Advanced cardiac life support (ACLS) in adults

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Life Support

Life support *Second Chance For Life* refers to the treatments and techniques performed in an emergency in order to support life after cardiac arrest

Cardiac Arrest

- A cardiac arrest is when heart suddenly stops pumping blood
- When heart stops pumping blood, brain is starved of oxygen
- This causes you to fall unconscious and stop breathing.

Symptoms and Signs of Cardiac Arrest

- Sudden collapse
- Loss of consciousness
- No pulse
- No normal breathing

Life Support

- Basic (BLS)
- Advanced (ACLS)

ACLS

- Team
- Airway management
- Drugs
- Diagnosis of reversible causes cardiac arrest

Team

Team leader

- The team leader should avoid performing technical procedures, as performance of a task inevitably shifts attention from the primary leadership responsibilities.

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

- Every participant in an ACLS class must correctly demonstrate adult CPR skills and use of an AED

Excellent CPR…Why?

1. Achieve adequate cerebral perfusion
2. Achieve coronary perfusion
3. Compromising a patient's chances for neurologically intact survival

Key principles in the performance of ACLS

- Excellent chest compressions **must** be performed throughout the resuscitation without interruption, using proper timing (100 to 120 compressions per minute) and force (5 to 6 cm [2 to 2.5 inches] depth), and allowing for complete chest recoil.

- Excellent chest compressions take priority over ventilation.

- Do **not** stop compressions until the defibrillator is fully charged.

Key principles in the performance of ACLS

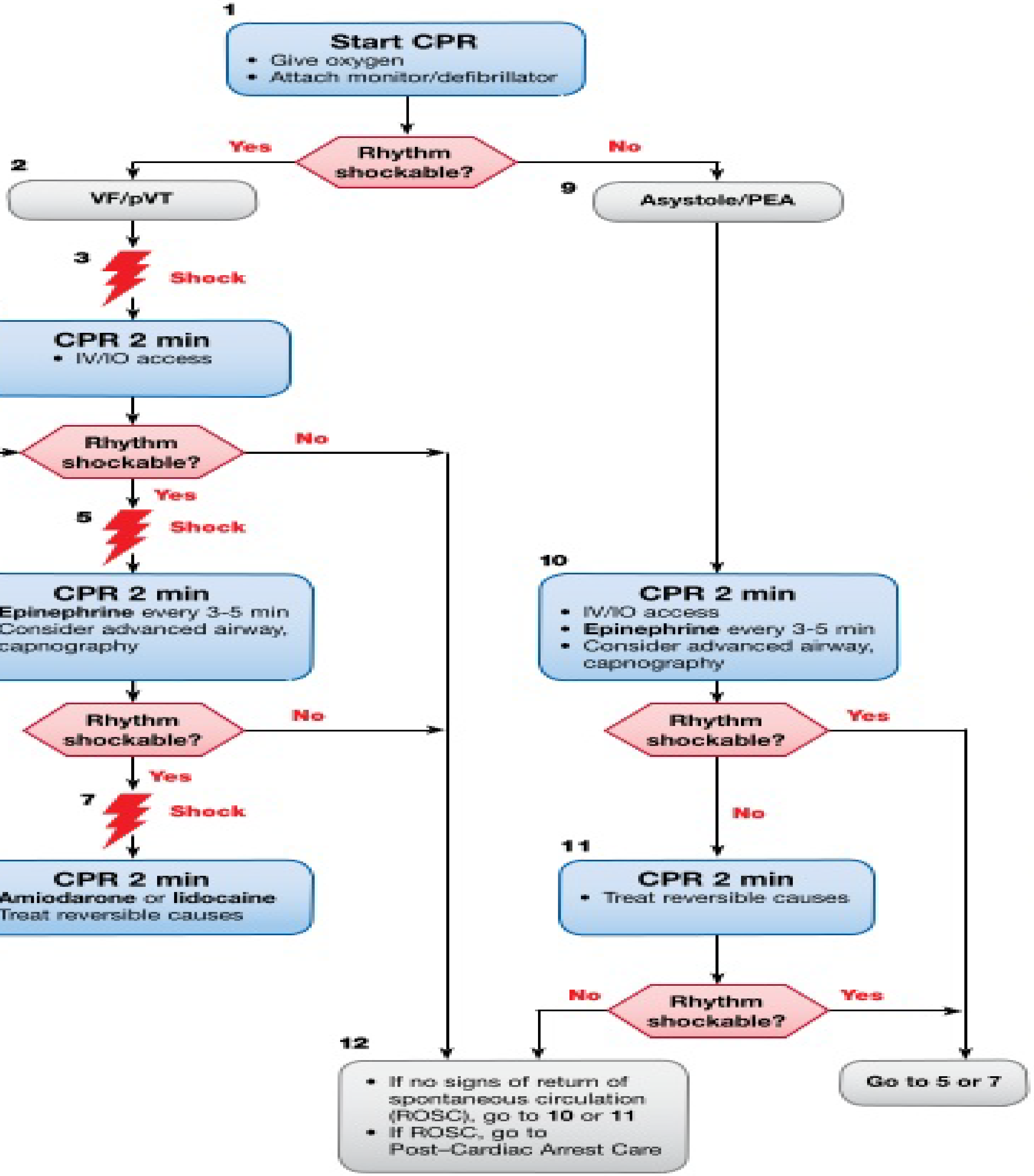
- Ventilations must be performed using proper timing (10 to 12 breaths per minute in the intubated patient; ratio of 30 compressions to 2 ventilations if not intubated) and force (deliver each breath over one second, and only until chest begins to rise).

