

# N01: Peri-Arrest Management

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Reviewed:

## Introduction

The peri-arrest period is the time either before or immediately following a full cardiac arrest, when the patient's condition is unstable. Paramedics caring for a patient in the peri-arrest period (the so-called "crashing patient") have an opportunity to significantly improve outcomes in comparison to patients in cardiac arrest, provided they are able to recognize and respond to signs of imminent deterioration.

## Essentials

A significant body of research demonstrates that many patients exhibit signs of clinical deterioration before experiencing cardiac arrest. The following features indicate that a patient is at high risk of being peri-arrest:

- Shock/hypotension (systolic blood pressure <90 mm Hg), pallor, sweating, cold clammy extremities, confusion or impaired consciousness, poor oxygenation
- Syncope: transient loss of consciousness due to global reduction in blood flow to the brain
- Myocardial ischemia: typical ischemic chest pain and/or evidence of myocardial ischemia on 12-lead ECG.
- Heart failure: pulmonary edema and/or raised jugular venous pressure
- Cardiac arrhythmias (relatively common in the peri-arrest period)

## Additional Treatment Information

The specific clinical findings will dictate the need for appropriate immediate treatment in the peri-arrest period. Depending on the nature of any underlying arrhythmia and clinical status of the patient, in particular the presence or absence of adverse features, immediate treatment options for patients in the peri-arrest period can be divided into four categories:

1. No treatment needed
2. Simple clinical interventions (e.g., Vagal maneuvers)
3. Pharmacological therapies
4. Electrical therapies (e.g., cardioversion or pacing)

Most drugs act slowly, and less reliably, than electrical treatments, so defibrillation or cardioversion is generally preferred for unstable patients with adverse features. Once treated, paramedics must continue to assess and monitor the patient to detect any additional abnormalities that may require treatment.

ACPs and above may consider the use of prophylactic antiarrhythmics following the successful termination of ventricular fibrillation or ventricular tachycardia. Although there are no studies that demonstrate improvement in long-term survival, the continued use of antiarrhythmic agents (particularly in cases where one was used to terminal a lethal arrhythmia) may be beneficial in maintaining a stable, perfusing rhythm and is supported by current American Heart Association Emergency Cardiovascular Care guidelines.

## General Information

Non-technical skills such as leadership, teamwork, communication and situational awareness enables a more effective response to the deteriorating patient and are critical to ensuring an appropriate response to patients in the peri-arrest period.

If the patient is palliative or otherwise at the end of their life, treat in accordance with relevant clinical practice guidelines.

## Interventions

**First Responder**

- Position patient supine, if appropriate. Warning: do not ambulate the patient.
- Supplemental oxygen as required
  - → [A07: Oxygen and Drug Administration](#)
- Position defibrillator electrodes in anticipation of cardiac arrest

**Emergency Medical Responder – All FR interventions, plus:**

- Use vital signs and patient observations to recognize deterioration, and to guide decision-making
- Supplemental oxygen as required to maintain  $\text{SpO}_2 \geq 94\%$ 
  - → [A07: Oxygen and Drug Administration](#)
- Initiate transport to nearest emergency department, with notification
- Consider ACP intercept but do not wait for ACPs to arrive

**Primary Care Paramedic – All FR and EMR interventions, plus:**

- Treat presenting symptoms per relevant BCEHS Clinical Practice Guidelines

**Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:**

- Treat presenting symptoms per relevant BCEHS Clinical Practice Guidelines

**References**

1. Massey D, et al. What factors influence ward nurses' recognition of and response to patient deterioration? An integrative review of the literature. 2017. [\[Link\]](#)
2. Panchal AR, et al. 2018 American Heart Association focused update on advanced cardiovascular life support use of antiarrhythmic drugs during and immediately after cardiac arrest: An update to the american heart association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. 2018. [\[Link\]](#)

## N02: Adult Cardiac Arrest

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### Introduction

Sudden cardiac arrest (SCA) and sudden cardiac death (SCD) refer to the sudden cessation of cardiac activity and subsequent hemodynamic collapse. Victims of SCA manifest one of four electrical rhythms: ventricular fibrillation (VF), pulseless ventricular tachycardia (pVT), pulseless electrical activity (PEA), and asystole.

