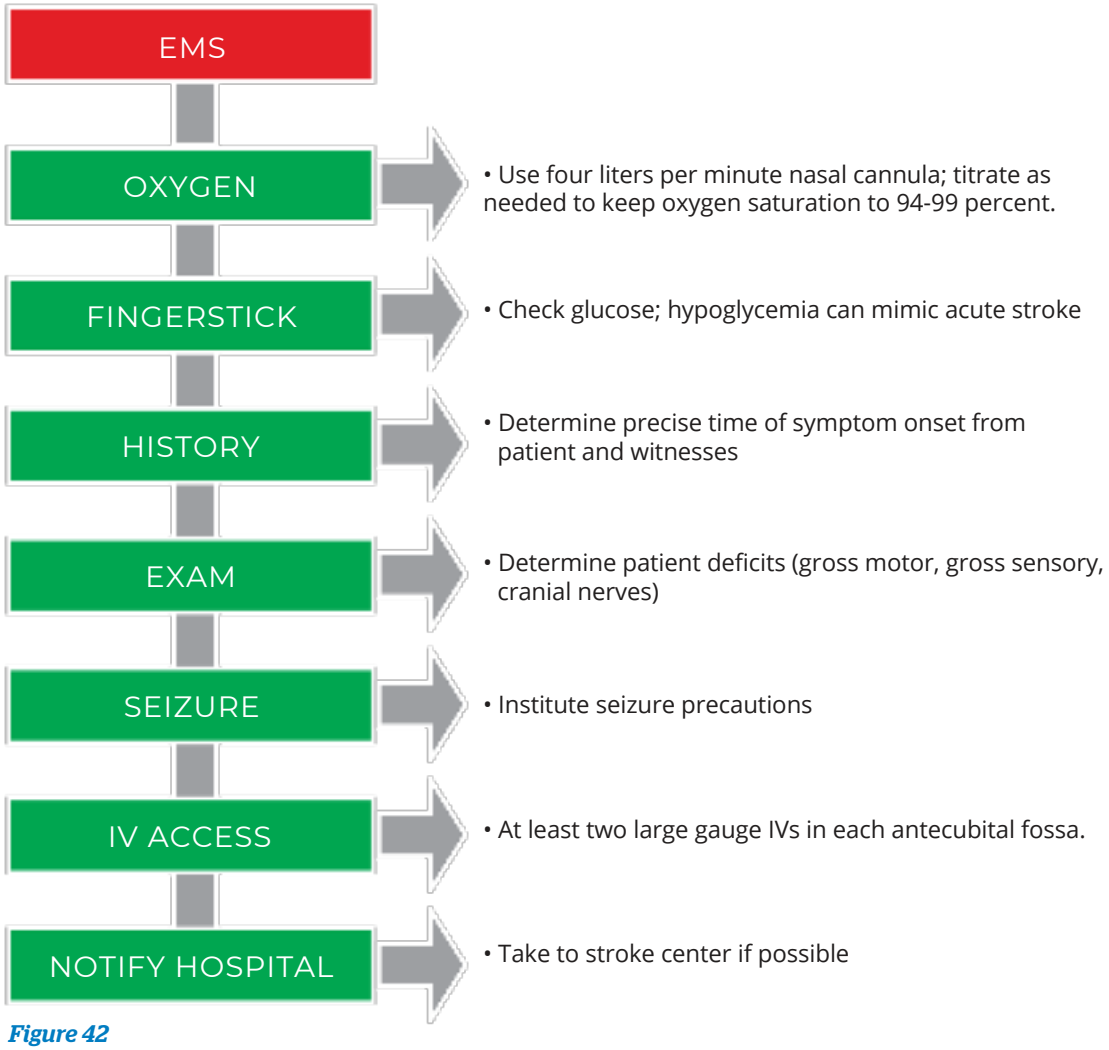


Figure 42

Clinical signs of stroke depend on the region of the brain affected by decreased or blocked blood flow. Signs and symptoms can include: weakness or numbness of the face, arm, or leg, difficulty walking, difficulty with balance, vision loss, slurred or absent speech, facial droop, headache, vomiting, and change in level of consciousness. Not all of these symptoms are present, and the exam findings depend on the cerebral artery affected.