Don’t Interrupt CPR

- In the past, clinicians frequently interrupted CPR to check for pulses, perform tracheal intubation, or obtain venous access.
- Current ACLS Guidelines strongly recommend that every effort be made **NOT** to interrupt CPR; other less vital interventions (eg, tracheal intubation or administration of medications to treat arrhythmias) should be carried out either while CPR

Excellent CPR

- ***<u>PUSH HARD</u>***
- ***<u>PUSH FAST</u>***
- ***<u>USE CORRECT RATIOS</u>***
- ***<u>MINIMIZE INTERRUPTIONS IN COMPRESSIONS</u>***
- ***<u>VENTILATE CAUTIOUSLY</u>***
- ***<u>DEFIBRILLATE APPROPRIATELY</u>***



1
Start CPR
• Give oxygen
• Attach monitor/defibrillator
Rhythm shockable?
Yes
No
2
VF/pVT
9
Asystole/PEA
3
Shock
4
CPR 2 min
• IV/IO access
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CPR 2 min
• Treat reversible causes
Rhythm shockable?
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12
• If no signs of return of spontaneous circulation (ROSC), go to 10 or 11
• If ROSC, go to Post–Cardiac Arrest Care
Go to 5 or 7

Suggested approach to airway management while performing ACLS

- Bag-mask device
- Blindly placed supraglottic airway
- Endotracheal tube
- Oropharyngeal and nasopharyngeal airways can be useful adjuncts

Suggested approach to airway management while performing ACLS

- The ACLS Guidelines support the use of a bag-mask device or a blindly placed supraglottic airway for ventilation during the initial management of SCA, deferring placement of an endotracheal tube, unless one cannot ventilate the patient by other less invasive means or there is high certainty of rapid, successful placement of the tracheal tube.

- However, no more than 10 to 15 seconds should be needed to secure the advanced airway.

Ventilation Rate

- If the patient is not intubated but ventilated using a BMV the compression to ventilation ratio is 30:2. Although rescuers may be tempted to deliver non-synchronized BMVs during CPR to minimize interruptions in compressions

- If the patient is intubated 10-12 ventilations per minute Tidal volumes of approximately 600 mL delivered in a controlled fashion such that chest rise occurs over no more than one second

Supplementary Oxygen

- Although evidence is lacking, it is reasonable to provide 100 percent oxygen during CPR.