Ventricular fibrillation represents a disorganized electrical activity in the ventricles. Pulseless ventricular tachycardia is an organized electrical activity of the ventricles; neither VF nor pVT have any meaningful cardiac output. Pulseless electrical activity, as a term, encompasses a heterogeneous group of organized electrical rhythms that are associated with either an absence of mechanical activity, or mechanical activity that is insufficient to generate a detectable pulse. Asystole (more specifically ventricular asystole) represents the absence of detectable ventricular electrical activity, with or without atrial electrical activity.

Survival from these rhythms requires both effective basic life support (BLS), and a system of advanced cardiovascular life support (ACLS) with integrated post-cardiac arrest care. An understanding of the importance of diagnosing and treating underlying causes is fundamental to the management of all cardiac arrest rhythms. During a cardiac arrest, paramedics should apply a systematic approach in searching for any factors that may have caused the arrest, or that may be complicating resuscitation efforts.

### Essentials

- High Quality Continuous CPR
- Early Rhythm Analysis & Defibrillation if indicated
- Appropriate Airway Management
- Reversible Cause Recognition & Correction
  - Hypovolemia
  - Hypoxia
  - Hydrogen ion (acidosis)
  - Hypo-/Hyperkalemia
  - Hypothermia
  - Tension pneumothorax
  - Tamponade, cardiac
  - Toxins (anaphylaxis)
  - Thrombosis, pulmonary
  - Thrombosis, coronary

### Additional Treatment Information

- Once the absence of a pulse is established and chest compressions are started, subsequent pulse checks must only be done during periods of analysis, or if signs of spontaneous circulation are observed, such as coughing, movement, or normal breathing.
- Where clear signs of prolonged cardiac arrest are present, or where paramedics consider continued resuscitation futile, **CPG N05** should be consulted for additional guidance.

### Referral Information

All patients in the cardiac arrest period should be treated in place with a consideration for immediate transport when reasonable.

## General Information

- Available evidence suggests that several therapies or interventions, which have historically been used in resuscitation, should no longer be used routinely:
  - Atropine during PEA
  - Sodium bicarbonate
  - Calcium
  - Magnesium
  - Vasopressin (offers no advantage over epinephrine)
  - Fibrinolysis
  - Electrical pacing
  - Cricoid pressure
  - Precordial thump (associated with a delay in starting CPR and defibrillation)
  - Crystalloid infusion outside of specific reversible causes.
- A rhythm change to one of organized electrical activity on the monitor is not an indicator for paramedics to pause chest compressions and assess for a pulse. Changes in EtCO<sub>2</sub> or signs of life are better indicators of return of spontaneous circulation.
- During cardiac arrest, the provision of high quality CPR and rapid defibrillation are the primary goals. Drug administration is a secondary consideration.
  - After beginning CPR and attempting defibrillation as required, paramedics can attempt to establish vascular access, either intravenously or intraosseously. This should be performed without interrupting chest compressions.
  - The primary purpose of IV/IO access during cardiac arrest is to provide drug therapy. It is reasonable for providers to establish IO access if IV access is not readily available.
  - If IV or IO access cannot be established, epinephrine, vasopressin, and lidocaine may be administered endotracheally during cardiac arrest.
  - Cardiac arrest resuscitations using tibial IO access appear to lead to worse outcomes when compared to IV access. Research to date demonstrates that drug delivery through IV and humeral IO sites are approximately the same with tibial being significantly worse. Definitive data does not yet exist though, so based on current information, we recommend the following practice.
    - A proximal IV is the preferred vascular access site for cardiac arrest resuscitation
    - For cases when an IV cannot be established, humeral IO is the next best option
    - Tibial IO should only be placed due to failure or delay in obtaining IV or humeral IO access
    - Consider external jugular cannulation where possible
  - Cardiac arrests related to opioid overdose are likely to be hypoxic in nature. Effective oxygenation, ventilation, and chest compressions are particularly critical for these patients. Naloxone is unlikely to be beneficial, and its use in cardiac arrest is not supported by current evidence.
  - Refer to [CPG N04](#) for additional details on post-cardiac arrest care

