PURPOSE:

To address Adult Post-ROSC (Return of Spontaneous Circulation) Care

ABBREVIATIONS:

- EMR - Emergency Medical Record
- EtCO2 - End Tidal Carbon Dioxide
- mmHg - Millimeters of Mercury
- MAP - Mean Arterial Pressure
- SBP - Systolic Blood Pressure

PROTOCOL:

Patient Care Goals:

The immediate ROSC period is critical in stabilizing patients and preparing for transport. The goal is therefore to maximize survival and optimize neurologic and cardiovascular function following a return of spontaneous circulation by the following steps:

1. Secure airway
2. Obtain vascular access
3. Maximize blood pressure
4. Identify ST-elevation myocardial infarction (STEMI) or reversible causes of arrest
5. Recognize pending re-arrest
6. Consider appropriate destination choice

Patient Presentation:

Inclusion Criteria

- Patient returned to spontaneous circulation following cardiac arrest resuscitation

Exclusion Criteria

- None recommended

Patient Management:

Assessment, Treatment, and Interventions

1. Perform general patient management attempting to identify cause of cardiac arrest.
2. Support life-threatening problems associated with airway, breathing, and circulation.
    - Anticipate approximately 5-10 minutes of patient evaluation and stabilization prior to moving patient
3. Monitor closely for reoccurrence of cardiac arrest using clinical and adjunctive criteria such as cardiac monitoring,
   EtCO2 monitoring, and physical signs of perfusion
4. Prior to patient movement
    - Administer oxygen ***[EMR]*** with a target of achieving 94-98% saturation. Do not hyperoxygenate.
    - Numeric or Waveform End-Tidial CO2 in place, if applicable for service level
    - Ensure ventilation rate of 8-10 per minute and $ETCO_2$ of 35–45 mmHg. Avoid