The Cincinnati Prehospital Stroke Scale (CPSS) is used to diagnose the presence of stroke in an individual if any of the following physical findings are seen: facial droop, arm drift, or abnormal speech. Individuals with one of these three findings as a new event have a 72% probability of an ischemic stroke. If all three findings are present, the probability of an acute stroke is more than 85%. Becoming familiar and proficient with the tool ***FAST*** *(Table 2)* utilized by the rescuers' EMS system is recommended. Mock scenarios and practice will facilitate the use of these valuable screening tools.

FAST: Face Drooping, Arm Weakness, Speech, and Time Symptoms Started

Individuals with ischemic stroke who are not candidates for fibrinolytic therapy should receive aspirin unless contraindicated by true allergy to aspirin. All individuals with confirmed stroke should be admitted to Neurologic Intensive Care Unit if available. Stroke treatment includes blood pressure monitoring and regulation per protocol, seizure precautions, frequent neurological checks, airway support as needed, physical/occupational/speech therapy evaluation, body temperature checks, and blood glucose monitoring. Individuals who received fibrinolytic therapy should be followed for signs of bleeding or hemorrhage. Certain individuals (age 18 to 79 years with mild to moderate stroke) may be able to receive tPA (tissue plasminogen activator) up to 4.5 hours after symptom onset. Under certain circumstances, intra-arterial tPA is possible up to six hours after symptom onset. When the time of symptom onset is unknown, it is considered an automatic exclusion for tPA. If time of symptom onset is known, the National Institute of Neurological Disorders and Stroke (NINDS) has established the time goals below.

Figure 43

10 MINUTES OF ARRIVAL	25 MINUTES OF ARRIVAL	60 MINUTES OF ARRIVAL	180 MINUTES OF ARRIVAL
• General assessment by expert • Order urgent CT scan without contrast	• Perform CT scan without contrast • Neurological assessment • Read CT scan within 45 minutes	• Evaluate criteria for use and administer fibrinolytic therapy ("clot buster") • Fibrinolytic therapy may be used within three hours of symptom onset (4.5 hours in some cases)	• Admission to stroke unit

- *Before giving anything (medication or food) by mouth, you must perform a bedside swallow screening. All acute stroke individuals are considered NPO on admission.*
- *The goal of the stroke team, emergency physician, or other experts should be to assess the individual with suspected stroke within 10 minutes of arrival in the emergency department (ED).*
- *The CT scan should be completed within 10-25 minutes of the individual's arrival in the ED and should be read within 45 minutes.*