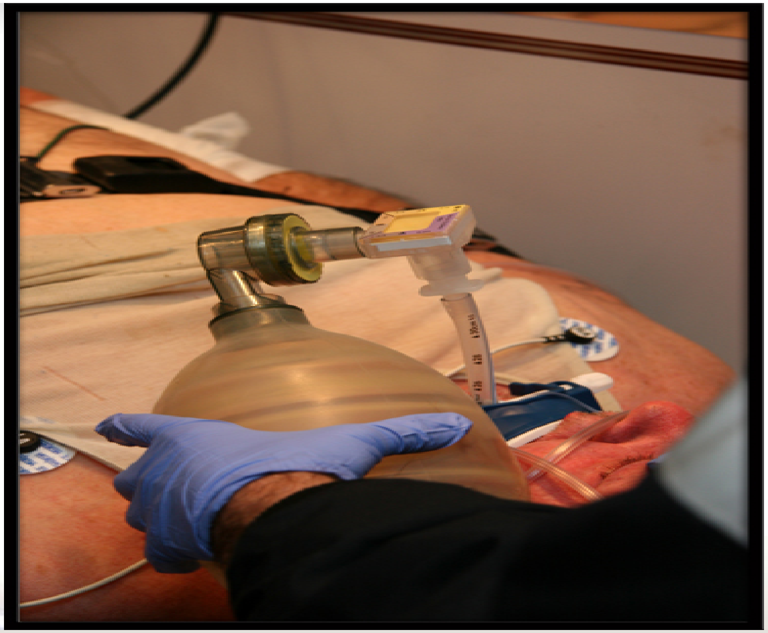
- In patients who are successfully resuscitated (ie, spontaneous circulation returns), it is important to maintain oxygen saturation above 94 percent.

Capnography

- Capnography is the monitoring of the concentration or partial pressure of carbon dioxide (CO2) in the respiratory gases.
- Continuous waveform capnography (performed in addition to clinical assessment) is recommended for both confirming and monitoring correct tracheal tube placement, and for monitoring the quality of CPR and the return of spontaneous circulation.
- If waveform capnography is not available, a non-waveform CO_2 detector may be used, in addition to clinical assessment.

CO2 Detector

A colorimetric CO_2 detector attaches directly to the endotracheal tube and responds quickly to exhaled CO_2 with a simple color change.

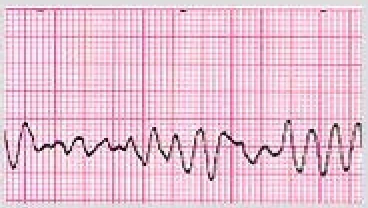


MANAGEMENT OF SPECIFIC ARRHYTHMIAS

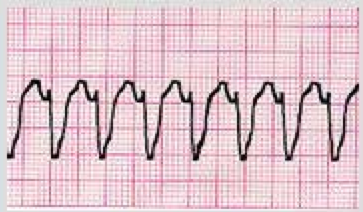
- Ventricular fibrillation (VF) and pulseless ventricular tachycardia (pVT) are non-perfusing rhythms emanating from the ventricles, for which early rhythm identification is critical

- Successful ROSC in patients with VF and pVT hinges on early defibrillation and excellent cardiopulmonary resuscitation (CPR)

