

## UF HEALTH FLAGLER HOSPITAL ICU CARDIAC ARREST PROTOCOL

As with any protocol, this protocol serves to provide evidence-based, comprehensive recommendations to guide our multidisciplinary team in patient care, with the expectation that expert practitioners will modify and customize as necessary the present protocol to meet individual patient needs. This Protocol is not intended to replace the physician's judgment; it is intended to provide guidance to the physician for the group of patients described in this Protocol.

### **BACKGROUND:**

In patients who suffer cardiac arrest is very important to develop a strategy to prevent, detect and correct secondary insults. The American Heart Association (AHA), the International Liaison Committee on Resuscitation (ILCOR) and the American Academy of Neurology guidelines were reviewed (1-4) as well as recommendations from the International Resuscitation Collaborative Members (5).

### **Adult Chain of Survival**

As recommended by the AHA 2020 guidelines (1,2), the primary focus of cardiac arrest management for providers is the optimization of all critical steps required to improve outcomes. These include activation of the emergency response, provision of high-quality CPR and early defibrillation, ALS interventions, effective post-ROSC care including careful treatment of underlying causes, prognostication, and support during recovery and survivorship.

It is understood that no single intervention is effective in the treatment of cardiac arrest, however, there is evidence supporting that adopting a protocol with development of an interdependent "bundle of care" can improve the likelihood of better neurological and survival outcome as stated by the International Resuscitation Collaborative Members (5). Therefore, comprehensive, structured, multidisciplinary system of care should be implemented in a consistent manner for the treatment of post-cardiac arrest patients (2).

Interventions associated with better outcomes involve community response, first responder/basic life support and in-hospital care with advanced life support. Particular interventions include:

- Dispatch assisted CPR, public AED, public training efforts and governmental support and involvement.
- Immediate chest compression, two hands facemask and supraglottic airway capabilities
- Mechanical CPR, IV access, intubation and ETCO<sub>2</sub> monitoring.
- Availability of cardiac catheterization laboratory and percutaneous coronary intervention (PCI).
- Therapeutic temperature management (TTM).
- Cardiac surgery and multispecialty practice.

EMS systems with reported better outcomes included the use of new technological tools for CPR such as the combination of an impedance threshold device (ITD) and automated mechanical CPR devices along with closely monitored quality CPR and use of designated receiving facilities that provided targeted temperature management (TTM) and rapid access to PCI (5).

However, a recent systematic review of 11 RCTs found no evidence of improved survival with good neurological outcome with mechanical CPR compared with manual CPR nor the evidence is conclusive for the use IDT in either OHCA or IHCA for which the routine use of mechanical CPR and IDT devices are not recommended by the AHA 2020 guidelines (2).

### **OBJECTIVE:**

To optimize the general care and physiological neuroprotection of patients with cardiac arrest at Flagler Hospital.

### **SCREENING:**

All patients admitted to the hospital with out of hospital cardiac arrest (OHCA) and in hospital cardiac arrest (IHCA) will be eligible to be included in the protocol.

#### **MONITORING AND INTERVENTIONS:**

Upon arrival to the ED or activation of Code Blue for IHCA, ALS protocol will be activated (see figures 1 to 3).

Upon sustained ROSC, stat intensivist consult will be requested. If the cause of the arrest is suspected to be cardiac or it is unknown, stat Cardiology consult will be requested. At the discretion of the consulting cardiologist, further cardiac intervention will be provided to the patient. Neurology consult will be requested after the first 24 hours when sedation targeting RASS -4 has been discontinued or before as clinically indicated.

*Targeted temperature management (TTM)* will be initiated as soon as possible in patients who meet inclusion criteria in all OHCA and IHCA.

#### **INCLUSION CRITERIA:**

- Age  $\geq 18$  years.
- Sustained ROSC defined as no need for chest compression for 20 consecutive minutes and signs of circulation persist.
- Unconsciousness defined as not being able to obey verbal commands with FOUR-score motor response of  $< 4$  (see appendix 1) after sustained ROSC.

#### **EXCLUSION CRITERIA:**

- The only absolute contraindication for TTM is an advanced directive that proscribes aggressive care/DNR status.
- Conditions in which TTM is not recommended:
  - Unwitnessed cardiac arrest with initial rhythm asystole.
  - Known disease making 6 months survival unlikely or known pre-arrest poor cerebral performance.

Will target normothermia with early treatment of fever for 72 hours after ROSC in all patients who meets inclusion criteria. If a patient develops fever defined as temperature  $37.8^{\circ}\text{C}$  or higher, cooling will be initiated with a target temperature of  $37.5^{\circ}\text{C}$  to complete 72 hours post ROSC (6). Sedation targeting RASS -4 will be maintained for 24 hours, then per ABCDEF Flagler protocol.