EMERGENCY DEPARTMENT STAFF

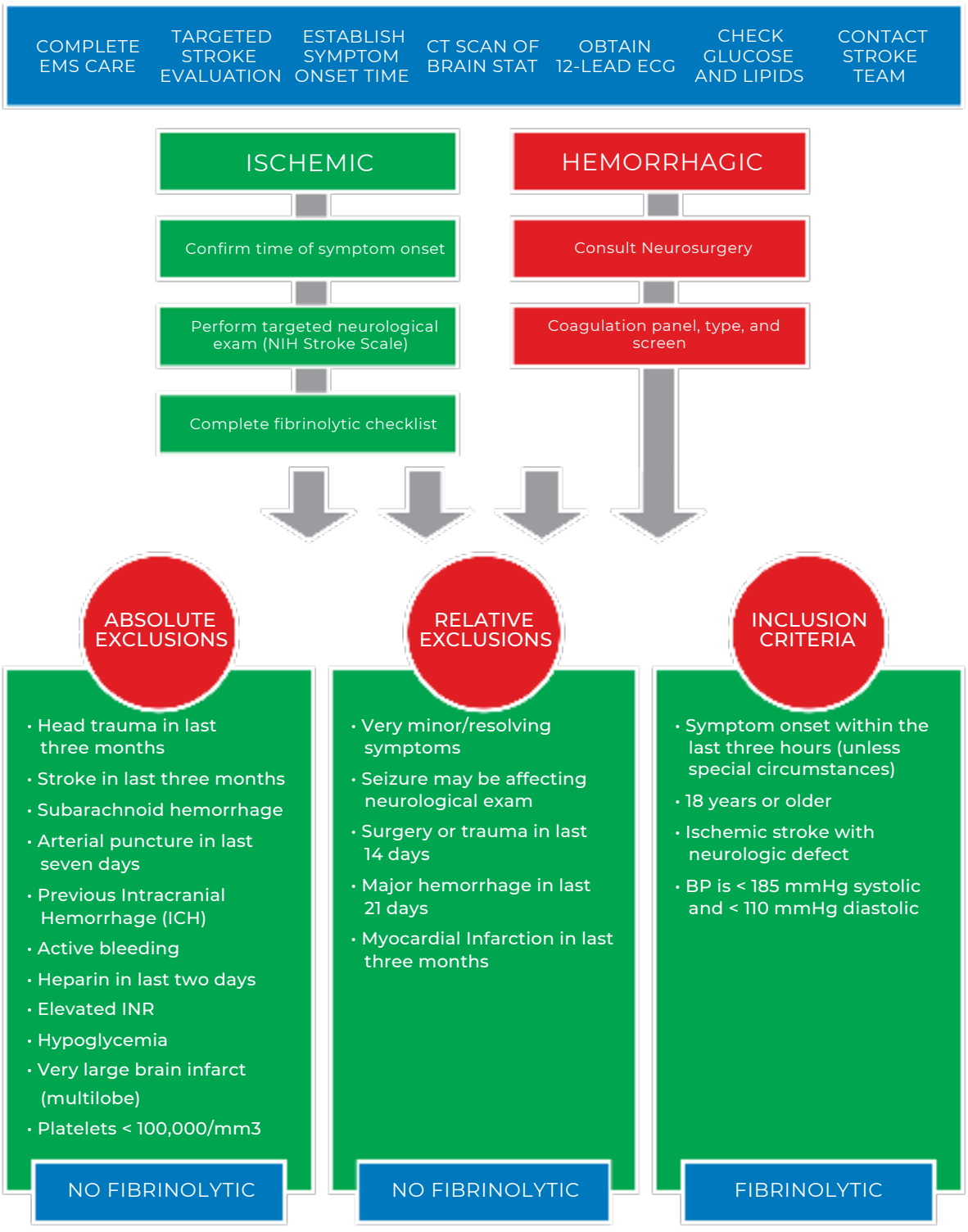


Figure 44

ACUTE STROKE ALGORITHM

Understanding the ACLS acute stroke algorithm is crucial for health care professionals involved in emergency and critical care. Prompt recognition and management of stroke symptoms can significantly improve patient outcomes. This guide provides an overview of the key aspects of the ACLS acute stroke algorithm, enhancing your ability to respond effectively during critical situations.

IMPORTANCE OF THE ACLS ACUTE STROKE ALGORITHM

The ACLS acute stroke algorithm is a systematic approach designed to assist clinicians in rapidly identifying and treating patients experiencing a stroke. It emphasizes:

- **Early Recognition:** Prompt identification of stroke signs and symptoms.
- **Timely Intervention:** Rapid initiation of appropriate therapies to reduce brain damage.
- **Coordinated Care:** Streamlining communication and procedures among health care teams.

By adhering to the ACLS acute stroke algorithm, health care providers can minimize the time between symptom onset and treatment, which is vital for preserving neurological function.

