2010 AHA Guidelines

For BLS and ACLS

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2005 Guidelines

- Push hard and fast
- Allow full chest recoil
- Minimize interruptions of chest compressions
- Avoid hyperventilation

그 이후 연구들에서...

- CPR 성공률 및 생존율은 증가, 하지만 흉부 압박 기술을 계속 향상해야 함.
- OHCA 시 지역간 생존율 차이가 심함.
- OHCA시 목격자 CPR을 받지 못함.

2010 Guidelines

- 능숙한 심폐소생술에 대한 지속적인 강조
  - 분당 최소 100회의 압박 수(분당 "약" 100회에서 변경)
  - 압박 깊이는 성인의 경우 최소 5cm(2인치), 유아 또는 아동의 경우 흉부 전,후직경의 최소 1/3 (유아는 약 4cm[1.5인치], 아동은 약 5cm[2인치]).
    - 4~5cm(1.5~2인치) 범위는 성인에게 더 이상 사용되지 않으며 유아 및 아동에 적용되는 절대 깊이는 이전 심폐소생술 및 심혈관 응급처치에 관한 미국 심장학회 지침보다 더 깊다는 점에 주목

– 매 압박 후 완전한 흉부반동이 가능하게 함
– 흉부압박 시 중단을 최소화함
– 과도한 인공호흡은 피함

30:2 는 변화 없음.

Quiz

- 병원에서 심정지가 발생하여 기도 삽관을 하였습니다. 이후 흉부압박:인공호흡 비율은?
  1) 30:2
  2) 30:4
  3) 15:2
  4) 15:1
  5) 흉부압박과 상관없이 6~8초마다 한 번씩

2010 Guidelines

- ***A-B-C에서 C-A-B로 변경***
  - 흉부압박을 더 일찍 시작
  - 목격자 심폐소생술 증가 기대
  - 팀으로 구조
  - 심정지의 가장 큰 원인에 구조행동을 맞춤

Chain of Survival 2010

그림 1
AHA ECC 성인 생존의 고리

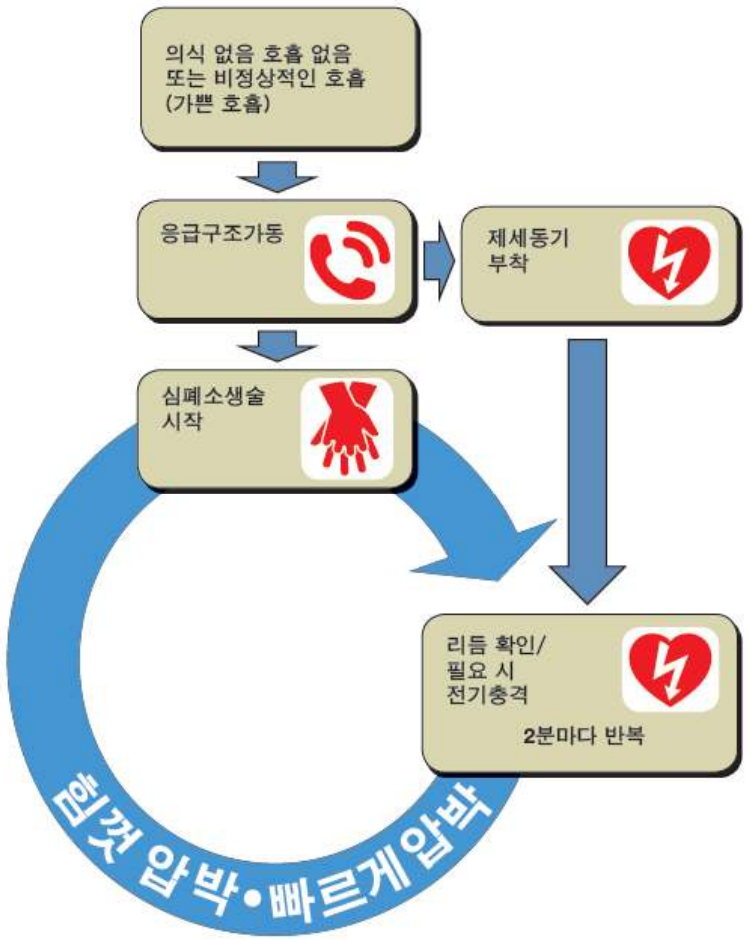
새로운 AHA ECC 성인 생존의 고리에서 링크는 다음의 역할을 수행한다.

1. 심정지의 신속한 **파악** 및 응급 구조 체계 **가동**
2. 흉부압박을 강조하는 조기 **심폐소생술**
3. 신속한 **제세동**
4. 효과적인 **전문 심폐소생술**
5. **심정지 후 처치** 통합

일반 구조자에 의한
성인 심폐소생술

- 단순화된 공통의 성인 대상 기본소생술 알고리듬이 개발되었다(그림 2).
- 무반응 증상에 기반한 응급 구조 체계의 즉각적인 인식 및 가동, 환자가 호흡이 정지되었거나 비정상적인 호흡(가쁜 호흡)을 보일 경우의 심폐소생술 시행에 대한 권고 사항을 세분화하였다.
- "호흡 상태 확인 과정"은 알고리듬에서 제외되었다.
- 능숙한 흉부압박 시행의 중요성(충분한 속도 및 깊이로 압박하고, 매 압박 후 완전한 흉부반동이 가능하게 하며, 흉부압박 시 중단을 최소화하고, 과도한 인공호흡을 피함)을 계속 강조하였다.
- 일인 구조자가 인공호흡을 하기 전에 먼저 흉부압박을 시행하도록 권고 순서를 (A-B-C 순서에서 C-A-B 순서로) 개정하였다. 일인 구조자는 최초 흉부압박 시행의 지체를 줄이기 위해 인공호흡 2회에 앞서 흉부압박 30회를 시행해야 한다.
- 흉부압박 속도는 분당 최소 100회가 되어야 한다 ("약" 100회가 아님).
- 성인의 경우 흉부압박 깊이는 4~5cm(1.5~2 인치)에서 최소 5cm(2인치)로 변경되었다.

그림 2
단순화된 성인 기본소생술 알고리듬



Hands only CPR 강조

- 목격자가 CPR교육을 받지 않은 경우
  - Hands only CPR
  - EMS 전화상담원 안내에 따라 시행
  - AED나 EMS 도착까지 해야 함.
- 목격자가 CPR교육을 받은 경우
  - 적어도 hands only CPR시행
  - AED나 EMS 도착까지 해야 함.

A-B-C 순서에서 C-A-B 순서로

- 사람 연구에서 목격자 CPR이 생존율을 올리고 동물 연구에서 흉부압박 시행이 지체되거나 방해받을 경우 생존율이 감소

- ***"호흡확인 과정"의 생략***
- 흉부압박 속도***: 분당 최소 100회***

의료진에 의한
성인 심폐소생술

Key Issues and Major Changes

HEALTHCARE PROVIDER BLS

Dispatcher Identification of Agonal Gasps

seizure-like activity or agonal gasps

help bystanders recognize cardiac arrest

"not breathing or only gasping."

Dispatcher Should Provide CPR Instructions

untrained lay rescuers → Hands-Only CPR for adults → until an AED arrives and is ready for use or EMS providers take over care of the victim.

for victims of likely asphyxial arrest → conventional CPR

Cricoid Pressure → not recommended

Emphasis on Chest Compressions* → trained rescuers

perform both compressions and ventilations

Activation of Emergency Response System → 2 pieces of information

healthcare provider

feel a pulse within 10 seconds

{ unresponsive
{ not breathing or only gasping

Key Issues and Major Changes

HEALTHCARE PROVIDER BLS

*Change in CPR Sequence: C-A-B Rather Than A-B-C**

the first rescuer begins chest compressions
the second rescuer opens the airway
deliver breaths as soon as the first rescuer has completed first set of 30 chest compressions

*Elimination of "Look, Listen, and Feel for Breathing"**

*Chest Compression Rate: At Least 100 per Minute**

*Chest Compression Depth** at least 2 inches

Team Resuscitation performing several actions simultaneously ⟸ ~~sequential~~

표 1

성인, 아동 및 유아 기본소생술의 핵심 내용*

	권장 사항		
구성 내역	**성인**	**아동**	**신생아**
식별	의식 없음(모든 연령)		
	호흡 없음 또는 비정상적인 호흡(가쁜 호흡)	호흡 없음 또는 가쁜 호흡	
	모든 연령에서 10초 이내에 맥박 촉진 안 됨(의료진에만 해당)		
심폐소생술 시행 순서	C-A-B		
압박속도	분당 최소 100회		
압박깊이	최소 5cm(2인치)	흉부전후직경의 최소 ⅓ 약 5cm(2인치)	흉부전후직경의 최소 ⅓ 약 4cm(1.5인치)
흉벽반동	흉부압박 간 완전한 반동이 가능하게 함 의료진은 2분마다 흉부압박을 재시행함		
압박중단	흉부압박 시 중단을 최소화함 중단 시간이 10초 미만이 되도록 함		
기도	이마는 젖히고 턱은 들어 올리는 자세(의료진에 의해 외상 의심: 하악견인법)		
흉부압박 대 인공호흡 비(전문 기도유지 장비가 삽입될 때까지)	30:2 1~2인 구조자	30:2 단일 구조자 15:2 2인 의료진 구조자	
인공호흡: 구조자가 교육을 받지 않았거나 받은 경우 및 능숙하지 않은 경우	흉부압박만		
전문 기도유지 장비로 환기(의료진)	6~8초마다 인공호흡 1회(분당 호흡 8~10회) 비동시성 흉부압박 호흡당 약 1초 가시적인 흉부상승		
제세동	가능한 빨리 자동제세동기 부착 및 사용. 전기충격 전후 흉부압박 중단을 최소화하고 각 전기충격 직후 흉부압박으로 심폐소생술 재개		