## Interventions

### First Responder

- CPR quality:
  - Rate (100-120/min), continuous compressions
  - Depth (at least 2 inches [5cm])
  - Ensure full chest recoil
  - Minimize interruptions in compressions
  - Relieve compressor every 2 minutes, or sooner if fatigued
  - [PR06: High Performance CPR](#)
- Defibrillation: Perform CPR while the defibrillator pads are being applied
  - Perform CPR while the defibrillator charges. As soon as energy is delivered, resume CPR for 2 minutes prior to reassessing rhythm

- Ventilation: Avoid excessive ventilation (10-12 breaths/minute or 1 breath every 6 seconds)
  - Administer high-flow O<sub>2</sub> to patients requiring CPR
  - Consider appropriate airway adjunct
  - → [A07: Oxygen and Medication Administration](#)
  - → [B01: Airway Management](#)
- Other: Contact CliniCall when possible to discuss treatment plan

#### Primary Care Paramedic – All FR and EMR interventions, plus:

- Consider placement of supraglottic airway when appropriate
  - → [PR08: Supraglottic Airway](#)
- Vascular access: Consider IV access, when appropriate
  - → [D03: Vascular Access](#)

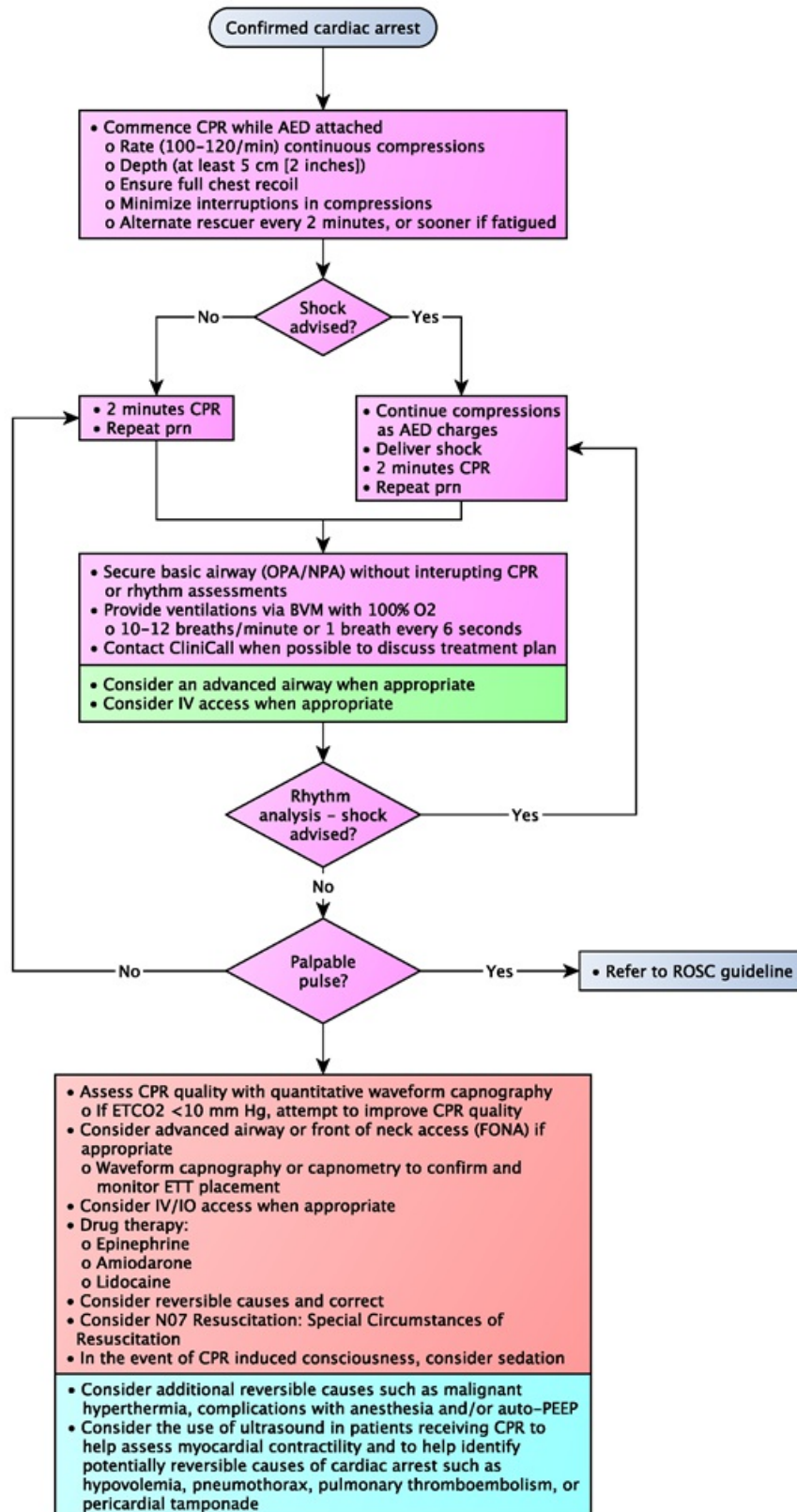
#### Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- CPR quality: Quantitative waveform capnography
  - If ETCO<sub>2</sub> <10 mm Hg, attempt to improve CPR quality
- Advanced airway: Consider advanced airway or front of neck access (FONA) if appropriate
  - Waveform capnography or capnometry to confirm and monitor ETT placement
- Vascular access: Consider IV/IO access, when appropriate
  - → [D03: Vascular Access](#)
  - → [PR12: Intraosseous Cannulation](#)
  - → [PR13: External Jugular Cannulation](#)
- Drug therapy:
  - [EPINEPHrine](#): administer EPINEPHrine early in cases of asystole or PEA; defer EPINEPHrine administration until after the first defibrillation in VF/pVT