Acute Stroke Algorithm

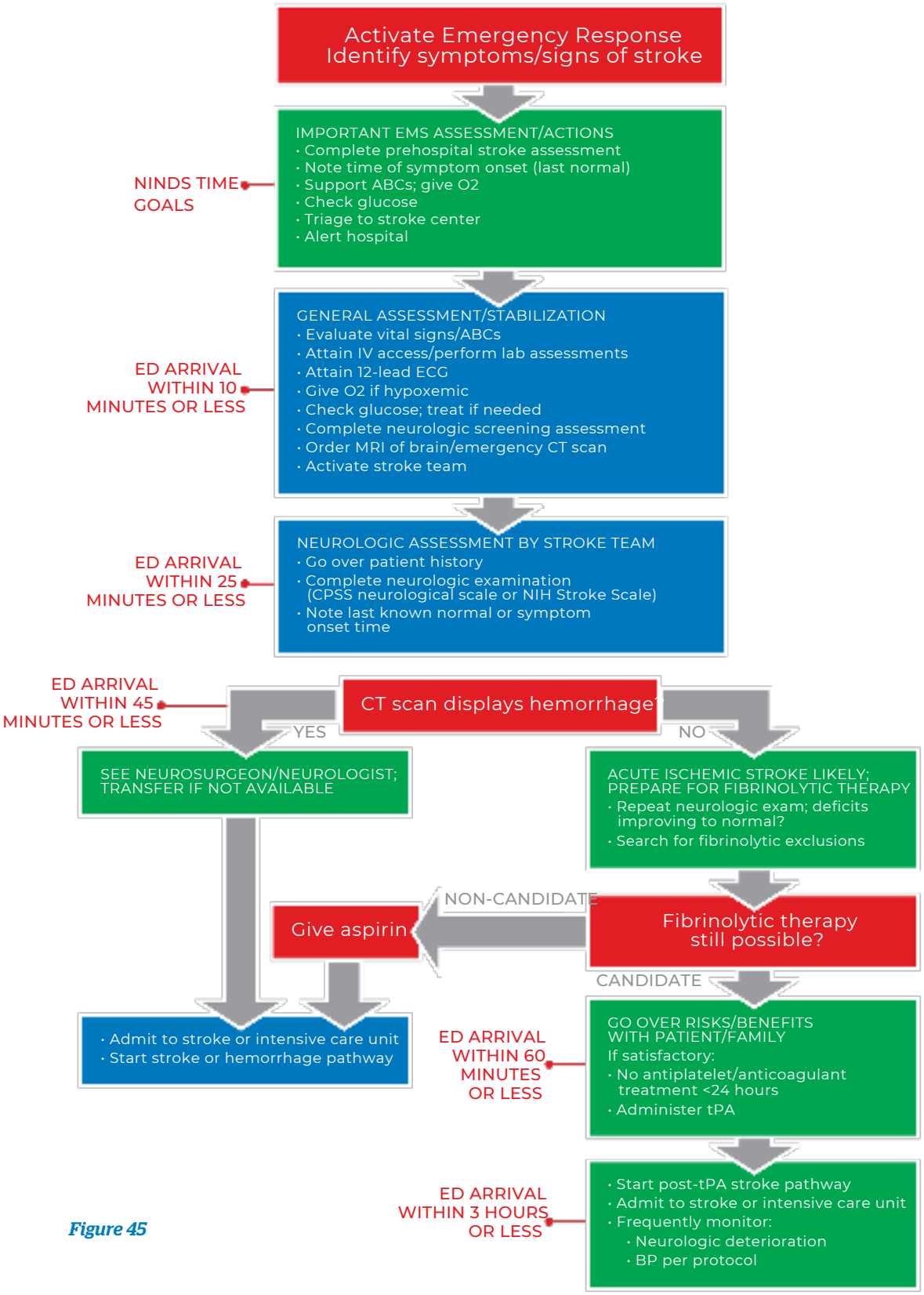


Figure 45

KEY STEPS OF THE ACLS ACUTE STROKE ALGORITHM

1. Immediate Assessment and Recognition

- **Identify Stroke Signs: Use the FAST mnemonic:**
  - Face drooping
  - Arm weakness
  - Speech difficulties
  - Time that symptoms started
- **Activate Emergency Response:** Notify the stroke team immediately upon suspicion.