Cardiac arrest heart rhythms summary



ventricular fibrillation



ventricular tachycardia

pulseless electrical activity

asystole

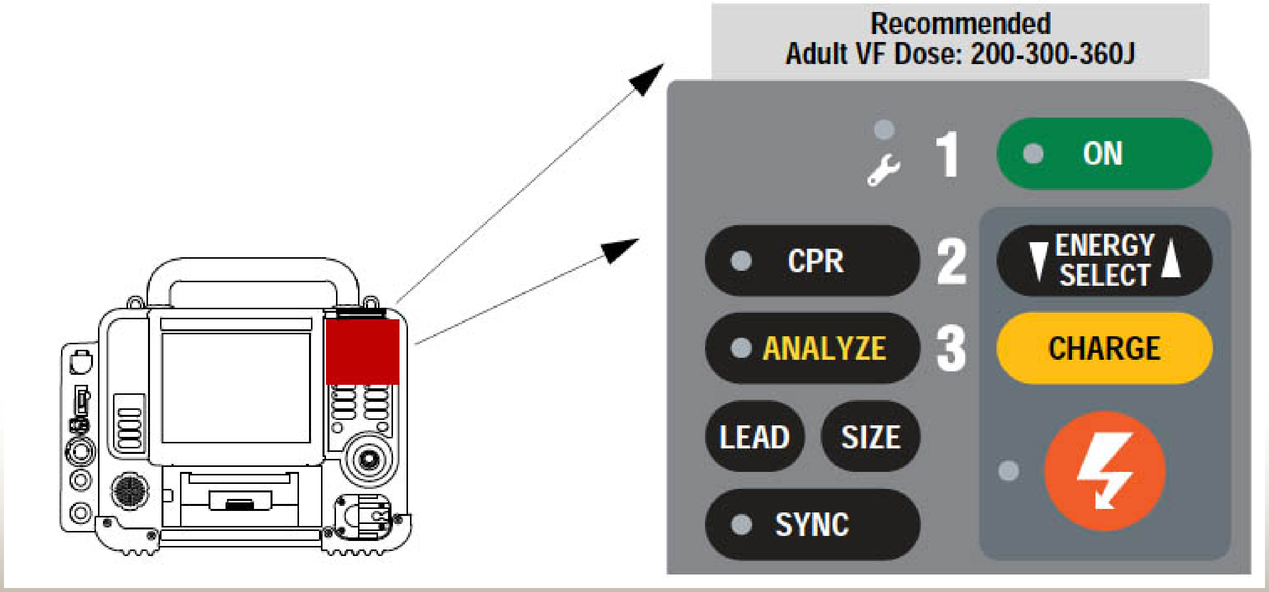
Shockable rhythms; need to defibrillate

Non-shockable rhythms; do not defibrillate

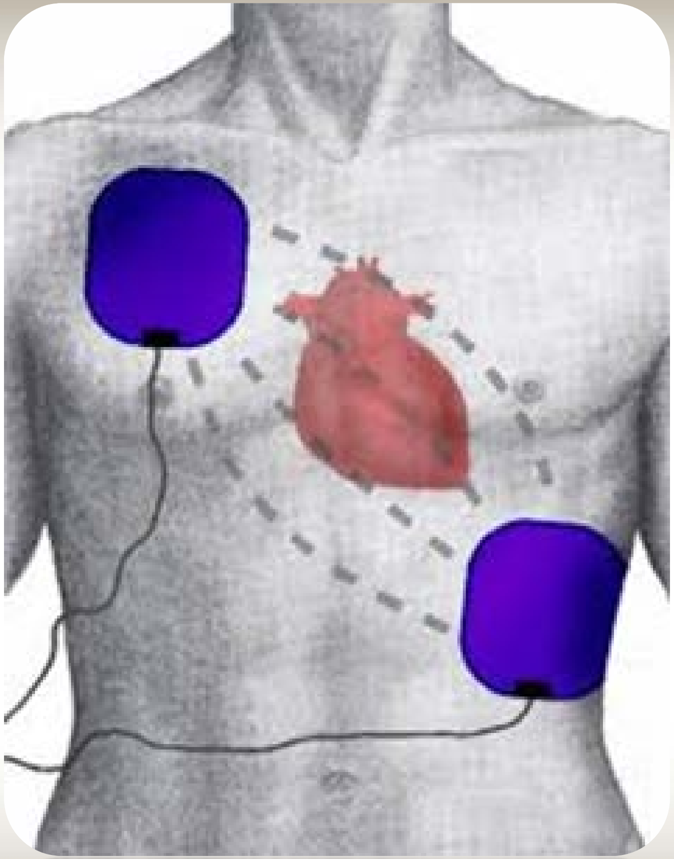
- Decreased time to defibrillation improves the likelihood of successful conversion to a perfusing rhythm and patient survival.