약어: AED - 자동제세동기, AP - 전후방, CPR - 심폐소생술, HCP - 의료진
*심정지 병인이 거의 항상 질식성인 신생아 제외

ELECTRICAL THERAPIES

Automated External Defibrillators

Integration of AEDs into the Chain of Survival system for public places

Community Lay Rescuer AED Programs

In-Hospital Use of AEDs ⟹ ≤3 minutes from collapse

AED Use in Children Now Includes Infants

children 1 to 8 years of age ⟹ pediatric dose-attenuator system

not available ⟹ standard AED

For infants (<1 year of age) ⟹ manual defibrillator

not available ⟹ AED with pediatric dose attenuation

AED without a dose attenuator may be used

early CPR and early defibrillation

Shock First vs CPR First

the rescuer should start CPR with chest compressions and use the AED as soon as possible

witnesses an out-of-hospital arrest | not witnessed | in monitored patients

ELECTRICAL THERAPIES

1-Shock Protocol vs 3-Shock Sequence *2010 (No Change From 2005)*

Defibrillation Waveforms and Energy Levels *2010 (No Change From 2005)*

Pediatric Defibrillation *for ease of teaching*

initial dose of 2 J/kg

subsequent shocks → at least 4 J/kg
not to exceed 10 J/kg or the adult maximum dose

Fixed and Escalating Energy *2010 (No Change From 2005)*

Electrode Placement → anterior-lateral pad

3 alternative pad positions { anterior-posterior,
anterior- left infrascapular,
anterior–right infrascapular }

Defibrillation With Implantable Cardioverter-Defibrillator → anterior-posterior and anterior-lateral

ELECTRICAL THERAPIES

Synchronized Cardioversion

Supraventricular Tachyarrhythmia

atrial fibrillation ⟶ 120 to 200 J biphasic
200 J monophasic

atrial flutter and other supraventricular rhythms ⟶ less energy
50 to 100 J with either a monophasic or a biphasic

Ventricular Tachycardia

Adult stable monomorphic VT ⟶ initial energies of 100 J
monophasic or biphasic waveform cardioversion (synchronized)

pulseless VT or polymorphic VT (irregular VT)
⟶ high-energy *unsynchronized* shocks (ie, defibrillation doses)

Fibrillation Waveform Analysis to Predict Outcome

2010 (No Change From 2005)

Pacing

2010 (No Change From 2005)

CPR TECHNIQUES AND DEVICES

CPR Techniques

conventional manual CPR

Alternatives → more personnel, training, equipment → improve hemodynamics
specific setting → short-term survival

precordial thump → witnessed, monitored, unstable VT (including pulseless VT)
it should not delay CPR

CPR Devices

no CPR device superior to standard conventional (manual) CPR
for out-of-hospital cardiac arrest

delay or interrupt CPR for the victim of cardiac arrest

initial training
ongoing monitoring
retraining programs

Comparison of Key Elements of Adult, Child, and Infant BLS

Component	Recommendations		
	Adults	Children	Infants
Recognition	Unresponsive (for all ages)		
	No breathing or no normal breathing (ie, only gasping)		
CPR sequence			
Compressi			
Compr			
Chest w			
Compress			
Airway			
Compression ratio (until adv airway placed)		Single rescuer 15:2 2 HCP rescuers	
Ventilations: wh untrained or trai not proficient	Compressions only		
Ventilations with advanced airway (HCP)	1 breath every 6-8 seconds (8-10 breaths/min) Asynchronous with chest compressions About 1 second per breath Visible chest rise		
Defibrillation	Attach and use AED as soon as available. Minimize interruptions in chest compressions before and after shock; resume CPR beginning with compressions immediately after each shock.		

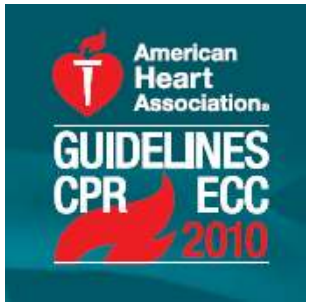
Abbreviations: AED, automated external defibrillator; AP, anterior-posterior; CPR, cardiopulmonary resuscitation; HCP, healthcare provider.

But, leader of a resuscitation attempt

- do not imply that care using past guidelines is either unsafe or ineffective
- not apply to all rescuers and all victims in all situations
- need to adapt application of these recommendations to unique circumstances

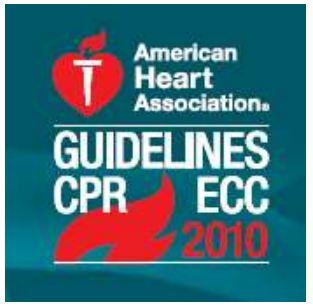
ACLS 2010

Adjuncts for Airway Control and Ventilation



– during the first few minutes of witnessed CA
  - a lone rescuer ***should not interrupt*** chest compressions for ventilation.
  - Advanced airway placement in CA ***should not delay*** initial CPR and defibrillation for VF CA.

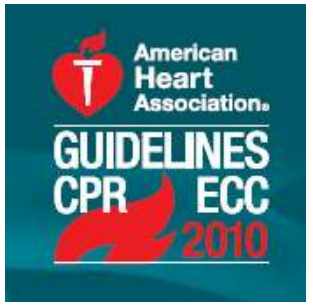
Adjuncts for Airway Control and Ventilation



– Bag-Mask Ventilation

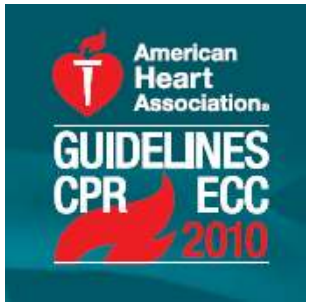
  • approximately ***600 mL*** of tidal volume sufficient to produce chest rise over 1 second

Adjuncts for Airway Control and Ventilation



- Cricoid pressure
  - The routine use of cricoid pressure in cardiac arrest is not recommended **(Class III, LOE C)**.

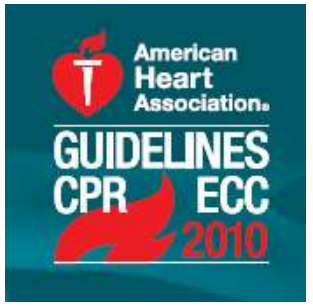
Adjuncts for Airway Control and Ventilation



– Advanced airways

: If advanced airway placement will interrupt chest compressions, providers may consider deferring insertion of the airway until the patient fails to respond to initial CPR and defibrillation attempts or demonstrates ROSC **(Class IIb, LOE C).**

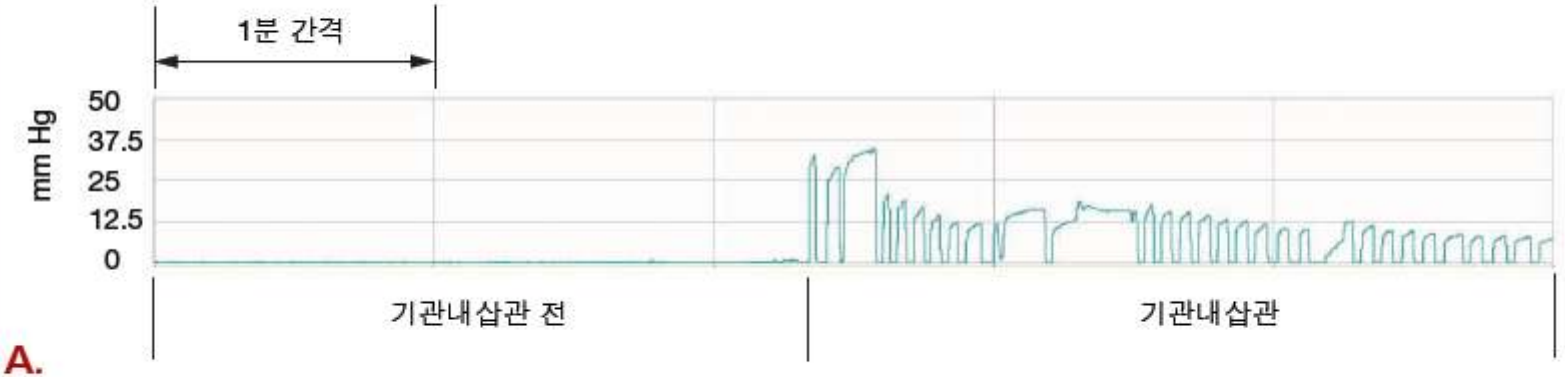
Adjuncts for Airway Control and Ventilation



– Continuous waveform capnography

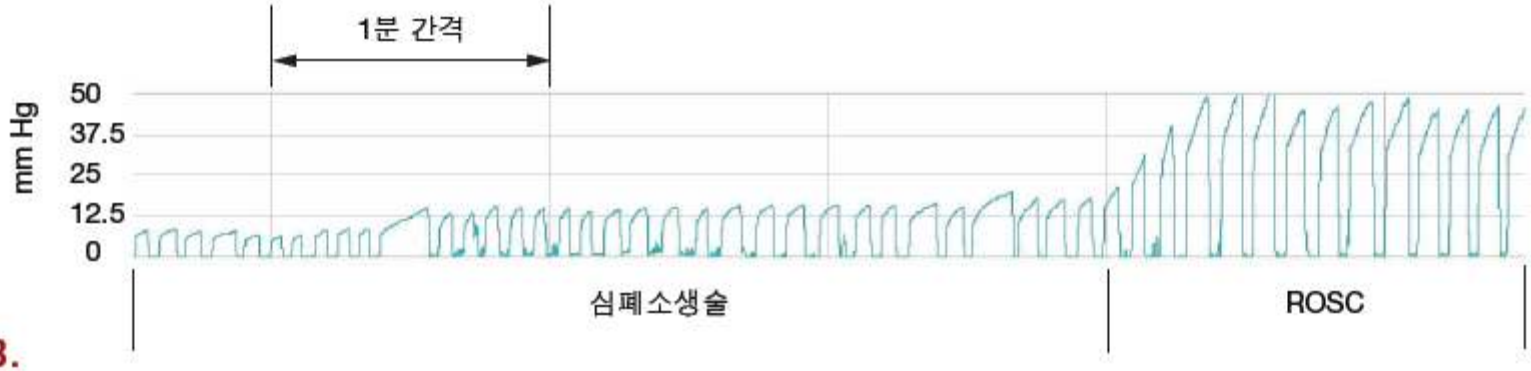
- *most reliable method* of confirming and monitoring correct placement of an endotracheal tube **(Class I, LOE A)**
- head flexion and extension
- patient is moved from one location to another

그림 3
카프노그래피 파형



A.