- Targeted normothermia:
  - Will maintain body temperature less than  $37.5^{\circ}\text{C}$  ( $99.5^{\circ}\text{F}$ ) for 72 hours post ROSC with early treatment of fever defined as body temperature  $> 37.5^{\circ}\text{C}$  ( $> 99.5^{\circ}\text{F}$ ).
  - If initial body temperature is above  $33^{\circ}\text{C}$  will not actively rewarm to normothermia.
  - If a patient has a temperature between  $30^{\circ}\text{C}$  and  $33^{\circ}\text{C}$ , the patient will be rewarmed to  $33^{\circ}\text{C}$  to reach the targeted temperature within 90 minutes or shorter.
  - Acetaminophen 650 mg q6h x 24h will be given to all patients.
  - If temperature is greater than  $37.5^{\circ}\text{C}$  but less than  $37.8^{\circ}\text{C}$  will add Ibuprofen 600 mg by OGT q8h x 24h unless contraindicated.
  - If body temperature reaches  $37.8^{\circ}\text{C}$  or higher despite above measures, a cooling device either surface device (Artic Sun) or endovascular catheter (Zoll) will be initiated within 30 minutes with a target temperature of  $37.5^{\circ}\text{C}$  x72 h along with a cutaneous counter warming with air-circulating blankets (BAIR Hugger).

#### *Management of shivering*

The bedside shivering assessment scale (BSAS) will be used to monitor shivering.

If shivering develops will proceed with a nonpharmacologic and pharmacologic stepwise approach targeting BSAS score of 0.

- *Non-pharmacologic interventions:*
  - Cutaneous counter warming with air-circulating blankets (BAIR Hugger) should be in place.
- *Pharmacologic interventions:*
  - Acetaminophen 650 mg q6h x 24h should be in place.
  - Target Mg level Mg >2 mg/dl should be in place.
  - If RASS less than -5, give 50 mcg of fentanyl IV bolus, titrate fentanyl up to max of 300 mcg/h and propofol up to max of 50 mcg/kg/min targeting RASS -5.
  - Add buspirone 30 mg by OGT q8h x 3 doses and Mg 1 gr IV over 30 min. Repeat Mg 2 gr IV over 30 min as needed targeting Mg level >3.
  - Give Cisatracurium 10 mg IV push, providing RASS -5, and call Intensivist or midlevel provider.
  - If shivering persists, add Ketamine IV infusion at 2 to 5 mcg/Kg/min and repeat Cisatracurium 10 mg IV push.
  - If shivering persists, give two consecutive boluses of 25 mg of meperidine q 10 min and repeat cisatracurium 10 mg IV push.
  - If shivering persists will initiate a neuromuscular blocking agent IV infusion per protocol.

*The following steps must be applied in parallel rather than in sequence upon admission to the ICU:*

- A. Assess vital signs and neurochecks** per unit protocol, or more frequently when clinically indicated.
- B. Keep head elevated** 30 degrees and in midline position unless otherwise specified by practitioner. Head elevation and midline position are important because they affect the brain venous drainage and consequently the intracranial pressure.
- C. Labs and ancillary tests upon admission to the ICU if not already done:**
  - CBC with platelets, PT/INR, PTT, fibrinogen, type and screen to blood bank, CMP, Mg, phosphorous, ionized calcium and ABG's with lactate will be requested. Then, every 6 hours x 4 times and then daily x 72 hours. Thereafter, as clinically indicated.
  - High sensitivity troponin every 3 hours x3 stat.
  - Blood cultures x2 sets stat.
  - Echocardiogram stat.
  - EKG stat, then as needed if any EKG changes noted on monitor.
  - CXR daily x3 days, then as clinically indicated.
  - CT brain with no contrast (optional).
  - If the cause of arrest is not clear, obtain CTA chest with PE protocol along with CT Abdomen and pelvis to look for occult bleeding and sepsis.
- D. Ventilator management**
  - Activate Flagler ABCDEF protocol including arterial line, OGT, and urinary indwelling catheter.
  - RASS will be maintained at -4 for the first 24 hours, then per ABCDEF Flagler protocol.
  - Lung protective strategy targeting oxygenation at 92% to 98% and PaCO<sub>2</sub> 35 to 45 mmHg.
- E. Keep euvolemia and electrolyte balance**  
Will use balanced solutions (plasmalyte or LR). Initial rate will be 125 ml/h or otherwise as indicated by the intensivist/midlevel.  
Keep serum K >4 and serum Mg >2 mg/dl.
- F. Blood pressure management.**

- All patients will have an arterial line for BP monitoring and those who need vasopressor therapy should have a midline, PICC line or central venous catheter following the established Flagler Infusion Service Protocol.
- Will target a MAP of  $\geq 65$  mmHg and SBP  $\geq 90$  mmHg. If hypotension develops after correction of volume deficit, a continuous infusion of vasopressors will be started. Norepinephrine, vasopressin, and epinephrine alone or in combination will be the first line options.