- For the monitored patient who sustains a witnessed VF or pVT arrest, if a defibrillator is immediately available and defibrillator pads are in place, immediately charge the defibrillator and deliver a shock.

Defibrillator



Site of paddle placement



- Biphasic defibrillators are recommended because of their increased efficacy at lower energy levels
- The ACLS Guidelines recommend that when employing a biphasic defibrillator clinicians use the initial dose of energy recommended by the manufacturer (120 to 200 J).

- If this dose is not known, the maximal dose may be used

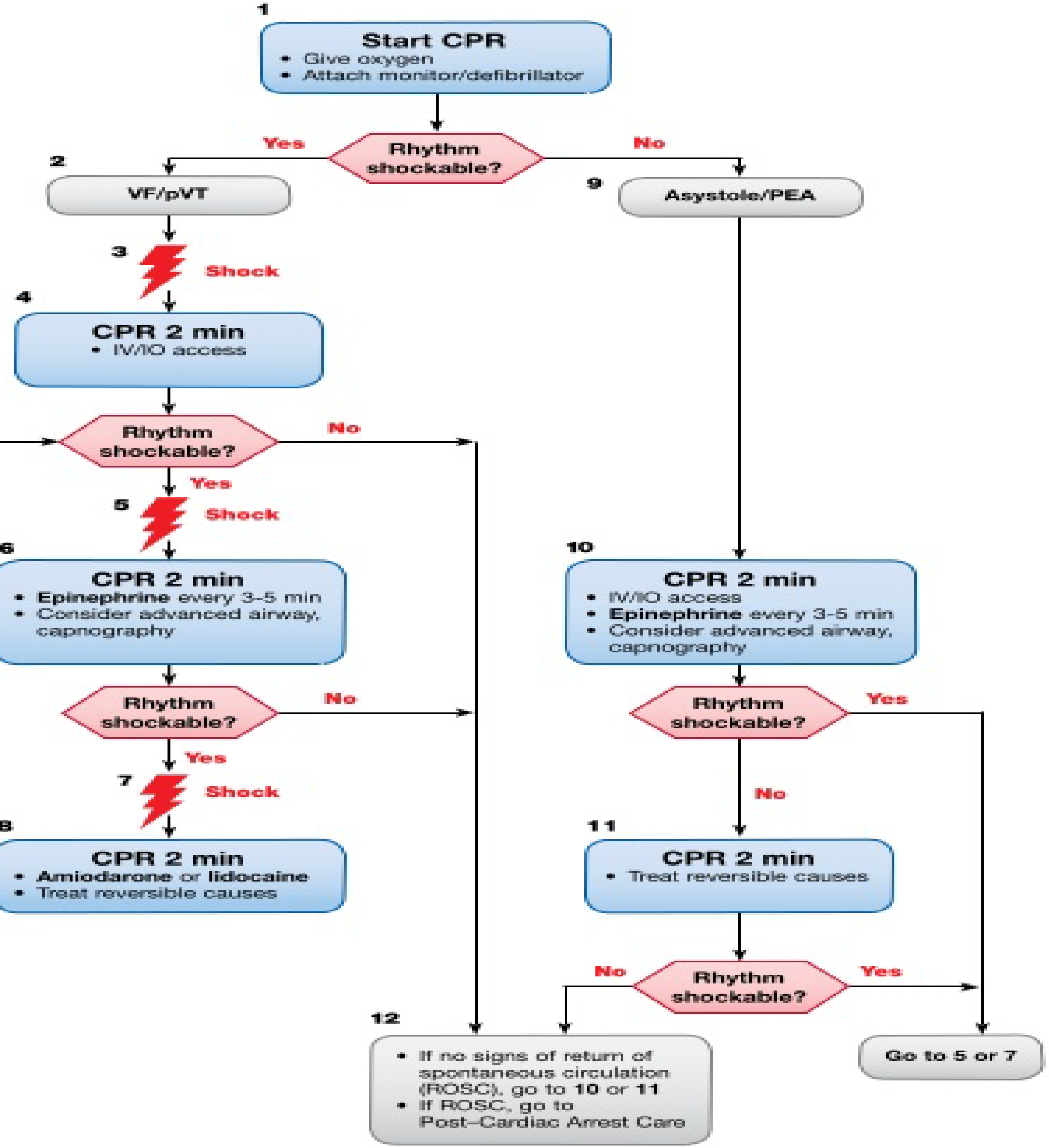
- The ACLS Guidelines recommend the resumption of CPR immediately after defibrillation without checking for a pulse.