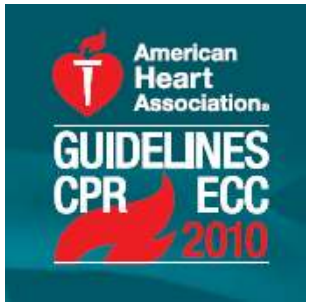
기관내관 배치 확인을 위한 카프노그래피. 이 카프노그래피 기록은 기관내삽관을 수행할 때 시간에 따라 배출되는 호기말 이산화탄소 분압(P_{ETCO_2})을 mm Hg 단위로 세로 축에 보여줍니다. 기관내삽관 환자에게서 이산화탄소 배출이 탐지되면 기관내관 배치가 완료된 것입니다. P_{ETCO_2}는 호흡 주기에 따라 변하며 호기말에 최대값이 됩니다.



B.

소생술 처치의 효과를 모니터링하는 카프노그래피. 이 두 번째 카프노그래피 기록은 시간에 따른 P_{ETCO_2} 압력을 세로 축에 mm Hg 단위로 보여줍니다. 이 환자는 기관내삽관이 된 상태이며 심폐소생술을 받고 있습니다. 인공호흡 속도는 분당 약 8~10회 호흡이라는 것을 알 수 있습니다. 흉부압박은 분당 100회보다 조금 빠른 속도로 가해지지만 이 기록에 나타나지 않습니다. 초기 P_{ETCO_2} 압력은 첫 1분 동안 12.5mm Hg 미만으로, 매우 낮은 혈류를 나타냅니다. 2~3분 사이에서는 지속적인 소생술로 혈류가 증가함에 따라 P_{ETCO_2} 압력이 12.5mm Hg와 25mm Hg 사이에서 증가합니다. 4분 정도에는 자발순환회복(ROSC)이 발생합니다. 자발순환회복은 P_{ETCO_2} 압력의 급격한 증가로 알 수 있습니다. 네 번째 세로 선 바로 다음부터 관측되는 것처럼, 혈류가 크게 증가함에 따라 압력이 40mm Hg 이상 증가합니다.

Adjuncts for Airway Control and Ventilation



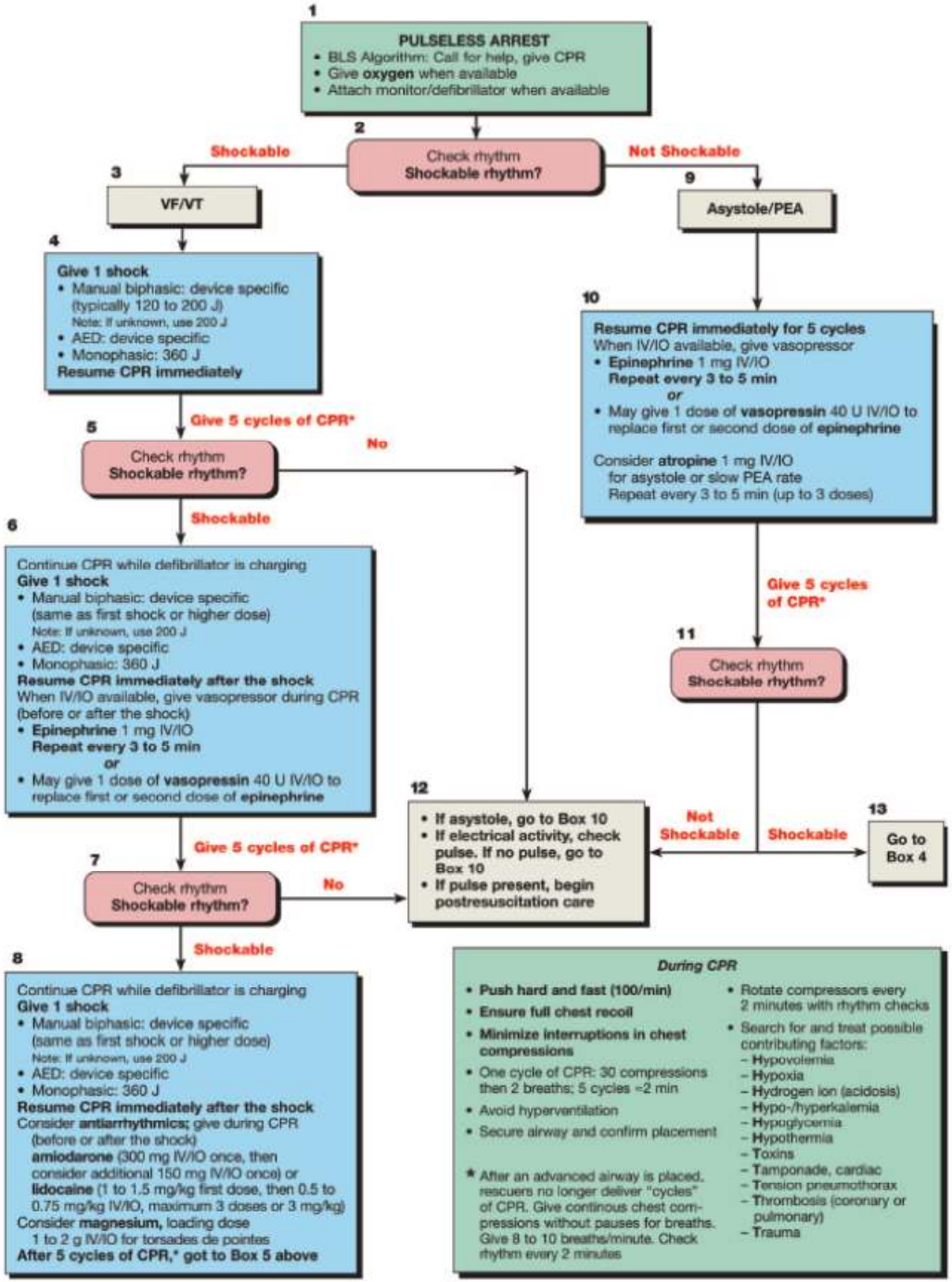
- Esophageal Detector Devices
  - morbid obesity
  - late pregnancy
  - status asthmaticus
  - copious endotracheal secretions

Management of Cardiac Arrest

- Foundation of ACLS care
  - **good BLS care**
    - high-quality bystander CPR
    - attempted defibrillation within minutes of collapse

    → vascular access, drug delivery, and advanced airway placement should not cause significant interruptions in chest compression or delay defibrillation.

2005


1
PULSELESS ARREST
• BLS Algorithm: Call for help, give CPR
• Give oxygen when available
• Attach monitor/defibrillator when available
2
Check rhythm
Shockable rhythm?
Shockable
Not Shockable
3
VF/VT
9
Asystole/PEA
4
Give 1 shock
• Manual biphasic: device specific (typically 120 to 200 J)
Note: If unknown, use 200 J
• AED: device specific
• Monophasic: 360 J
Resume CPR immediately
10
Resume CPR immediately for 5 cycles
When IV/IO available, give vasopressor
• Epinephrine 1 mg IV/IO
Repeat every 3 to 5 min
or
• May give 1 dose of vasopressin 40 U IV/IO to replace first or second dose of epinephrine
Consider atropine 1 mg IV/IO for asystole or slow PEA rate
Repeat every 3 to 5 min (up to 3 doses)
Give 5 cycles of CPR*
5
Check rhythm
Shockable rhythm?
No
Shockable
6
Continue CPR while defibrillator is charging
Give 1 shock
• Manual biphasic: device specific (same as first shock or higher dose)
Note: If unknown, use 200 J
• AED: device specific
• Monophasic: 360 J
Resume CPR immediately after the shock
When IV/IO available, give vasopressor during CPR (before or after the shock)
• Epinephrine 1 mg IV/IO
Repeat every 3 to 5 min
or
• May give 1 dose of vasopressin 40 U IV/IO to replace first or second dose of epinephrine
Give 5 cycles of CPR*
11
Check rhythm
Shockable rhythm?
12
• If asystole, go to Box 10
• If electrical activity, check pulse. If no pulse, go to Box 10
• If pulse present, begin postresuscitation care
Not Shockable
Shockable
13
Go to Box 4
7
Check rhythm
Shockable rhythm?
No
Shockable
8
Continue CPR while defibrillator is charging
Give 1 shock
• Manual biphasic: device specific (same as first shock or higher dose)
Note: If unknown, use 200 J
• AED: device specific
• Monophasic: 360 J
Resume CPR immediately after the shock
Consider antiarrhythmics; give during CPR (before or after the shock)
amiodarone (300 mg IV/IO once, then consider additional 150 mg IV/IO once) or lidocaine (1 to 1.5 mg/kg first dose, then 0.5 to 0.75 mg/kg IV/IO, maximum 3 doses or 3 mg/kg)
Consider magnesium, loading dose 1 to 2 g IV/IO for torsades de pointes
After 5 cycles of CPR,* go to Box 5 above
During CPR
• Push hard and fast (100/min)
• Ensure full chest recoil
• Minimize interruptions in chest compressions
• One cycle of CPR: 30 compressions then 2 breaths; 5 cycles ≈2 min
• Avoid hyperventilation
• Secure airway and confirm placement
• Rotate compressors every 2 minutes with rhythm checks
• Search for and treat possible contributing factors:
– Hypovolemia
– Hypoxia
– Hydrogen ion (acidosis)
– Hypo-/hyperkalemia
– Hypoglycemia
– Hypothermia
– Toxins
– Tamponade, cardiac
– Tension pneumothorax
– Thrombosis (coronary or pulmonary)
– Trauma
* After an advanced airway is placed, rescuers no longer deliver "cycles" of CPR. Give continous chest compressions without pauses for breaths. Give 8 to 10 breaths/minute. Check rhythm every 2 minutes