2. Critical Initial Actions

- **Monitor Vital Signs:** Check airway, breathing, and circulation.
- **Oxygen Administration:** Provide supplemental oxygen if hypoxia is present.
- **Establish IV Access:** Secure venous access for medication administration.
- **Blood Glucose Check:** Hypoglycemia can mimic stroke symptoms; correct if necessary.

3. Neurological Evaluation

- **Perform NIH Stroke Scale Assessment:** Quantify the severity of neurological deficits.
- **Obtain Patient History:** Determine the exact time of symptom onset or last known well time.

4. Imaging and Diagnostic Tests

- **Immediate CT or MRI Scan:** Rule out hemorrhagic stroke.
- **Laboratory Tests:** Complete blood count, coagulation profile, and other relevant labs.

5. Determine Eligibility for Fibrinolytic Therapy

- **Assess Contraindications:** Evaluate for any medical conditions that preclude thrombolytic use.
- **Initiate Treatment:** If eligible, administer tissue plasminogen activator (tPA) within the appropriate time window.

6. Post-Thrombolysis Monitoring

- **Frequent Neurological Checks:** Monitor for improvement or deterioration.
- **Manage Blood Pressure:** Maintain optimal levels to prevent complications.
- **Watch for Bleeding:** Observe for signs of hemorrhage due to thrombolytic therapy.

7. Transfer to the Stroke Unit or Intensive Care

- **Continued Care:** Provide specialized monitoring and rehabilitation services.
- **Collaborative Approach:** Work with multidisciplinary teams for comprehensive care.

SELF-ASSESSMENT FOR ACLS CASES

1. Which of the following is the correct next step in management after delivery of a shock?

    a. Check pulse.
    b. Ventilate only.
    c. Do chest compressions.
    d. Shock again.

2. Where does the electrical impulse for normal cardiac activity originate?

    a. Unknown
    b. SA node
    c. AV node
    d. Purkinje fibers

3. Choose the correct sequence of electrical activity in the heart for normal sinus rhythm?

    a. SA node, Purkinje, AV node, Bundle of His
    b. Purkinje, Bundle of His, AV node, SA node
    c. SA node, AV node, Bundle of His, Purkinje fibers
    d. AV node, SA node, Bundle of Hers, Purkinje fibers

4. What does the QRS complex on an ECG represent?

    a. Ventricular contraction
    b. AV valve closure
    c. Atrial contraction
    d. Septum relaxation

5. What is the recommended method to monitor breathing during ACLS care?

    a. Look, listen, and feel
    b. Capnography
    c. Venous blood gas
    d. Monitoring chest rise

6. You are transporting an individual who goes into cardiac arrest during transport. IV access is unsuccessful. What is the next step?

    a. Terminate resuscitation.
    b. Obtain intraosseous access.
    c. Place a central line.
    d. Administer all medications through ET tube.

7. An individual has been ill, and the monitor reveals sinus tachycardia with a heart rate of 135. What is the primary goal in treating this individual?

    a. Determine the underlying cause.
    b. Prepare for synchronized cardioversion.
    c. Transfuse packed red blood cells.
    d. Administer Adenosine.