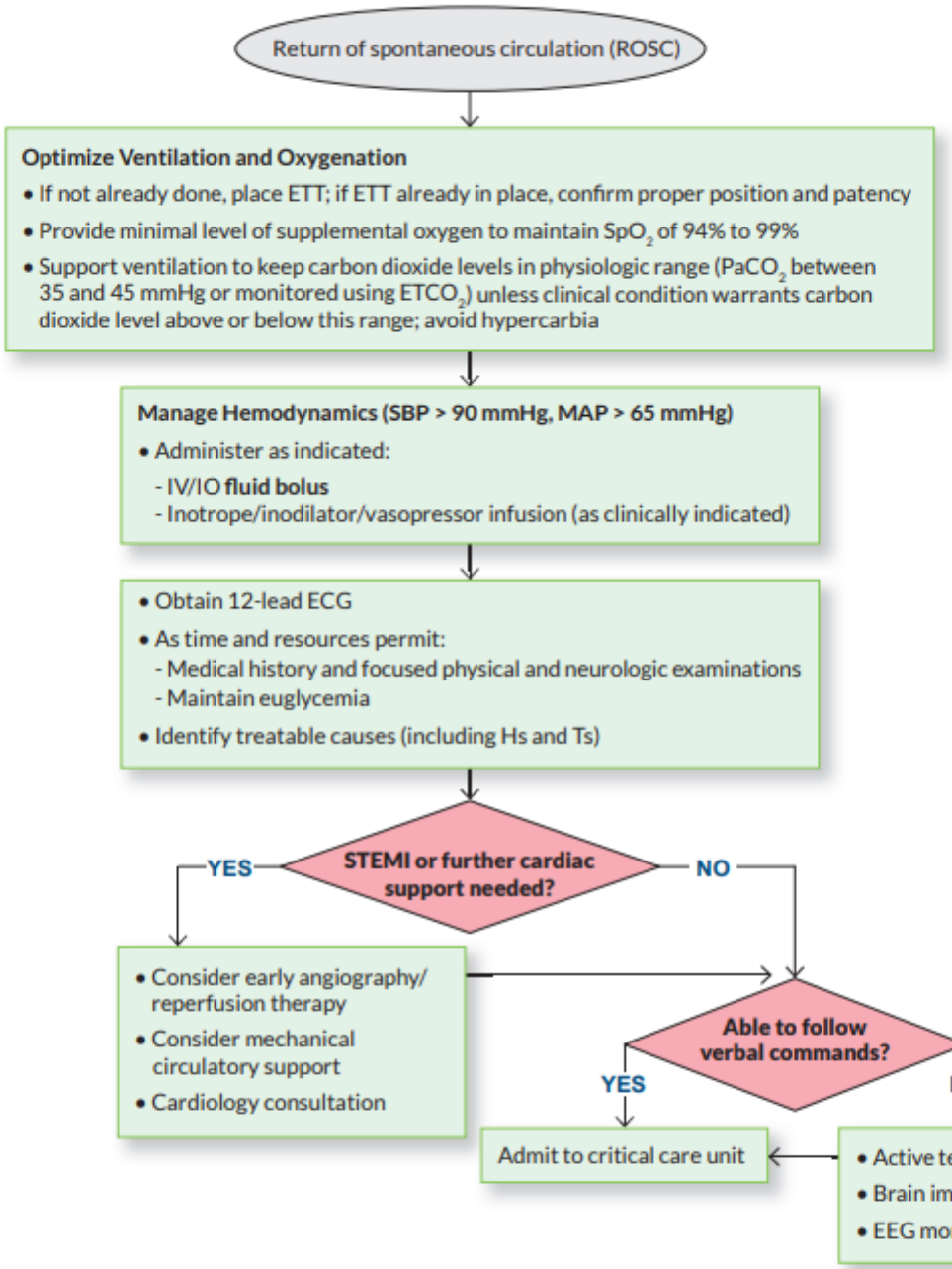
hyperventilation

- Secure vascular access, ideally 2 points of access
- Initiate IVF and vasopressors for hypotension (SBP less than 90 mmHg or MAP less than 65): titrated to MAP greater than 65mmHg. Consider concurrent intiation of IVF and vasopressors.
    1. **Norepinephrine infusion*/PARA/* 0.025-3 mcg/kg/min IV/IO**
    2. **Epinephrine Push Dose [PARA] 5–20 mcg (0.5 mL to 2mL)**
    3. **Epinephrine infusion*/PARA/* 0.05-2 mcg/kg/min IV OR 2-10mcg/min** first line if bradycardia
    4. **Dopamine [PARA] 2-20mcg/kg/min IV/IO**
- Perform 12-lead ECG to assess for evidence of reversible cause of arrest such as STEMI or electrolyte derangement (e.g., hyperkalemia)

5. Consider anti-arryhthmic medications
    - **Amiodarone [PARA]:**
        1. If no loading dose previosly administered: 150 mg IV over 10 minutes
        2. If loading dose previously administered: 1 mg/min X 6 hours
    - **Lidocaine [PARA]:** 1 mg/kg bolus followed by 1-4 mg/min infusion
6. Consider pain management/sedation, if applicable
7. Post-cardiac arrest patients should preferentially transported to hospital with cardiac catheterization laboratory. Consider Medical Control Consultation to help determine most appropriate destination.
8. Check blood glucose
    - If hypoglycemic, treat per Hypoglycemia guideline.
    - If hyperglycemic, notify hospital on arrival.
9. If patient seizes, treat per Seizures guideline.
10. Do not allow the patient to become hyperthermic. If the patient temperature greater then 37^{o}C consider
    - Reduce ambient air temperature in transport vehicle or helicopter.
    - Place ice packs to patient's neck, axilla and femoral groins.
    - Administer cold intravenous fluids at 150 ml/hr.
    - Monitor temperatures frequently and adjust methods of cooling as appropriate to maintain normothermia (36°-37°C)