- If VF or pVT persists after at least one attempt at defibrillation and 2 minutes of CPR, administer epinephrine (1 mg intravenous [IV] or intraosseous [IO] every three to five minutes) while CPR is performed

Antiarrhythmic Drugs

- The timing of a antiarrhythmic drugs: after a third shock.

- Amiodarone (300 mg IV/IO bolus with a repeat dose of 150 mg IV as indicated) or lidocaine (1 to 1.5 mg/kg IV/IO bolus, then 0.5 to 0.75 mg/kg every 5 to 10 minutes) may be administered in VF or pVT unresponsive to defibrillation, CPR, and epinephrine.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Asystole and Pulseless Electrical Activity

- **Asystole** is defined as a complete absence of demonstrable electrical and mechanical cardiac activity.
- **Pulseless electrical activity (PEA**) is defined as any one of a heterogeneous group of organized electrocardiographic rhythms without sufficient mechanical contraction of the heart to produce a palpable pulse or measurable blood pressure.
- Asystole and PEA are non-perfusing rhythms requiring the initiation of excellent CPR immediately when either is present.

Asystole and Pulseless Electrical Activity

- Epinephrine is administered as soon as is feasible after CPR is begun(1 mg IV every 3 to 5 minutes)

- Neither asystole nor PEA responds to defibrillation.

- If IV/IO access is delayed or cannot be established, epinephrine may be given by the endotracheal route at a dose of 2 to 2.5 mg

- The drug should be diluted in 5 to 10 mL of sterile water or normal saline solution and then injected directly into the ET tube

Table I – Treatable Causes of Cardiac Arrest: The H's e T's

H's	T's
Hypoxia	Toxins
Hypovolemia	Tamponade (cardiac)
Hydrogen ion (acidosis)	Tension pneumothorax
Hypo/Hyperkalemia	Thrombosis, pulmonary (embolism)
Hypothermia	Thrombosis, coronary (ACS)

Hypoxia

- Hypoxia is a life-threatening condition that results when the lungs are incapable of functioning correctly and do not provide enough oxygen to maintain perfusion to tissues.

- The decrease in oxygen perfusion leads to stress and the buildup of lactic acid throughout the body's muscles. In coronary vessels, this amounts to a loss of oxygen for cardiac muscle, which may lead to tissue death and loss of electrical activity.

Treatment

- The treatment for hypoxia depends on the cause.
- Since it may result from exposure to carbon monoxide (CO), drowning, asphyxiation, lung disorders, or extreme sedation, such as an opioid overdose, the treatment will change.
- In general, it includes establishing an advanced airway, performing rescue breaths as part of CPR and ACLS, and the administration of oxygen.

Hypovolemia

- Hypovolemia refers to the loss of a significant volume of bodily fluids, typically blood.
- Traumatic blood loss, gastrointestinal bleed, severe diarrhea and vomiting, ongoing dehydration, or even extreme sweating may result in decreased blood flow and loss of perfusion.
- As the body enters a state of shock, the heart weakens and eventually stops beating.