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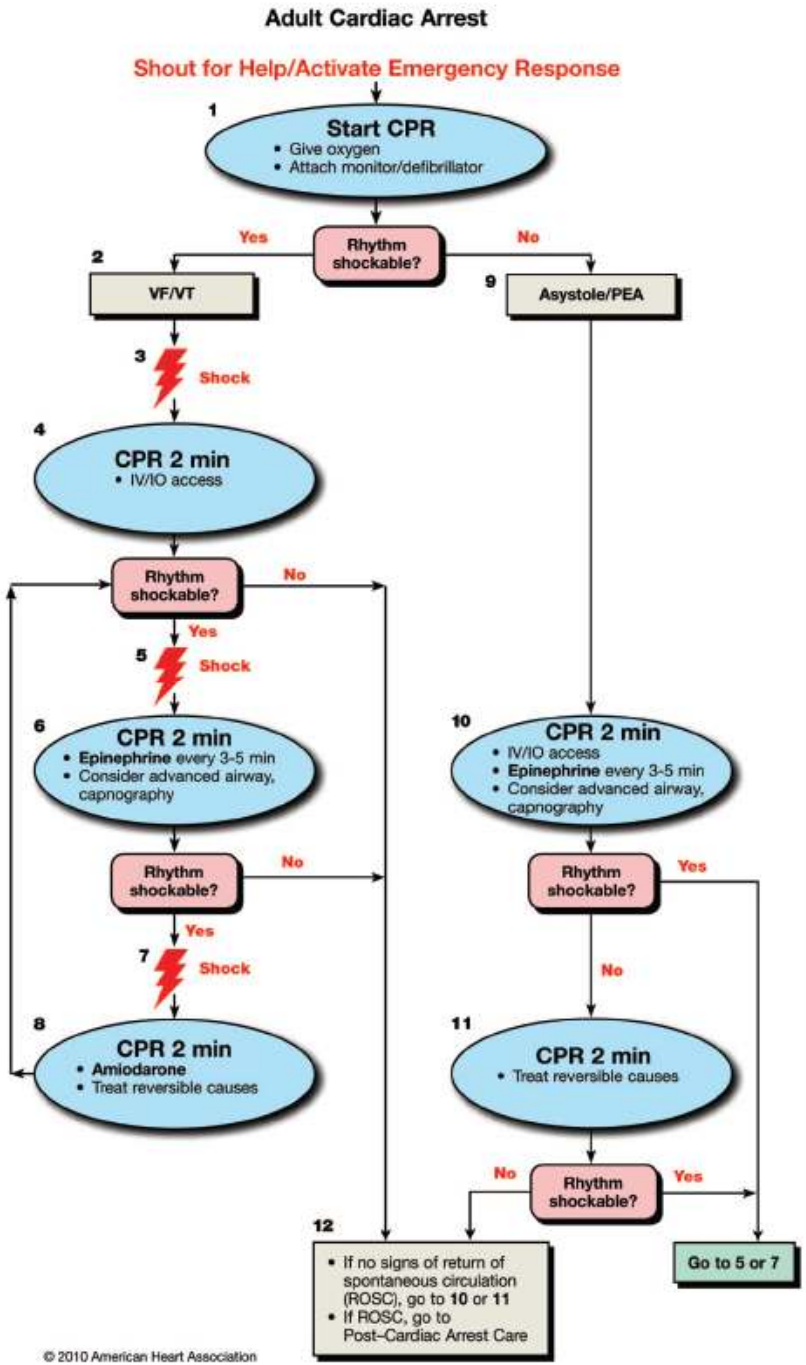

CPR Quality
- Push hard (≥2 inches [5 cm]) and fast (≥100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 30:2 compression-ventilation ratio
- Quantitative waveform capnography
  - If P_{ETCO_2} <10 mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
  - If relaxation phase (diastolic) pressure <20 mm Hg, attempt to improve CPR quality

Return of Spontaneous Circulation (ROSC)
- Pulse and blood pressure
- Abrupt sustained increase in P_{ETCO_2} (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

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

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

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

Reversible Causes
- **H**ypovolemia
- **H**ypoxia
- **H**ydrogen ion (acidosis)
- **H**ypo-/hyperkalemia
- **H**ypothermia
- **T**ension pneumothorax
- **T**amponade, cardiac
- **T**oxins
- **T**hrombosis, pulmonary
- **T**hrombosis, coronary

Figure 1. ACLS Cardiac Arrest Algorithm.