ADULT POST–CARDIAC ARREST CARE

ALS - 2021 VERSION



Medications	Ventilation and Oxygenation Goals	Hs and Ts	Active Temperature Control*
IV/IO fluid bolus • 1 to 2 L NS or LR solution **Dopamine** • 5 to 20 mcg/kg/min IV/IO **Epinephrine** • 2 to 10 mcg/min IV/IO **Norepinephrine** • 0.1 to 0.5 mcg/kg/min IV/IO	**Ventilation** • Start at 10 breaths/min; adjust as needed • $PaCO_2$: 35 to 45 mmHg **Oxygenation** • Provide minimal level needed to maintain SpO_2 of 94% to 99%	• Hypovolemia • Hypoxemia • Hydrogen ion excess (acidosis) • Hyperkalemia/hypokalemia • Hypothermia • Hyperglycemia/hypoglycemia • Tamponade (cardiac) • Tension pneumothorax • Thrombosis (pulmonary embolism) • Thrombosis (myocardial infarction) • Toxins	Actively prevent fever and maintain a temp of 37.5° C or less for at least 72 hours Consider hypothermic temperature control subpopulations. If targeting a hypothermic monitor for negative consequences of hypo Use fever prevention/temperature control (e.g., uncovering patient, acetaminophen, cooling devices with temperature monitorin feedback) Continuously monitor core temperature via esophageal, rectal or bladder catheter

*In the prehospital setting, providers should not initiate active temperature control or rapid infusion of large volumes of cold intravenous fluid immediately after ROSC. The evidence for active temperature control is constantly evolving. Defer to institutional protocols and clinician judgment based on the latest evidence.

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Prognostication Following Return of Spontaneous Circulation (ROSC)		
Clinical management	Active Temperature Control (if indicated) Initiate fever prevention/temperature control methods or normothermic temperature control: • Consider hypothermic temperature control	For at least 72 hours post-ROSC
	Rewarming (if indicated)	30 to 54 hours post-ROSC
	Minimize sedation and analgesia as possible; controlled normothermia	54 to 72+ hours post-ROSC
Multimodal prognostication in the post–cardiac arrest period should not be determined before 72 hours after ROSC and following return to normothermia.		
Modality	**Predictor**	**Timeframe Post-ROSC**
Imaging	Brain computed tomography (CT) • Gray-to-white matter ratio (GWR)	0 to 24 hours
	Brain diffusion-weighted MRI (DWMRI) • Apparent diffusion coefficient (ADC)	24 to 72+ hours
Electrophysiology	Somatosensory evoked potentials (SSEPs) • Bilaterally absent N20 SSEPs	24 to 72+ hours
	Electroencephalography (EEG) • Seizure activity • Burst suppression	72+ hours
Clinical examination	Myoclonus or status myoclonus*	24 to 72 hours
	Pupillary light reflexes	72+ hours
	Quantitative pupillometry	72+ hours
	Corneal reflexes	72+ hours
Serum biomarkers	Serum neuron-specific enolase (NSE)	24 to 72 hours

*Obtain EEG with myoclonic jerks.

Patient Safety Considerations

1. Avoid hyperthermia
2. Prehospital initiation of therapeutic hypothermia is not routinely recommended

Notes and Educational Pearls

Key Considerations

- Hyperventilation is a significant cause of hypotension and recurrence of cardiac arrest in the post resuscitation phase and must be avoided. Similarly, hypoventilation (suggested by an EtCO2 greater than 40–45) contributes to worsening acidosis and may precipitate re-arrest.
- Most patients are comatose immediately after resuscitation and will require airway management and ventilatory assistance.
- Many patients experience “stunning” of the cardiac muscle after ROSC. Hypotension is common, and volume resuscitation or vasopressor support is often required. Refer to the [Shock Guideline] for further recommendations. Anticipate and prepare for subsequent cardiac arrest.
- Common non-cardiac causes of post-resuscitation hypotension include hyperventilation,

hypovolemia, and traumatic pneumothorax from chest compressions.
- The condition of post-resuscitation patients fluctuates rapidly and continuously requiring close monitoring. A significant percentage of post-ROSC patients will re- arrest.
- Current research has demonstrated that care of patients with ROSC at specialized centers is associated with both decreased mortality and improved neurologic outcomes.
- Maintain mechanical CPR device in place in preparation for re-arrest.
- A moderate number of adult post-ROSC patients may have transient ST-elevation on EKG Consider performing serial EKGs. Post-ROSC patients should preferentially be transported to centers capable of managing STEMI, whenever possible.

Pertinent Assessment Findings

- Assess post-ROSC rhythm, lung sounds, and for signs of hypoperfusion.