Treatment:

- While proper chest compressions and rescue breaths will help the remaining volume circulate, the root of the problem must be treated.

- This includes the administration of plasma, IV fluids, blood, and clotting factors, depending on the issue leading to the decreased volume of blood fluids.

Hydrogen Ion Buildup

- Also known as acidosis, a high concentration of hydrogen ions in the blood may lead to cardiac arrest.
- Any solution with a higher concentration of hydrogen ions has an acidic pH level, and in the body, this may be the result of metabolic or respiratory actions.
- Drawing an arterial blood gas provides an immediate determination of whether the person is suffering from acidosis.

Treatment:

- Respiratory acidosis is treated by providing proper ventilation and oxygen.
- Meanwhile, metabolic acidosis is treated with the administration of sodium bicarbonate.

Hyper/Hypokalemia

- Potassium is one of the significant electrolytes used by the body to enable muscle contraction and the transmission of electrical signals through nerves, also known as action potentials

- If the potassium level becomes extreme in either direction (hypokalemia for too little or hyperkalemia for too much), cardiac arrest is likely.

- Causes of these conditions may range from chronic kidney disease to consuming too much potassium in the diet.

Treatment:

- Having too little potassium is treatable with an infusion of potassium.
- Hyperkalemia can be treated with dialysis for those suffering from kidney disease or medications, including sodium bicarbonate or calcium.

Hypothermia

- Hypothermia is one of the most uncommon causes of arrest and occurs when the body's core temperature drops significantly.
- The official threshold is 30 C or 86 F.At this temperature, cardiac output decreases, increasing the risk for cardiac arrest.
- Unfortunately, CPR and defibrillation have the potential to be ineffective for treating this cause.

Treatment:

- The immediate solution to hypothermia is rewarming.
- If external warming with blankets and heat sources is possible, you may begin CPR provided, it doesn't interfere with the rewarming process.
- Although a cause of cardiac arrest, hypothermia is one of the few conditions where it may be advisable to hold off on CPR until directed to begin CPR during rewarming. However, if you lack such direction, administering ACLS and rewarming the body simultaneously is preferred

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Tension Pneumothorax

- **Treatment:** The best cure for a tension pneumothorax is to remove the air from the pleural space through needle decompression or a chest tube.

Tamponade

- Cardiac tamponade occurs when the pericardial sac, which surrounds the heart, fills with fluid or blood.
- The fluid places additional pressure on the heart, constricting the ventricles' ability to expand and limiting blood flow

Treatment:

- The treatment requires drainage with a needle through a procedure known as pericardiocentesis or surgical options, such as a thoracotomy.

POCUS
Point-of-Care Ultrasound

POCUS may be useful during cardiac arrest for:

1. Identifying underlying pathology
2. Monitoring resuscitation
3. Determining the presence of spontaneous cardiac activity
4. Interventions