### **G. Glycemic Control**

Maintenance of normoglycemia: both hyperglycemia and hypoglycemia should be avoided. Blood glucose will be maintained within a range of 110 to 180 mg/dL.

1. For glucose less than 70 mg/dl, institute the Flagler Hospital hypoglycemia protocol.
2. For glucose between 70 and 149 mg/dl continue monitoring per unit protocol.
3. For glucose greater than 149 mg/dl, institute the standard Flagler Hospital sliding scale insulin dose regimen.
4. For glucose greater than 215 mg/dl for two consecutive tests institute continuous IV insulin infusion per Flagler hospital protocol.

### **H. Seizures assessment and management and neuro prognostication**

- EEG will be performed and interpreted in all patients who remain unresponsive after lighten sedation between 48 and 96 hours after ROSC or at any time when seizures or non-convulsive status are clinically suspected.
- The same anticonvulsant regimens used for the treatment of seizures caused by other etiologies will be used.
- CT brain will be performed, if not done, in all patients who remain unresponsive after lighten sedation between 48 and 96 hours after ROSC or at any time when clinically indicated.
- Neuro prognostication will be performed on all patients that remain in the ICU for 96 hours or more.
- If there is no motor response after being off sedation for longer than 24 hours, Flagler Brain Assessment Protocol will be initiated pursuant to Hospital Policy E-RM-003.

### **I. Gastric stress ulcer prophylaxis**

Pantoprazole 40 mg IV x1. Thereafter, Pantoprazole 40 mg IV daily or Lansoprazole 30 mg oral dissolving tablet via feeding tube daily.

### **J. Nutrition**

All patients will be placed on a strict nothing-by-mouth order x 24 hours. Then Enteral Nutrition Flagler Protocol will be activated until an assessment of the ability to swallow is completed by speech therapy.

### **K. Venous thromboembolism prevention**

Chemical VTE prophylaxis with subcutaneous heparin will be initiated unless contraindicated or patient undergoing heparin IV infusion. If heparin is contraindicated, will use a mechanical compression device.

### **L. PT/OT and mobilization**

All patients will have Physical Therapy, Occupational Therapy evaluation and regular skin assessments. Mobilization will begin as soon as the patient's condition is considered stable following Flagler protocol.

### **M. Spiritual care aspects of care will be addressed/implemented on admission**

#### **N. Recovery and survivorship after cardiac arrest**

- A structured assessment for anxiety, depression, posttraumatic stress, and fatigue for cardiac arrest survivors and their caregivers will be implemented. Psychiatry consult will be requested when patient able to communicate.
- Cardiac arrest survivors will have a multimodal rehabilitation assessment and treatment for physical, neurological, cardiopulmonary, and cognitive impairments before discharge from the hospital.
- Cardiac arrest survivors and their caregivers will receive a comprehensive, multidisciplinary discharge plan, to include medical and rehabilitative treatment recommendations and return to activity/ work expectations.
- In the event that a patient requires additional post-cardiac arrest interventions not available at this institution such as extracorporeal membrane oxygenation (ECMO) or cardiac transplant, that transfer should occur in accordance with Flagler Health+ Transfer policy and procedure.

#### **O. Post-cardiac arrest resuscitation and care quality analysis and performance review**

- Debriefing is to be performed and documented after every training and/or cardiac arrest event per hospital protocol.
- Resuscitation event reviews and debriefings may include but are not limited to early warning signs of a cardiac event, timeliness of response team activation and intervention, quality and efficacy of interventions and outcomes, etc.
- Continuous Quality Review Committee (CQRC) along with other interdisciplinary committee member may make recommendations to revise the resuscitation protocol as further evidence is gathered.