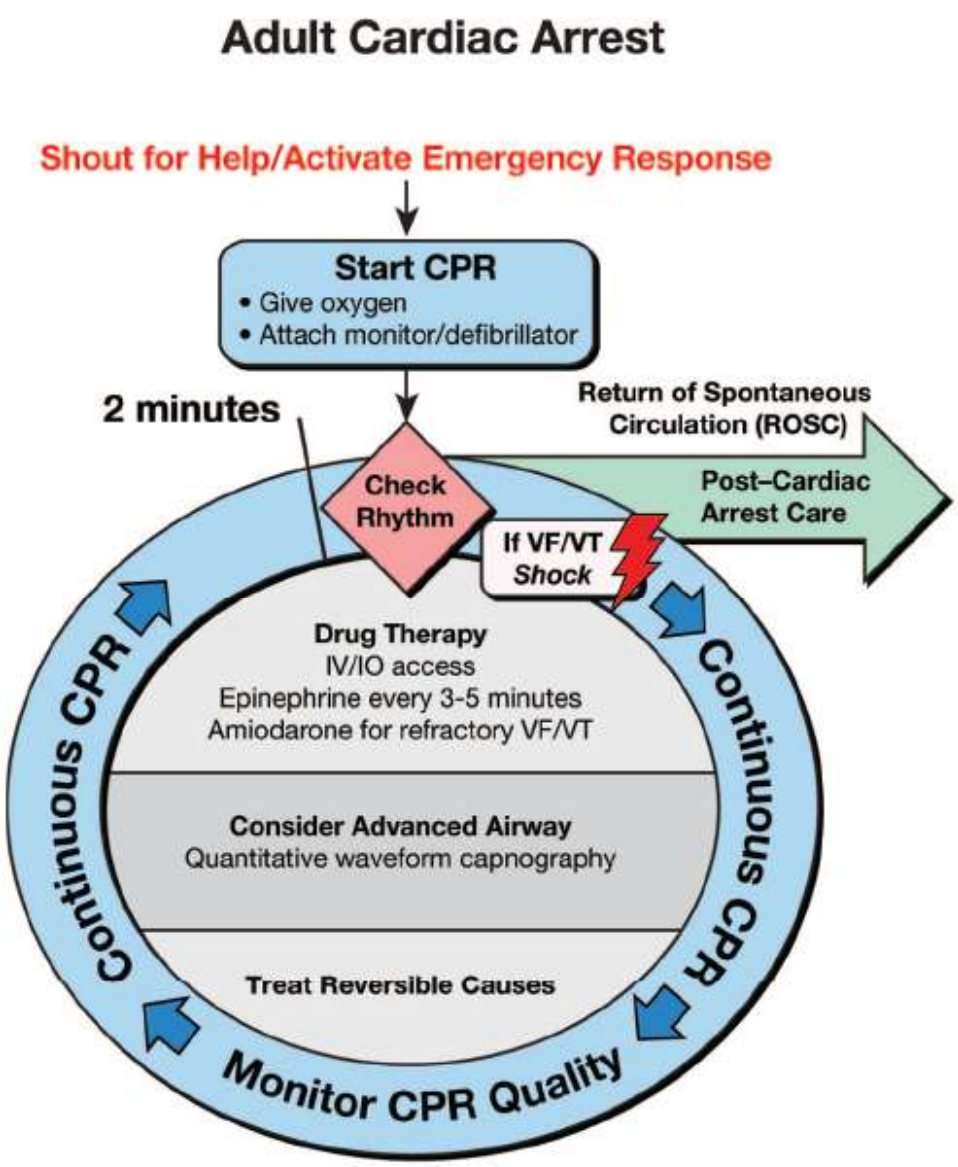

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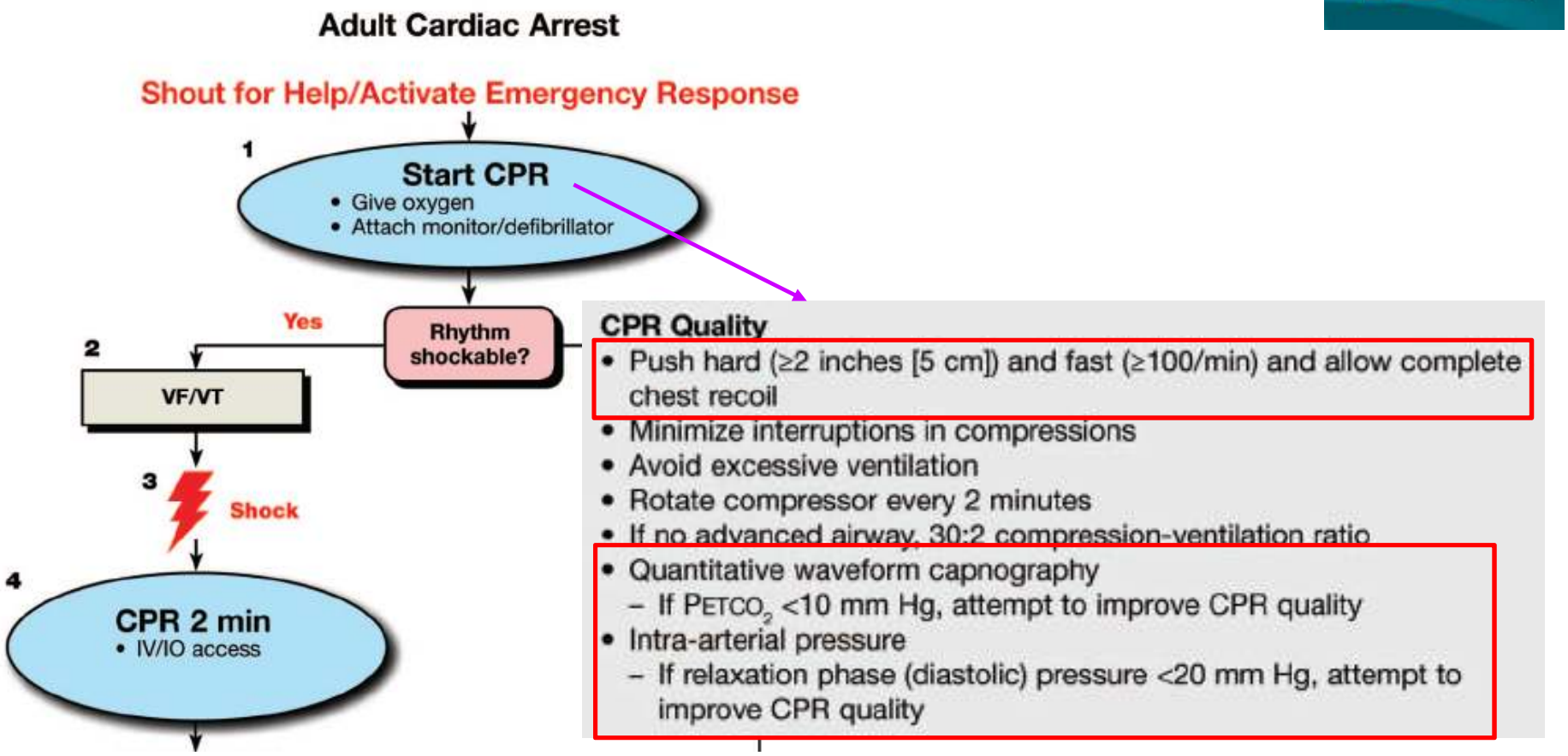
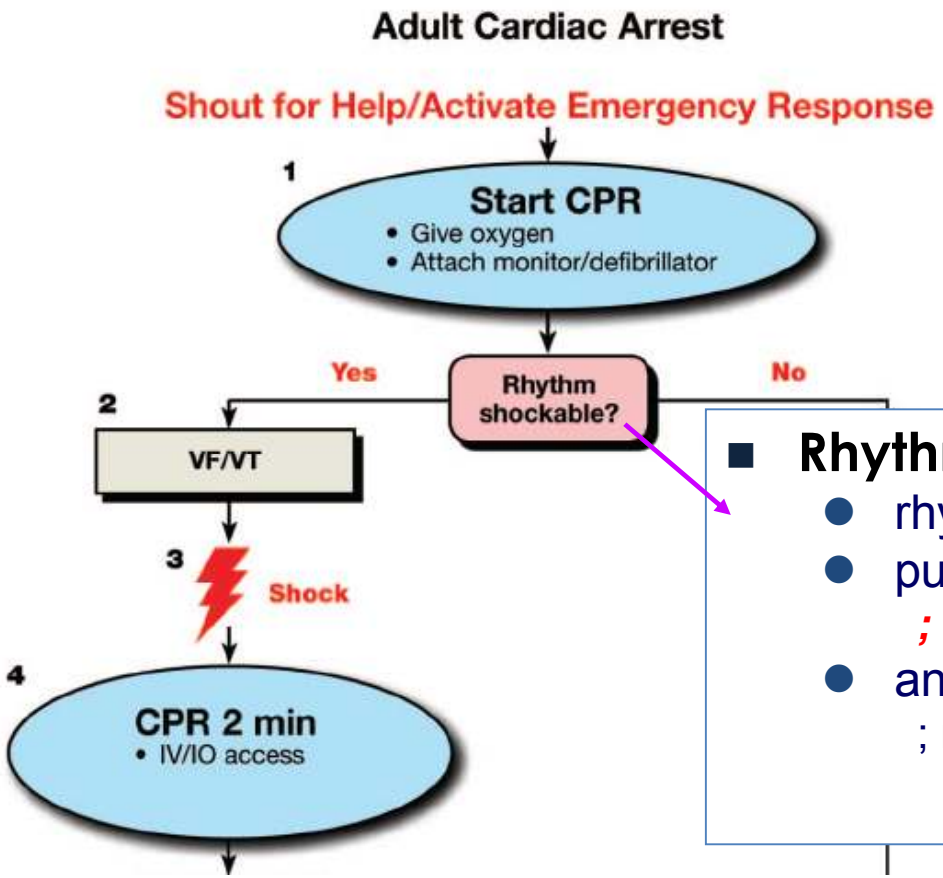
Figure 2. ACLS Cardiac Arrest Circular Algorithm.

Management of Cardiac Arrest

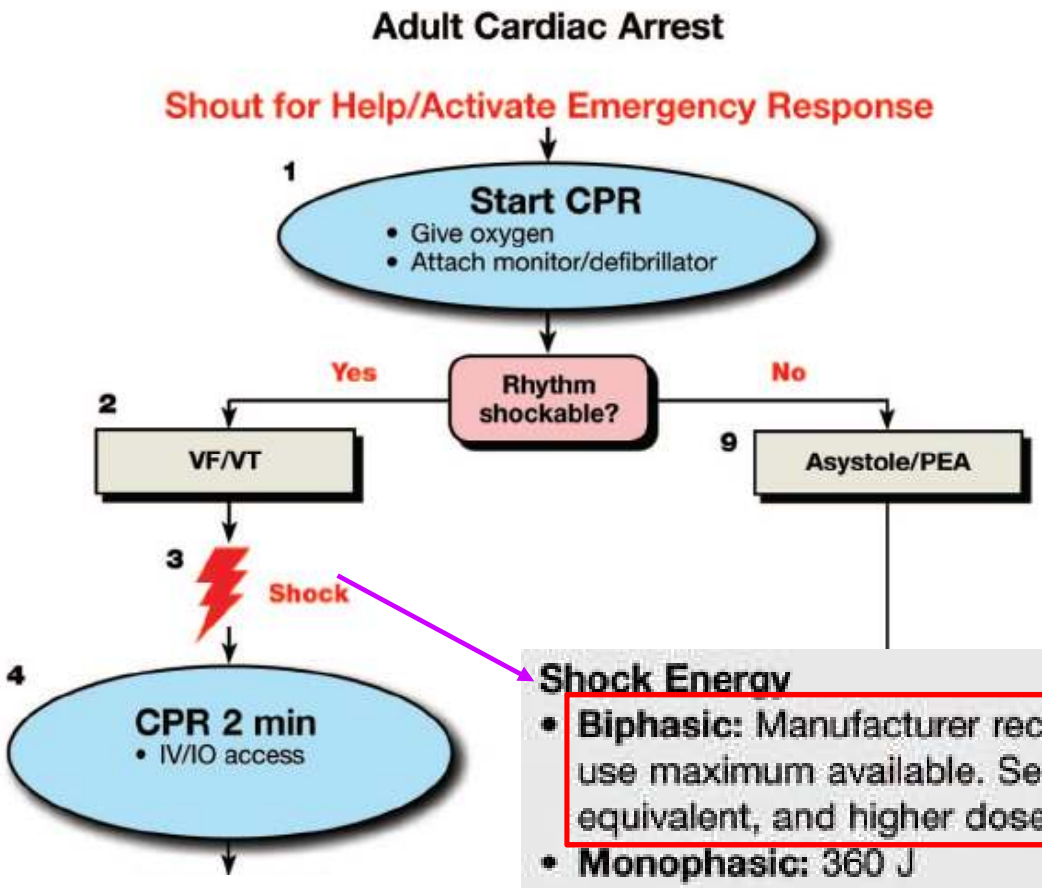


Management of Cardiac Arrest



- **Rhythm-Based Management of CA**
  - rhythm check
  - pulse check
    ; if an organized rhythm is observed
  - any doubt about the presence of a pulse
    ; resume chest compressions immediately