  - [Amiodarone](#): administer amiodarone/lidocaine following the *second* defibrillation in VF/pVT
  - [Lidocaine](#)
- In the event of CPR induced consciousness, consider sedation
  - [MIDAZOLam](#)

#### Critical Care Paramedic – All FR, EMR, PCP, and ACP interventions, plus:

- Consider additional reversible causes such as malignant hyperthermia, complications with anesthesia and/or auto-PEEP
- Consider the use of ultrasound in patients receiving CPR to help assess myocardial contractility and to help identify potentially reversible causes of cardiac arrest such as hypovolemia, pneumothorax, pulmonary thromboembolism, or pericardial tamponade

## Algorithm



## Evidence Based Practice

[General Cardiac Arrest](#)

## References

American Heart Association. 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. 2015. [[Link](#)]

American Heart Association. 2020 American Heart Association Guidelines for CPR and ECC. 2020. [[Link](#)]

## N03: Return of Spontaneous Circulation

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### Introduction

Return of spontaneous circulation (ROSC) is the resumption of sustained perfusing cardiac activity following cardiac arrest. Regardless of the cause of the cardiac arrest, the hypoxemia, ischemia, and reperfusion that occur during cardiac arrest and resuscitation may damage multiple organ systems. The severity of this damage can vary widely among patients, and even among organ systems within individual patients.

Effective post-cardiac arrest care consists of identification and treatment of the precipitating cause of cardiac arrest, combined with the assessment and mitigation of ischemia and reperfusion injury to multiple organ systems.