### **Updates**

#### **Critical Care Management of Patients After Cardiac Arrest: A Scientific Statement from the American Heart Association and Neurocritical Care Society – 2023**

- These recommendations are mainly applicable for patients without meaningful recovery after cardiac arrest (CA).
- **Main new changes:**
  - Target MAP >80 mmHg rather than >65 mmHg unless there are clinical concerns or evidence of adverse consequences in patients without advanced cerebral monitoring.
  - Target oxygen saturation 92% to 98% rather than >94%.
- The ictal-interictal continuum criteria (IIC) Statements

#### **Brain Oxygenation, Perfusion, Edema, and ICP Statements**

- Optimize cerebral oxygen delivery by maintaining:
  - Optimal cerebral perfusion pressure (CPP)
  - Arterial normocapnia
  - Adequate arterial oxygen content (Hb and O2Sat), while avoiding arterial hyperoxemia
- Consider invasive ICP monitoring
  - In patients with clinical indicators of cerebral edema and elevated ICP as measured by head CT, optic nerve ultrasound, or deterioration of clinical examination.
  - Patients with elevated ICP may benefit from pharmacological and nonpharmacological strategies to lower ICP.

#### **EEG Monitoring and Seizures Statements**

- Monitor for seizures with EEG as early as possible after CA for patients without meaningful neurological recovery.

- Continuous EEG (cEEG) monitoring for 3 to 5 days after CA in patients who fail to recover consciousness.
  - Intermittent EEG monitoring can be considered as an alternative monitoring modality, depending on the resources.
    - Obtain EEGs daily during the first 3 to 5 days after CA in patients who fail to recover consciousness.
- If seizures is diagnosed, the duration and frequency of EEG monitoring are individualized on the basis of treatment goals.
- Continue cEEG monitoring for at least 24 hours after post-CA seizures initially abate. electrographically in patients who fail to recover consciousness because of the possibility of nonconvulsive seizures.
- Follow the same treatment standards used for other causes of seizures assuming that the goals of care are compatible with aggressive treatment.
- The treatment goal for post-CA SE is seizure suppression or burst suppression for a minimum of 24 hours.
- Valproic acid and levetiracetam are reasonable first-line agents for seizure and for electroclinical myoclonus or electrographic seizures.
  - Do not aggressively treat clinical myoclonus without electrographic correlation unless myoclonic activity interferes with other aspects of care (eg, ventilation).

#### The ictal-interictal continuum criteria (IIC) Statements

- The IIC is a spectrum of abnormal periodic or rhythmic EEG patterns that do not meet criteria for seizures or status epilepticus but may affect brain function or cause brain injury
- IIC patterns are common after CA; however, it is unknown which IIC patterns benefit from treatment with antiseizure medication. and whether treatment improves outcomes.
- Treat IIC patterns in selected cases and when worsening trends are observed with longitudinal EEG monitoring.
- Do not treat sporadic epileptiform discharges.

#### Sedation and Analgesia Statements

- The goals of analgesia and sedation during temperature control after CA are to provide comfort, to reduce shivering, and to prevent recall during NMB
- Short-acting sedative and analgesic agents are preferred for patients in post-CA coma undergoing temperature control to reduce the duration of mechanical ventilation, time to awakening, and confounding of delayed prognostication.
  - Propofol and fentanyl are favored over midazolam and morphine infusions.
- Use NMB intermittently as needed during temperature control rather than as a continuous infusion as they may mask seizures in unmonitored patients.

#### Cardiac Management Statements

- Target MAP >80 mmHg unless there are clinical concerns or evidence of adverse consequences in patients without advanced cerebral monitoring
- Target CPP >60 mmHg in patients with advanced cerebral monitoring.
- Perform echocardiography as soon as possible to guide hemodynamic management and to search for correctable causes of the CA.
  - Serial echocardiography can be helpful to guide ongoing hemodynamic management at least until unsupported hemodynamic stability occurs.
- Individualize the choice of using inotropes, vasopressors, or fluids to treat post-CA hypotension and to target the likely cause(s) contributing to the shock and hemodynamic state.
  - Serial measurements of central venous oxygen saturation, and lactate are helpful in monitoring the adequacy of systemic perfusion and the effectiveness of therapies used to treat shock.

- In patients with refractory hypoperfusion, evaluate early for mechanical circulatory support (including intra-aortic balloon pump, temporary right or left ventricular assist device, and ECMO) to improve end-organ perfusion.
- Early coronary angiography in post-CA patients with no ST-segment elevation on the presenting ECG may still be of benefit by potentially salvaging myocardium and decreasing the incidence of systolic heart failure in survivors.

### **Pulmonary Statements**

- Lung-protective ventilation is the standard of care for most critically ill patients who are at risk for developing ARDS, including those after CA.
  - Target oxygen saturation 92% to 98%.
  - Target normocapnia (Paco<sub>2</sub> (35–45 mm Hg) after ROSC.

### **Hematologic Management Statements**

- PRBC transfusion thresholds targeting hemoglobin >7 g/dL and >9 g/dL in patients with acute coronary disease.
- Initiate DVT prophylaxis within 48 hours after admission unless there is contraindication.
  - Low-molecular-weight heparin is the first choice unless kidney dysfunction.