Management of Cardiac Arrest



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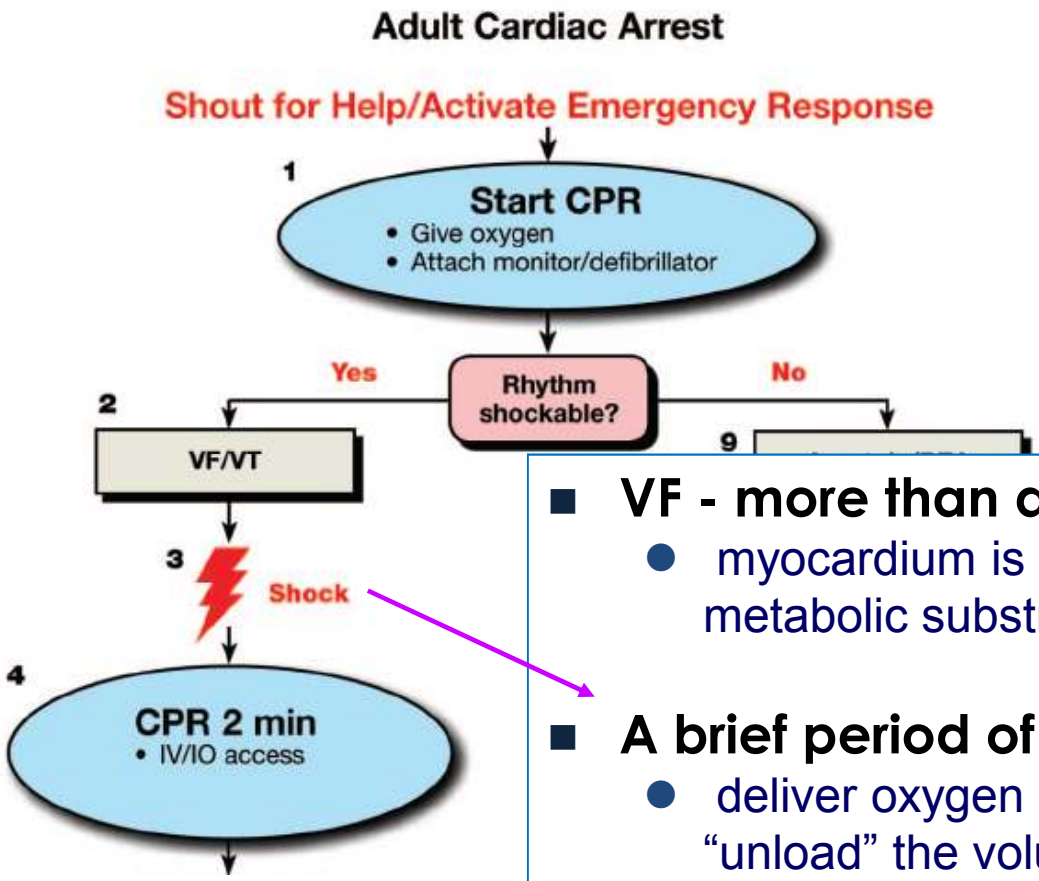
- **Monophasic:** 360 J

Management of Cardiac Arrest

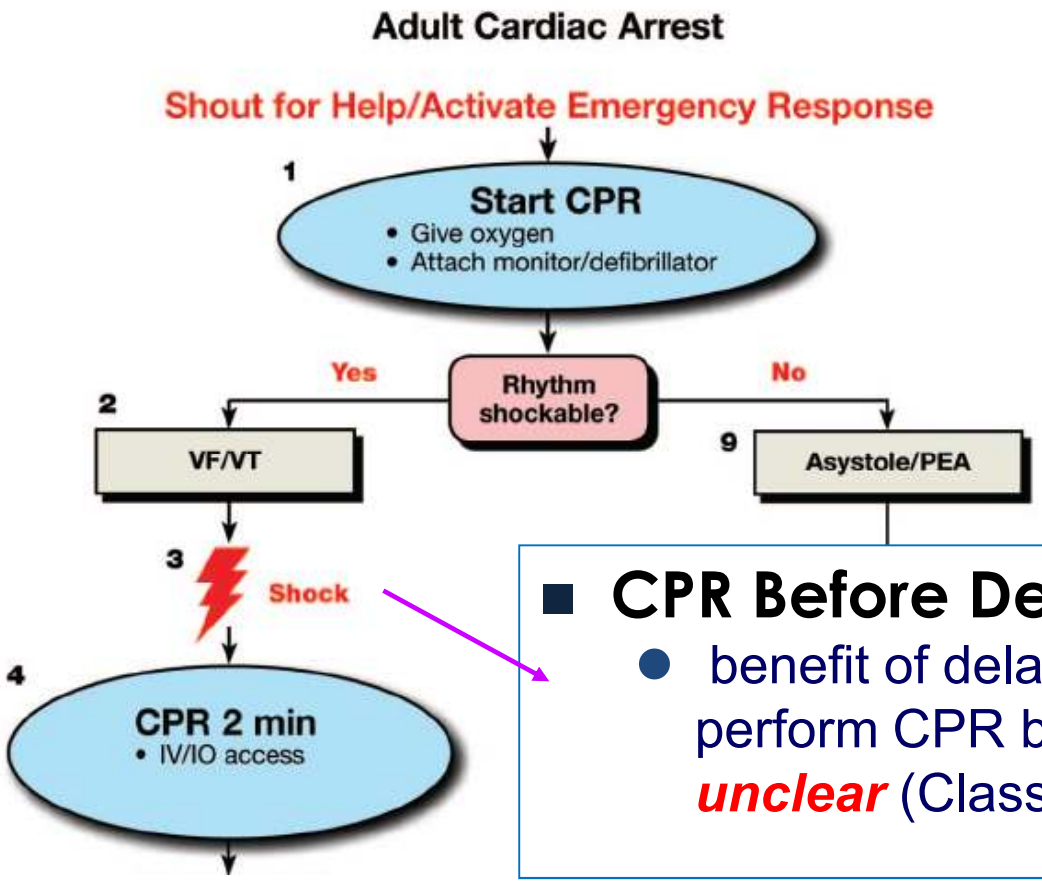


- **VF - more than a few minutes**
  - myocardium is depleted of oxygen and metabolic substrates.

- **A brief period of chest compressions**
  - deliver oxygen and energy substrates and "unload" the volume-overloaded RV

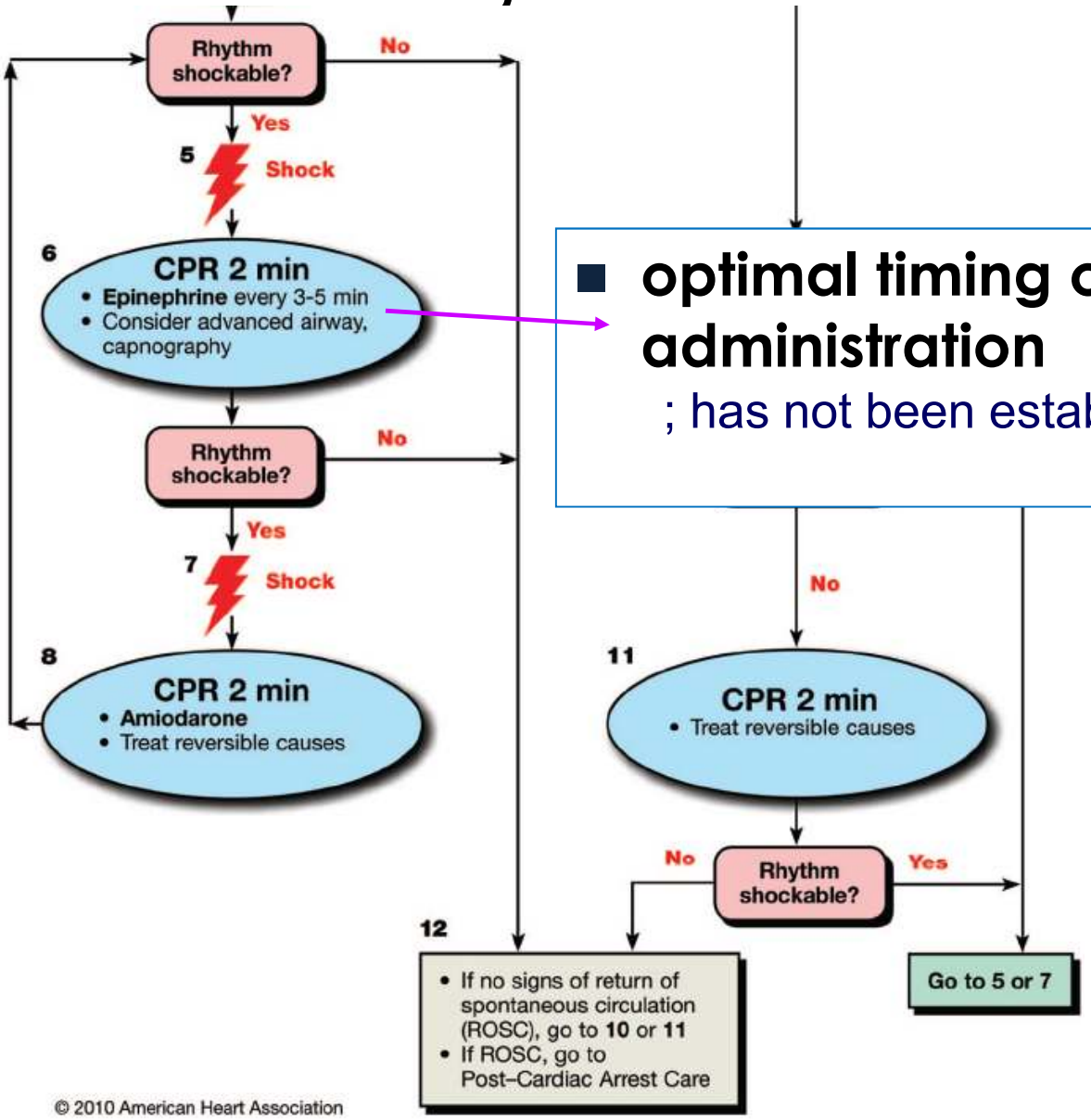
  → increasing the likelihood that a perfusing rhythm will return after shock delivery

Management of Cardiac Arrest



- **CPR Before Defibrillation**
  - benefit of delaying defibrillation to perform CPR before defibrillation is ***unclear*** (Class IIb, LOE B).