8. A 79-year-old individual is in SVT. BP is 80/50, and he is complaining of chest discomfort and feels like passing out. What is the next appropriate step?

    a. Carotid massage
    b. Synchronized cardioversion
    c. Amiodarone
    d. Lidocaine

9. You are treating an individual who presented in ventricular fibrillation. After CPR and one attempt at defibrillation, his new rhythm is third-degree AV block. What is the next step in management?

    a. Repeat defibrillation
    b. Vasopressin
    c. Transcutaneous pacing
    d. High dose epinephrine

10. A 55-year-old male has stroke symptoms, and the CT scan shows multilobar infarction (more than one-third of the cerebral hemisphere). What therapy is contraindicated?

    a. Oxygen
    b. Monitoring glucose
    c. Thrombolytic therapy
    d. Blood pressure monitoring

11. What piece of data is critical to obtain in all stroke individuals?

    a. Date of birth
    b. Hemoglobin A1c
    c. Bilateral arm blood pressure
    d. Time last seen normal

12. True or False: The goal of stroke care is to complete the ED initial evaluation within 10 minutes, the neurologic evaluation within 25 minutes of arrival, and have the head CT read within 45 minutes of arrival.

ANSWERS

1. C
   CPR is resumed for two minutes before any reassessment is performed. Begin with compression followed by ventilation in a 30:2 ratio for adults.
2. B
   The SA node generates electrical impulse in normal cardiac activity. The impulse then travels to the rest of the conduction system and facilitates contraction of the atria and ventricles.
3. C
   Normal cardiac electrical impulse travels in a consistent pattern producing normal sinus rhythm.
4. A
   The QRS represents ventricular contraction. The T wave represents repolarization of the ventricles.
5. B
   Quantitative waveform capnography is the recommended method to assess breathing/ventilation during ACLS. In addition, pulse oximetry should be assessed, and clinical assessment plays a role as well.
6. B
   An intraosseous line can be placed rapidly and is the next best route for drug delivery. Absorption after ET tube delivery is unreliable.
7. A
   The primary objective of treating sinus tachycardia is to determine the underlying cause. Appropriate treatment decisions can then be made.
8. B
   This individual is symptomatic with hypotension and chest pain. Adenosine could be considered if IV access is already in place, while preparation is made for cardioversion. Carotid massage may cause complications in elderly individuals.
9. C
   Transcutaneous pacing is indicated for Mobitz Type II second degree AV block, third-degree AV block, and bradycardia with symptomatic ventricular escape rhythm.
10. C
    Thrombolytic therapy is contraindicated in large strokes that involve more than one-third of a cerebral hemisphere.
11. D
    Eligibility for thrombolytic therapy hinges on the time of onset of symptoms. Current guidelines support administering tPA for eligible individuals with symptom onset of three hours or fewer. Selected individuals may be eligible for up to 4.5 hours from onset.
12. True
    Stroke is a neurologic emergency and rapid evaluation and treatment may improve outcomes. The mantra “Time is Brain” should be used here.

CHAPTER 8

ACLS ESSENTIALS

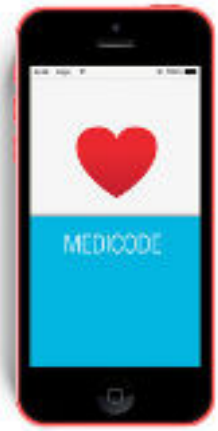
- Prompt recognition and intervention with high-quality CPR is critical in any arrest situation.
- Mentally prepare for resuscitation as you approach the scene and the individual.
- Scene safety is critical; do not get injured yourself.
- BLS focus is early CPR and early defibrillation.
- Do not attempt to place an oropharyngeal airway in an awake individual.
- Pull the jaw up into the mask; do not push the mask onto the face as it may close the airway.
- IV or IO is the preferred route for drug delivery; ET route is discouraged and unpredictable.
- The dose of amiodarone is different for VF and VT with a pulse.
- Resume chest compressions immediately after delivering a shock.
- Temperature control is utilized after return of spontaneous circulation.
- Learn specific cardiac rhythms: sinus tachycardia, SVT, atrial fibrillation/flutter, VF, VT, torsades de pointes, and asystole.
- Confirm asystole in two separate leads.
- VF and pulseless VT are treated the same: deliver a shock.
- Remember the reversible causes of cardiac arrest: the H's and the T's.
- Capnography is a valuable tool in resuscitation. If PETCO2 is lower than 10 mmHg, attempt to improve CPR quality and investigate the advanced airway placement.
- If capnography is still less than 10 mmHg, consider termination of efforts.
- Use nitroglycerin with caution in individuals with inferior myocardial infarction; avoid if systolic blood pressure (SBP) is less than 90 mmHg, or if taking erectile dysfunction medications (phosphodiesterase inhibitors) within 24 hours.
- Confusion may be a presenting sign of a stroke.