### **Digestive System Statements**

- Initiate enteral nutrition (EN) as soon as possible after ICU admission.
  - In patients with enteral intolerance or shock, start with trophic EN (rates of 10–20 mL/h) and adjust according to tolerance.
- Start parenteral nutrition when enteral feeding is not tolerated or is contraindicated after 5 to 7 days after CA.
- Give proton pump inhibitor or H<sub>2</sub> blockers for stress ulcer prophylaxis per standard indications in the critically ill patient.
  - In patients receiving EN, stress ulcer prophylaxis may not be necessary.

### **Infectious Disease Statements**

- No need for empirical antibiotics. In patients treated with temperature management to a hypothermic target empirical antibiotics may be used. Not applicable to us since we target normothermia not hypothermia.

### **Endocrine and Fluids Management Statements**

- Volume management takes into consideration the cause of arrest, hemodynamic target chosen, and underlying organ dysfunction and is individualized to each patient.
  - Balance the risk for cerebral edema with complications associated with hyperchloremia when choosing intravenous fluid.
    - The preferred choice in the setting of cerebral edema is normal saline
    - Balanced crystalloid solutions may minimize hyperchloremia and the potential for AKI when cerebral edema is not present.
- Do not use sodium bicarbonate routinely in patients after CA who have metabolic acidosis.
  - Sodium bicarbonate may be considered in patients with severe metabolic acidosis (pH <7.2) and AKI stage 2 or 3.
- Consider RRT after CA for when life-threatening changes in fluid, electrolytes, and/or acid-base balance exist and for conditions that can potentially be modified with RRT.
- Treatment of hyperglycemia with glucose targets of 81 to 180 mg/dL.\

## **ADDITION FROM 2023 ILCOR GUIDELINES**

### **Double sequential defibrillation (DSED)**

- Consider or patients who remain in VF or pulseless VT after  $\geq 3$  consecutive shocks with a single operator activating the defibrillators in sequence.

### Prediction of Good Neurological Outcome

- Combination of tests to determine outcome in patients who remain comatose
- Indicators of favorable outcome
  - GCS motor score  $>3$  evaluated within 4 days after ROSC.
  - Absence of diffusion restriction on MRI between 72 hours and 7 days after ROSC.
  - Normal neuron-specific enolase (NSE) ( $<17 \mu\text{g/L}$ ) within 72 hours after ROSC.
  - Continuous or nearly continuous EEG background without periodic discharges or seizures within 72 hours from ROSC.
  - Against using somatosensory evoked potential SSEP.

### 2023 AHA Focused Update on Adult ACLS: Key Points

Dec 21, 2023 | Sandra M. Oliver-McNeil

The following are key points to remember about a 2023 American Heart Association (AHA) focused update on adult advanced cardiovascular life support (ACLS):

1. **Epinephrine** should be administered for patients in cardiac arrest (Class 1).
  - Vasopressin alone or with methylprednisolone in combination with epinephrine may be considered in cardiac arrest but is not a substitute for epinephrine (Class 2b).
  - High-dose epinephrine is not recommended for routine use in cardiac arrest.
2. **Amiodarone or lidocaine** may be considered for ventricular fibrillation/pulseless ventricular tachycardia that is unresponsive to defibrillation (Class 2b).
3. Routine administration of **calcium, sodium bicarbonate, and magnesium** for cardiac arrest is not recommended.
4. **Use of extracorporeal cardiopulmonary resuscitation (ECPR)** for patients with cardiac arrest refractory to standard ACLS is reasonable when equipment and trained staff are available (Class 2a).
5. **Coronary angiography** should be performed emergently for all cardiac arrest patients with suspected cardiac arrest and ST-segment elevation on electrocardiography (Class 1).
  - It is reasonable in patients without ST-elevation, but with elevated risk of significant coronary artery disease, where revascularization may provide benefit (Class 2a).
  - Neurological status should not be the deciding factor on whether a patient should have revascularization (Class 2a).
  - There is no benefit of emergency coronary angiography over delayed coronary angiography for patients with return of spontaneous circulation (ROSC) but without any the following:
    - ST-segment elevation
    - Shock
    - Electrical instability
    - Signs of significant ongoing myocardial damage
    - Ongoing ischemia
6. All adults who do not follow commands after ROSC, irrespective of arrest location or presenting rhythm, should receive treatment that includes a deliberate **strategy for temperature control**.
7. **Hospitals should develop protocols** for post-arrest temperature control.



- During post-arrest temperature control, a constant temperature between 32°C and 37.5°C should be maintained (Class 1).