Management of Cardiac Arrest



- **optimal timing of vasopressor administration**
  ; has not been established.

Management of Cardiac Arrest

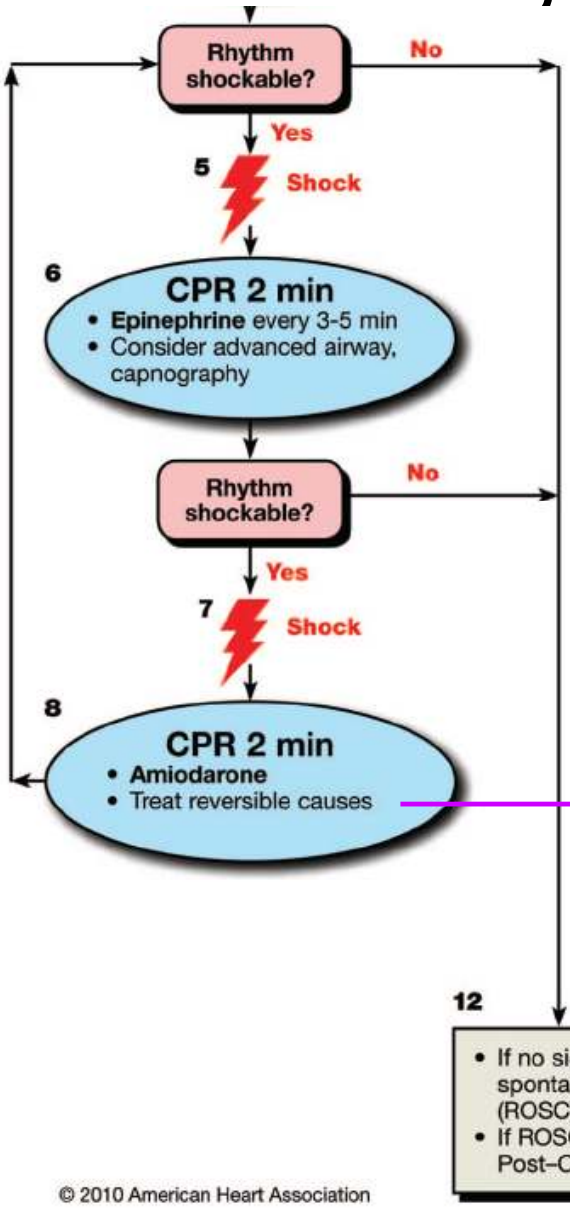


Table 1. Treatable Causes of Cardiac Arrest: The H's and T's

H's	T's
Hypoxia	Toxins
Hypovolemia	Tamponade (cardiac)
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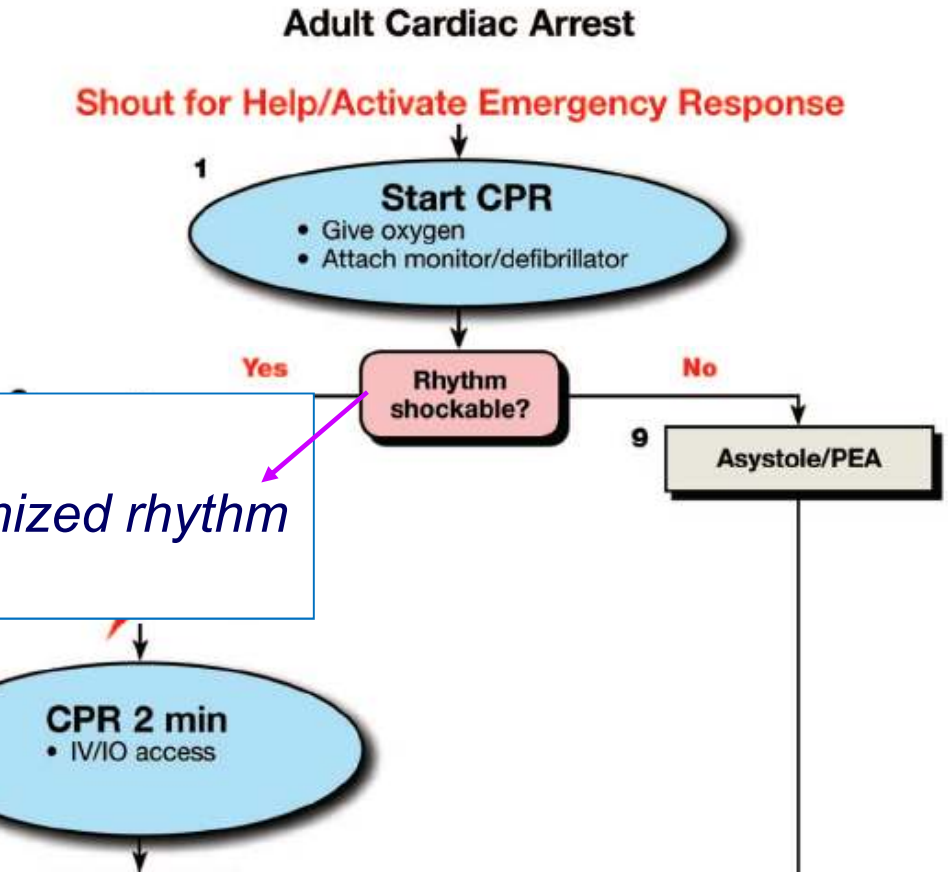
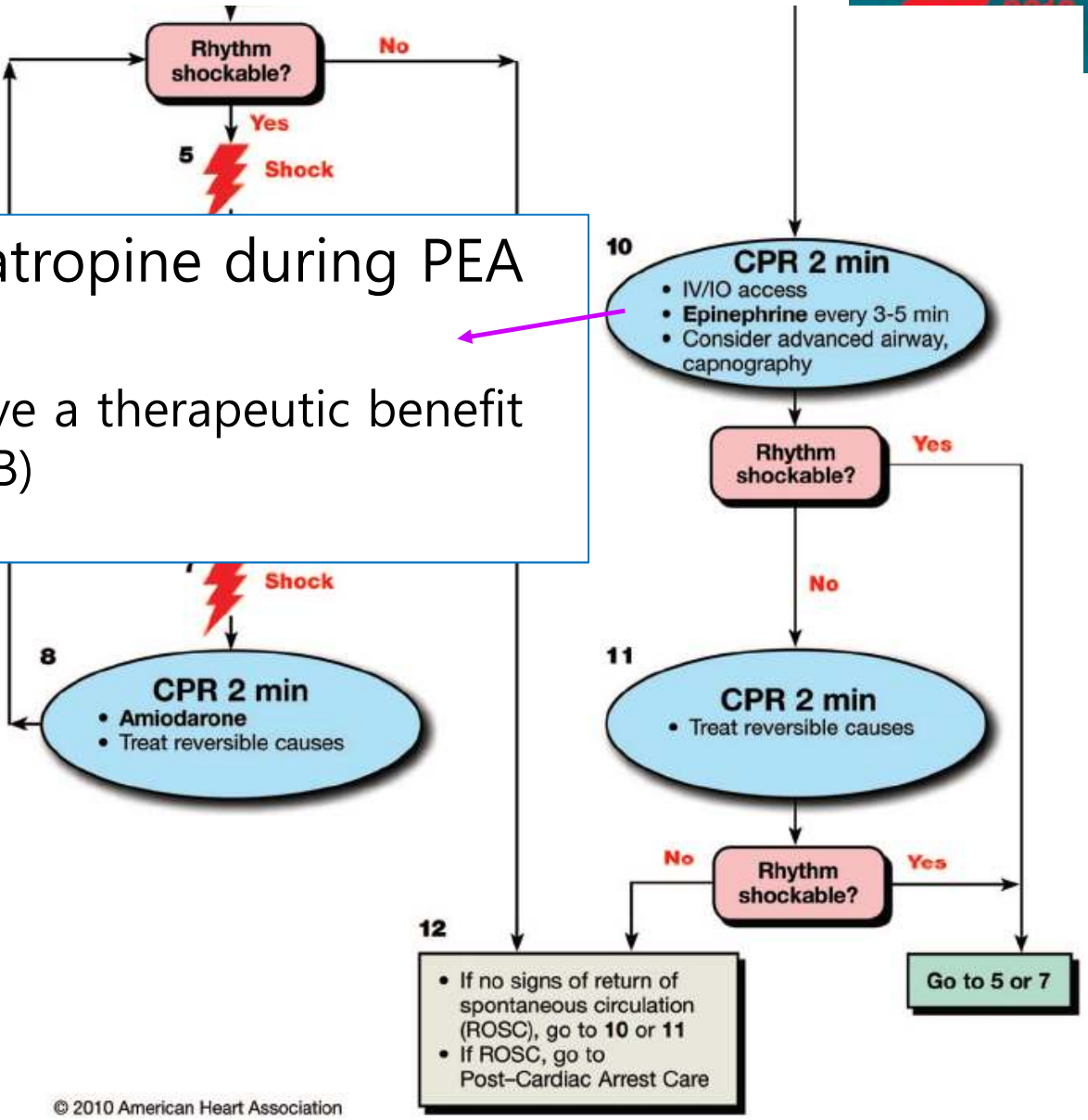
Hypo-/hyperkalemia	Thrombosis, pulmonary
Hypothermia	Thrombosis, coronary