Quality Improvement

Associated NEMSIS Protocol(s) (eProtocol.01)

- 9914019—Cardiac Arrest-Post Resuscitation Care

Key Documentation Elements

- Immediate post-arrest rhythms, vital signs, oxygen saturation, neurologic status assessment
- Post-ROSC 12-lead ECG

Performance Measures

- Percent of ROSC patients transported to appropriate facility as defined by the EMS system

REFERENCES:

1. Aufderheide TP, Lurie KG. Death by hyperventilation: a common and life- threatening problem during cardiopulmonary resuscitation. *Crit Care Med.* 2004;32(suppl):S345–51.
2. Bernard SA, Gray TW, Buist MD, et al. Treatment of comatose survivors of out-of- hospital cardiac arrest with induced hypothermia. *N Engl J Med.* 2002;346:557– 63.
3. Callaway CW, Donnino MW, Fink EL, et al. Part 8: Post cardiac arrest care: 2015 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation.* 2015;132(18 Suppl 2):S465-82.
4. De Backer D et al. Comparison of dopamine and norepinephrine in the treatment of shock. *N Engl J Med.* 2010;362:779-89.
5. Kim F, Nichol G, Maynard C, et al. Effect of prehospital induction of mild hypothermia on survival and neurological status among adults with cardiac arrest. JAMA. 2014;311(1):45-52.
6. Nolan JP, Neumar RW, Adrie C, et al. Post-cardiac arrest syndrome: epidemiology, pathophysiology, treatment, and prognostication. A scientific statement from the International Liaison Committee on Resuscitation; the American Heart Association Emergency Cardiovascular Care Committee; the Council on Cardiovascular Surgery and Anesthesia; the Council on Cardiopulmonary, Perioperative, and Critical Care; the Council on Clinical Cardiology; the Council on Stroke. *Circulation.* 2008;79(3):350-79.
7. Garot P, Lefevre T, Eltchaninoff H, et al. Six-month outcome of emergency percutaneous coronary intervention in resuscitated patients after cardiac arrest complicating ST-elevation myocardial infarction. *Circulation.* 2007;115(11):1354–62.
8. Kim F, Nichol G, Maynard C, et al. Effect of prehospital induction of mild hypothermia on survival and neurological status among adults with cardiac arrest: a randomized clinical trial. *JAMA*. 2014;311(1):45-52.
9. Kim F, Olsufka M, Longstreth WT Jr., et al. Pilot randomized clinical trial of prehospital induction of mild hypothermia in out-of-hospital cardiac arrest patients with a rapid infusion of

4°C normal saline. *Circulation.* 2007;115(24):3064–70.
10. Kliegel A, Janata A, Wandaller C, et al. Cold infusions alone are effective for induction of therapeutic hypothermia but do not keep patients cool after cardiac arrest. *Resuscitation.* 2007;73(1):46–53.
11. Nielsen N, Wetterslev J, Cronberg T, et al. Targeted temperature management at 33 degrees C versus 36 degrees C after cardiac arrest. *N Engl J Med*. 2013;369(23):2197-206.
12. Oddo M, Schaller MD, Feihl F, Ribordy V, Liaudet L. From evidence to clinical practice: effective implementation of therapeutic hypothermia to improve patient outcome after cardiac arrest. *Crit Care Med.* 2006;34(7):1865–73.
13. Quintero-Moran B, Moreno R, Villarreal S, et al. Percutaneous coronary intervention for cardiac arrest secondary to ST-elevation acute myocardial infarction: influence of immediate paramedical/medical assistance on clinical outcome. *J Invasive Cardiol.* 2006;18(6):269–72.
14. Vereczki V, Martin E, Rosenthal RE, Hof PR, Hoffman GE, Fiskum G. Normoxic resuscitation after cardiac arrest protects against hippocampal oxidative stress, metabolic dysfunction, and neuronal death. *J Cereb Blood Flow Metab.* 206;26(6):821-35.
15. Virkkunen I, Yli-Hankala A, Silfvast T. Induction of therapeutic hypothermia after cardiac arrest in prehospital patients using ice-cold Ringer's solution: a pilot study. *Resuscitation.* 2004;62(3):299–302.

SUPPORTING DOCUMENTS:

- None

ADDENDUM:

- None

COMMITTEE APPROVALS:

- None