### **Hypothermia for neuroprotection in adults after cardiac arrest**

#### **Cochrane Database of Systematic Reviews**

Version published: 22 May 2023 <https://doi.org/10.1002/14651858.CD004128.pub5>

- Therapeutic hypothermia with target temperature 32 °C to 34 °C compared with fever prevention or no cooling may improve neurological outcomes after cardiac arrest.
  - 8 studies, 2870 participants
  - RR 1.60, 95% CI 1.15 to 2.23; 8 studies, 2870 participants). Low certainty of the evidence
- Therapeutic hypothermia with target temperature 36 °C compared with fever prevention or no cooling showed no evidence of a difference between groups.
  - 3 studies, 1044 participants.
  - RR 1.78, 95% CI 0.70 to 4.53. Low certainty of the evidence

#### **Cooling across all studies**

- Had no effect on survival.
- Was associated with an increased risk of pneumonia, hypokalemia and severe arrhythmias

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9. Oliver-McNeil. 2023 AHA Focused Update on Adult ACLS: Key Points Dec 21, 2023.

Figure 1: Adult Cardiac Arrest Algorithm.

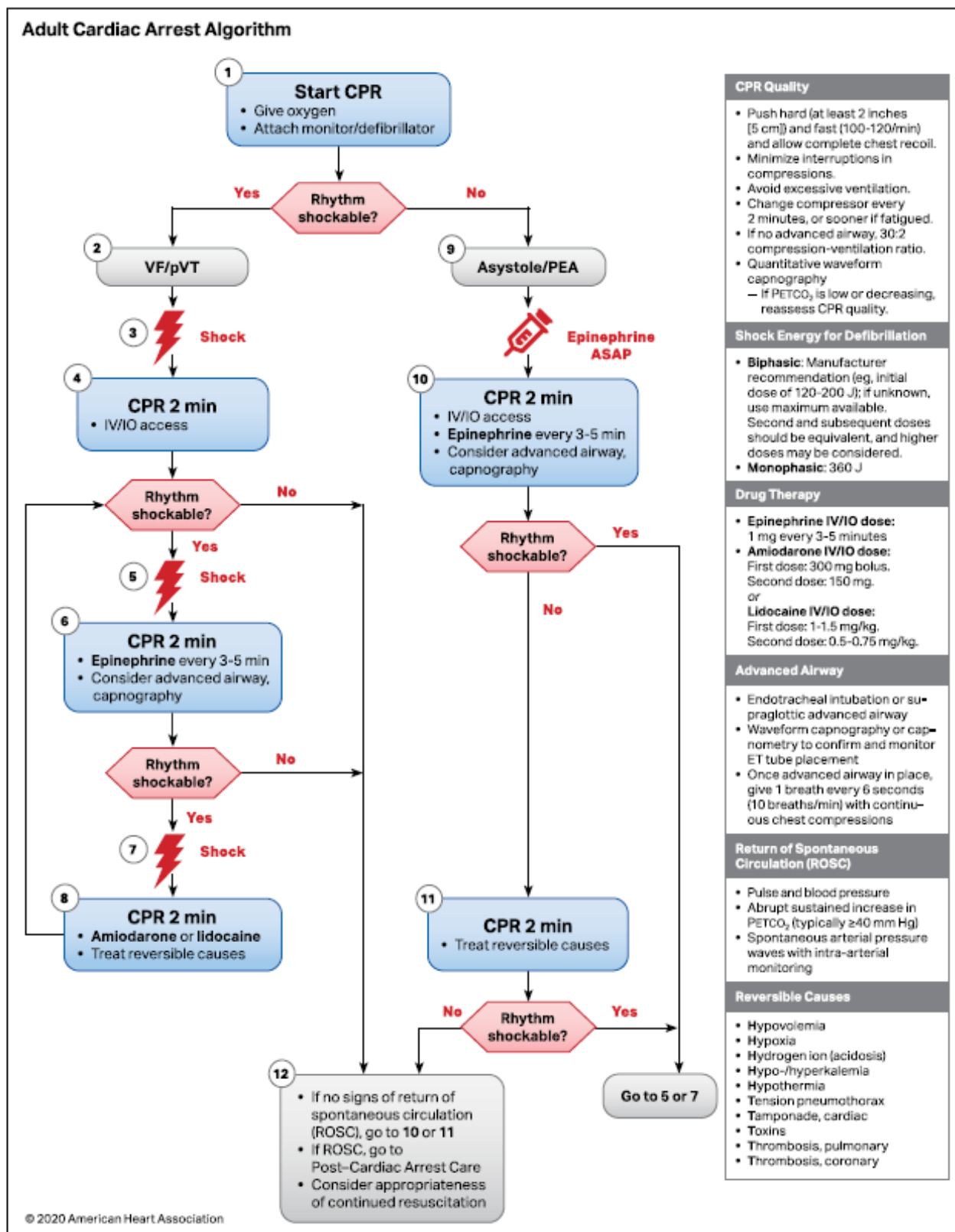


Figure 2: Adult Cardiac Arrest Circular Algorithm.