Toxins

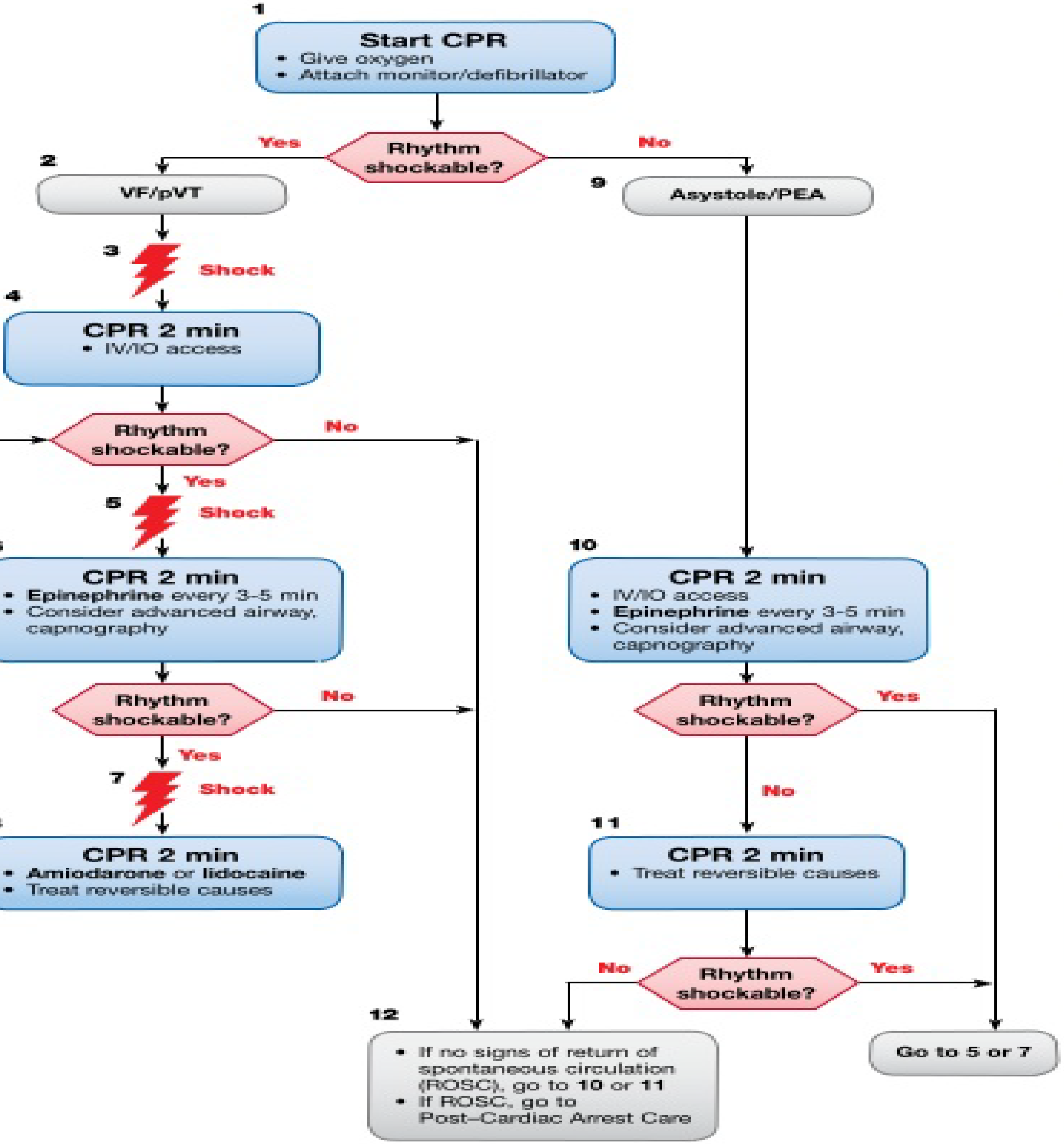
- Any substance can reach toxic levels in the blood, but in this discussion, toxins are limited to toxins introduced through animal bites and the ingestion of poisons.
- Treatment: With the exception of antidotes for specific, known toxins, such as rattlesnake antivenom, there are not currently any particular recommendations for the treatment of toxicity in the course of ACLS.

Thrombosis
Pulmonary and Coronary

- Thrombosis refers to a blockage of a major vessel.
- Pulmonary thrombosis, also known as a pulmonary embolism, results when a blockage occurs in the pulmonary artery or vein.
- As a result, the heart cannot receive adequate blood flow.
- Coronary thrombosis occurs when a blockage occurs in one of the vessels providing blood flow to cardiac tissue. The result is a myocardial infarction (heart attack).

Treatment:

- The treatment for a pulmonary embolism may include fibrinolytic therapy, an embolectomy, or the administration of anticoagulants.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