CHAPTER 9

ADDITIONAL TOOLS

MEDICODE

With MediCode, you no longer will have to carry a set of expandable cards with you at all times while at work. You will never have to waste valuable time in an emergency situation searching through multiple algorithms until you find the right one. All of the algorithms are now accessible from the palm of your hand, and you will be selecting your desired algorithm by memory in no time. Choose between multiple viewing options and easily share algorithms with co-workers and friends through email and social media.



To improve functionality and speed in obtaining your desired algorithm as quickly as possible in an emergency, they have been divided between BLS, ACLS, PALS, and CPR. All are accessible from the home screen. The individual algorithms included in this app are:

- Basic Life Support (BLS)
- Advanced Cardiac Life Support (ACLS)
- Pediatric Advanced Life Support (PALS)
- Cardiopulmonary Resuscitation (CPR) AED, and First Aid

CERTALERT+

CertAlert+ is the perfect app to minimize a potential area of stress and distraction in your life. With CertAlert+, you will have all your licenses and certifications in one place anytime you need them. We will keep track and remind you when your expiration date approaches, and we will help you with your registration whenever possible.

With CertAlert+, you can:

- Compile all required licenses and certifications in one location.
- Take photos (front and back) of certification cards and licenses for simple reference.
- Record all expiration dates and store with ease.
- Choose when you want to be reminded of your approaching expiration dates.
- Send all license or certification information directly to your email after exporting from the app.
- Quick access to easily register for online certification and recertification courses.

CHAPTER 10

ACLS REVIEW QUESTIONS

1. The following are included in the ACLS Survey:

    a. Airway, Breathing, Circulation, Differential Diagnosis
    b. Airway, Breathing, Circulation, Defibrillation
    c. Assessment, Breathing, Circulation, Defibrillation
    d. Airway, Breathing, CPR, Differential Diagnosis

2. The primary focus of treating cardiac arrest is:

    a. Effective CPR
    b. Early defibrillation
    c. Drug administration
    d. Both A and B

3. Which of the following is not an example of an advanced airway?

    a. Oropharyngeal airway
    b. Esophageal-tracheal tube
    c. Laryngeal mask airway
    d. Combitube

4. The following are possible effects of hyperventilation:

    a. Increased intrathoracic pressure
    b. Decreased venous return to the heart
    c. Both A and B
    d. None of the above

5. The normal sinus rhythm of the heart starts in the:

    a. Left ventricle
    b. Atrioventricular node
    c. Sinoatrial node
    d. Right ventricle

6. What is high-quality CPR?

    a. 80 compressions per minute at a depth of at least one-inch (2.5 cm)
    b. 100 to 120 compressions per minute at a depth of 2 to 2.4 inches (5 to 6 cm)
    c. 80 compressions per minute at a depth of at least two inches (5 cm)
    d. 100 compressions per minute at a depth of at least one inch (2.5 cm)

7. Before placement of an advanced airway, the compression to ventilation ratio during adult CPR is:

    a. 30:1
    b. 30:2
    c. 15:1
    d. 20:2

8. You should_____ in an individual with ventricular fibrillation immediately following a shock.

    a. Resume CPR
    b. Check heart rate
    c. Analyze rhythm
    d. Give amiodarone

9. _____ joules (J) are delivered per shock when using a monophasic defibrillator.