Management of Cardiac Arrest



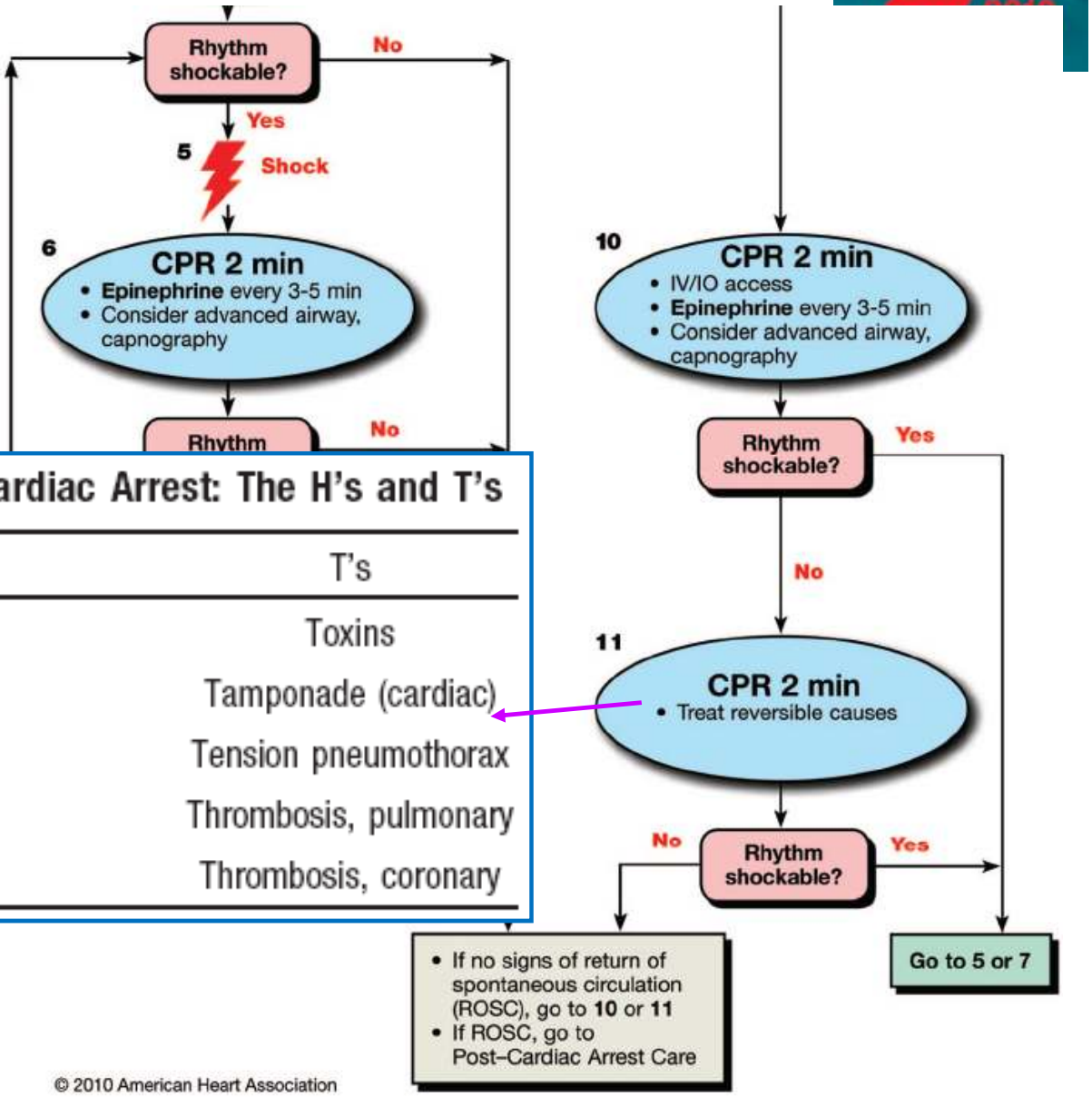
- ***pulse check (PEA)***
  ; monitor reveals *an organized rhythm*

Management of Cardiac Arrest



- routine use of atropine during PEA or Asystole
  ; unlikely to have a therapeutic benefit (Class IIb, LOE B)

Management of Cardiac Arrest



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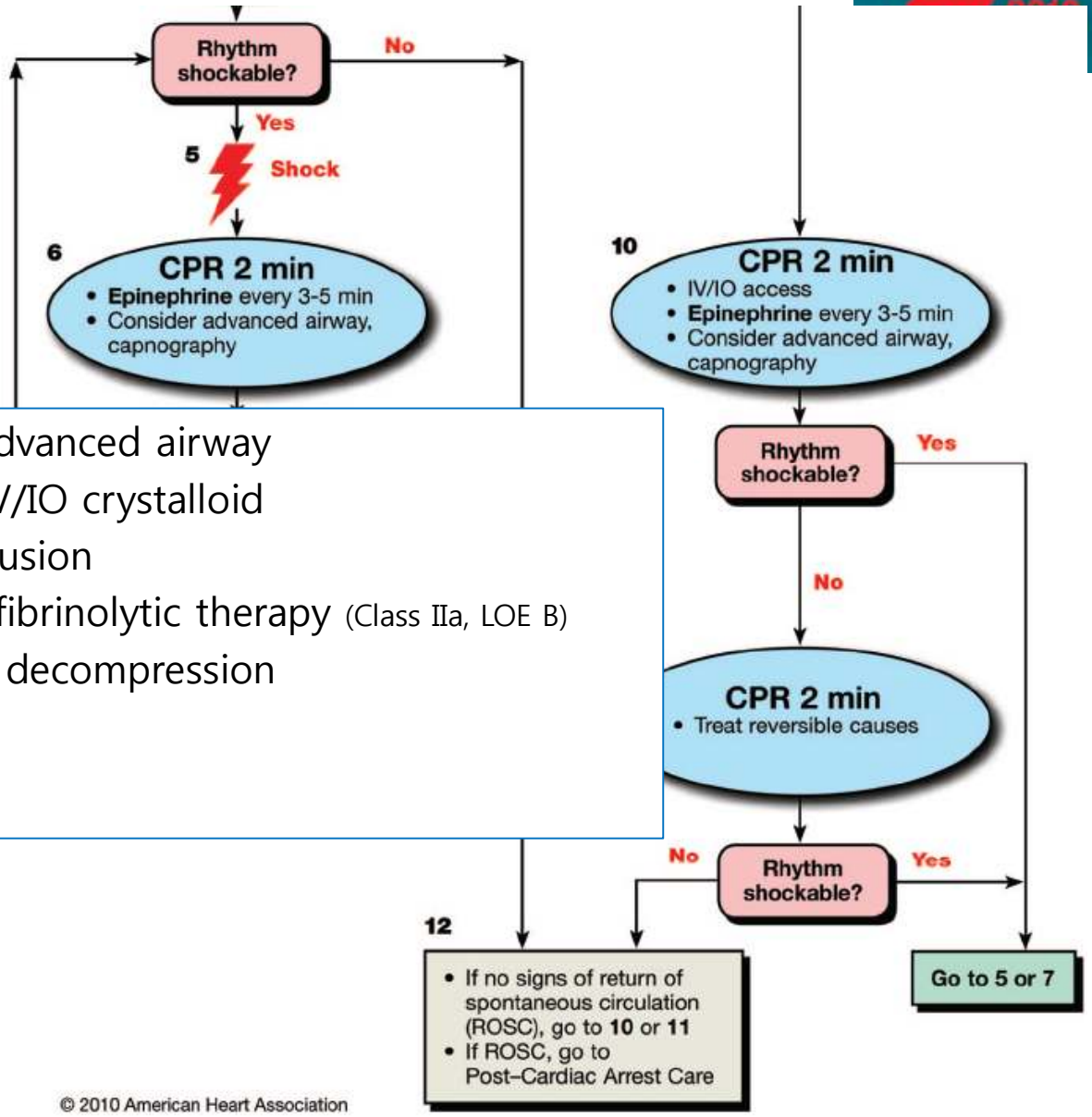
Management of Cardiac Arrest



- Hypoxemia - placement of an advanced airway
- severe volume loss or sepsis - IV/IO crystalloid
- severe blood loss - blood transfusion
- pulmonary embolism empirical fibrinolytic therapy (Class IIa, LOE B)
- tension pneumothorax - needle decompression

*** echocardiography

Management of Cardiac Arrest

- Physiologic Parameters
  - monitoring of $PETCO_2$, CPP, $ScvO_2$
    - correlate with cardiac output and myocardial blood flow during CPR
    - abrupt increase – sensitive indicator of ROSC
  - $PETCO_2$ < 10 mmHg
  - Arterial relaxation “diastolic” pressure < 20 mmHg
  - $ScvO_2$ < 30%