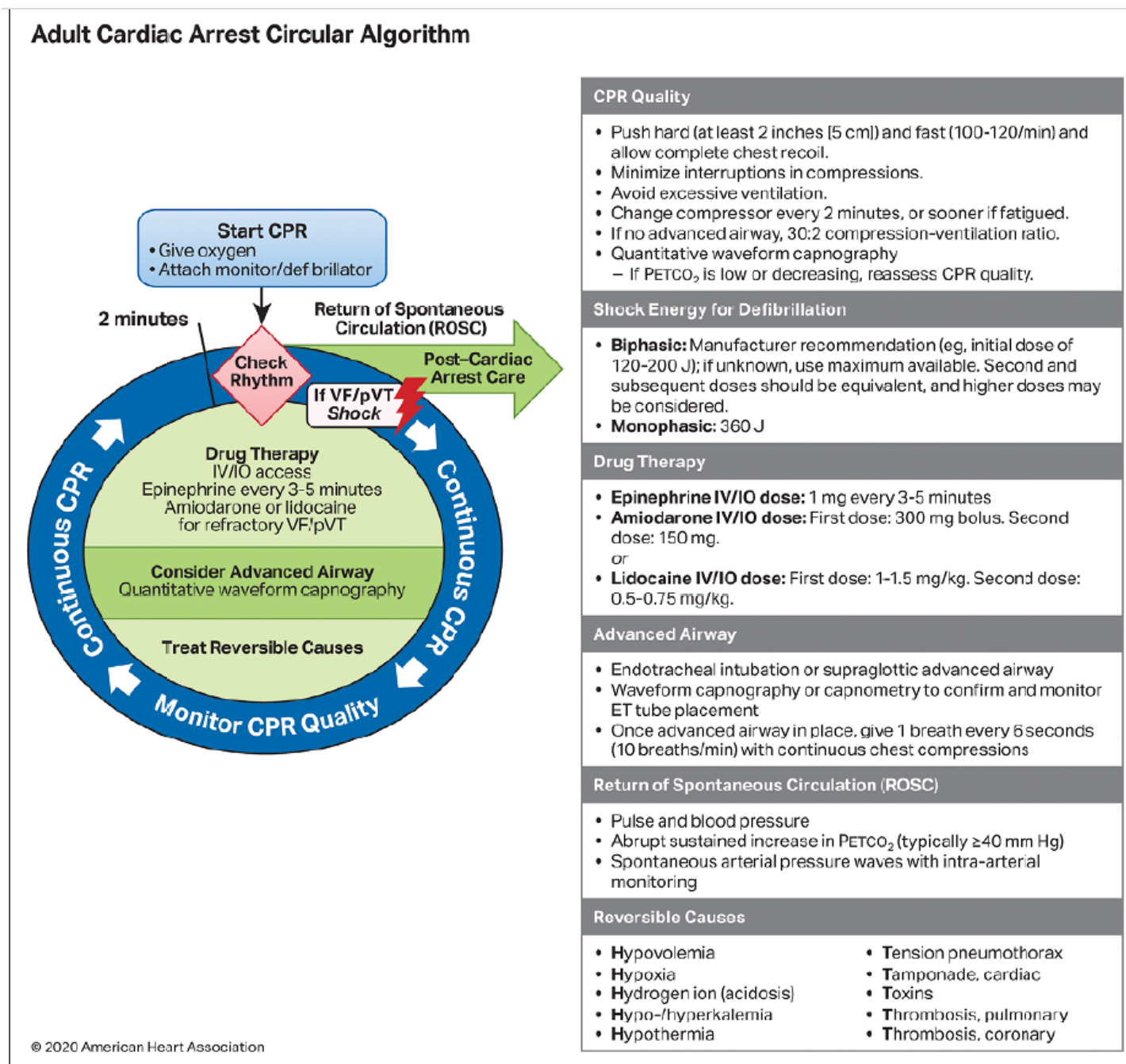
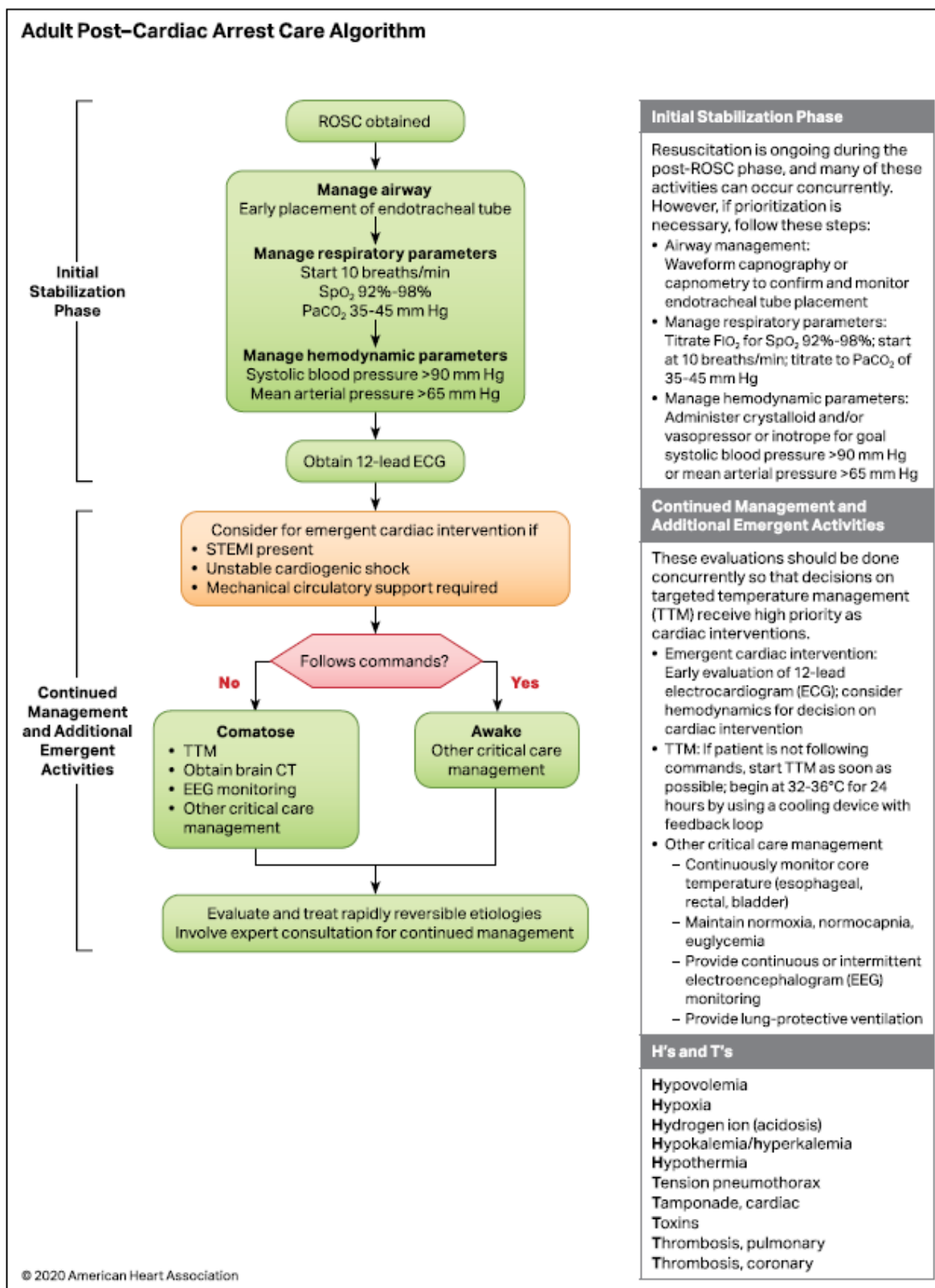


Figure 3: Adult Post-Cardiac Arrest Algorithm



**Appendix 1**  
**FOUR motor response (upper extremities)**

| <i>Score</i> | <i>Definition</i>                                   |
|--------------|---|
| +4           | Thumbs-up, fist or peace sign                       |
| +3           | Localizing to pain                                  |
| +2           | Flexion response to pain                            |
| +1           | Extension response to pain                          |
| 0            | No response to pain or generalized myoclonus status |

**Appendix 2**  
**The Bedside Shivering Assessment Scale - BSAS**

| <i>Score</i> | <i>Definition</i>  |
|--------------|--|
| 0            | <b>None:</b> no shivering noted on palpation of the masseter, neck, or chest wall                            |
| 1            | <b>Mild:</b> shivering localized to the neck and/or thorax only  |
| 2            | <b>Moderate:</b> shivering involves gross movement of the upper extremities (in addition to neck and thorax) |
| 3            | <b>Severe:</b> shivering involves gross movements of the trunk and upper and lower extremities               |