    a. 380
    b. 320
    c. 340
    d. 360

10. The following medication(s) can be used to treat hypotension during the post-cardiac arrest phase:

    a. Dopamine
    b. Milrinone
    c. Amiodarone
    d. Both A and B

11. The following antiarrhythmic drug(s) can be used for persistent ventricular fibrillation or pulseless ventricular tachycardia, except:

    a. Amiodarone
    b. Lidocaine
    c. Atropine
    d. Epinephrine

12. Which of the following is not a potential cause of PEA?

    a. Toxins
    b. Hyperkalemia
    c. Hyperventilation
    d. Trauma

13. Which of the following is a shockable rhythm?

    a. Ventricular fibrillation
    b. Ventricular tachycardia (pulseless)
    c. Torsades de Pointes
    d. All of the above

14. The following drug(s) may be used in an ACS individual for cardiac reperfusion:

    a. Fibrinolytic therapy
    b. Epinephrine
    c. Atropine
    d. Both A and C

15. All of the following are bradycardic rhythms except:

    a. Atrial fibrillation
    b. First-degree heart block
    c. Mobitz Type I
    d. Third-degree heart block

16. _____ access is preferred in arrest due to easy access and no interruption in CPR.

    a. Central
    b. Peripheral
    c. Intraosseous
    d. Endotracheal

17. Which of the following is first-line treatment for ACS?

    a. Morphine
    b. Aspirin
    c. Nitroglycerin
    d. All of the above

18. The following are classic signs of an acute stroke except:

    a. Facial droop
    b. Arm drift
    c. Abnormal speech
    d. Seizure

19. Which of the following is not found within the 8 D's of stroke care?

    a. Detection
    b. Dispatch
    c. Delivery
    d. Defibrillate

ANSWERS

1. A
   Airway, Breathing, Circulation, Differential Diagnosis
2. D
   Both A and B
3. A
   Oropharyngeal airway
4. C
   Both A and B
5. C
   Sinoatrial node
6. B
   100 to 120 compressions per minute at a depth of 2 to 2.4 inches (5 to 6 cm)
7. B
   30:2
8. A
   Resume CPR
9. D
   360
10. A
    Dopamine
11. C
    Atropine
12. C
    Hyperventilation
13. D
    All of the above
14. A
    Fibrinolytic therapy
15. A
    Atrial fibrillation
16. B
    Peripheral
17. D
    All of the above
18. D.
    Seizure
19. D
    Defibrillate

Who is the Disque Foundation?

The Disque Foundation was created for the sole purpose of empowering others to save lives! We do this by providing advanced healthcare education to underserved populations of the U.S. and the world through technology. To fulfill this mission, we have created the Save a Life Initiative. We offer the world's first free life support training courses online through our partnership with SaveaLife.com (Save a Life Certifications by NHCPS). Saving lives means giving others the chance to make a difference in the world. Our goal is to empower 10 million people with the ability to save a life by 2025.

How can I help?

Through the help of committed supporters like yourself, the Disque Foundation will have the ability to grow and expand our cause across the globe. Please help us by making a tax-deductible gift to the Disque Founda- tion. A donation of any size will help support our mission and your generous contribution will go directly to strengthening our efforts to empower others to save lives.

Donations can be made at **DisqueFoundation.org** or by mailing a check to:
Disque Foundation Donations Department
1609 W 100 S.
Brownstown, IN 47220
For more information, contact us at **info@disquefoundation.org.**

DISQUE FOUNDATION

Learn more at **DisqueFoundation.org**

Save a Life INITIATIVE

The idea behind the Save a Life Initiative is simple – take the same advanced life-saving training we developed for health care providers, and give it to the underserved, at home and abroad. We work in conjunction with SaveaLife.com to fulfill its mission of advancing health care education to the underserved through advanced technology. When we put the knowledge, skills, and ability to perform CPR and other proven techniques in people's hands around the world, the power to save lives is possible.

Presented by the:

Save a Life ♥ INITIATIVE™