In the prehospital environment, ROSC management is oriented towards maintaining appropriate oxygenation, ventilation, and hemodynamics, while attempting to identify the precipitating cause, and initiating rapid transport to hospital for further diagnostics and interventions.

### Essentials

- Target oxygenation and ventilation to SpO<sub>2</sub> of 94-99%, and EtCO<sub>2</sub> of 30-40mmHg
- Avoid hypotension. The target systolic blood pressure is > 100 mmHg (or a mean arterial pressure > 65 mmHg). Limit fluid bolus to a maximum of 20 mL/kg unless treating suspected hypovolemia.
- Allow approximately ten minutes of perfusion before attempting to acquire a 12-lead ECG
- Elevate the head of cot to 30° where possible
- Allow passive cooling via minimal blankets and using room temperature saline when fluid bolus is required. Do not allow passive cooling in cases of traumatic cardiac arrest.
- Manage dysrhythmias in accordance with the appropriate CPG
- Consult the [Post Arrest Checklist](#) for additional guidance
- Consider the etiology of the cardiac arrest, and treat according to appropriate CPG

### Additional Treatment Information

- Manage the airway in a staged approach based upon license level
  - If the patient is able to maintain adequate oxygenation and is ventilating effectively, provide supplemental oxygen only. Titrate oxygen flow rates to the minimum required to maintain SpO<sub>2</sub> ≥ 94%. If pulse oximetry is unreliable because of peripheral perfusion deficits, use the highest available oxygen concentration.
  - Patients who remain comatose following a return of spontaneous circulation may have an advanced airway (either a supraglottic device or an endotracheal tube) placed. Maintain EtCO<sub>2</sub> between 30 and 40 mmHg. Monitor the patient for changes in level of consciousness, and consider the need for sedation or removal of the airway device should a gag reflex return.
- Hypotension may be managed with normal saline boluses up to 20 mL/kg as required. Large volumes of saline are associated with poor outcomes; paramedics should aim to maintain a systolic blood pressure of 100 mmHg (or a mean arterial pressure of 65 mmHg).
- EPINEPHrine is the preferred vasopressor in post arrest care
- The initial post-arrest phase can have bizarre and atypical cardiac rhythms. Treat sustained dysrhythmias in accordance with the appropriate guidelines. Allow at least ten minutes following the return of spontaneous circulation for the rhythm to stabilize prior to acquiring a 12-lead ECG.
- Except in cases of traumatic cardiac arrest, allow for passive cooling
- Elevating head of bed to 30° promotes cerebral drainage and reduces the incidence of cerebral edema and aspiration
- Check blood sugar and treat hypoglycemia accordingly

### Referral Information



Patients who have been resuscitated from cardiac arrest and who have an identified STEMI on 12-lead ECG, or who have a suspected cardiac cause of their arrest, should be transported to the closest PCI center. If there is no PCI center within a reasonable transport time the closest hospital must be selected.

Post arrest patients with suspected non-cardiac causes should be transported to the closest hospital.

## General Information

- In patients who achieve ROSC after out of hospital cardiac arrest, subsequent morbidity and mortality are due largely to the cerebral and cardiac dysfunction that accompanies prolonged whole-body ischemia. This syndrome, called the post cardiac arrest syndrome, comprises anoxic brain injury, post cardiac arrest myocardial dysfunction, systemic ischemia/reperfusion response, and persistent precipitating pathology.
- In hospital treatment for post cardiac arrest syndrome will vary depending on the length of the cardiac arrest, the cause of the arrest and the pre-existing co-morbidities of the patient.
- In series in which consecutive post-cardiac arrest patients with suspected cardiovascular cause were taken to coronary angiography, a coronary artery lesion amenable to emergency treatment was found in 96% of patients with ST elevation and in 58% of patients without ST elevation.
- Although targeted temperature management has been shown to be beneficial in post arrest care in hospital, there is no evidence to suggest that active prehospital cooling has a positive effect on either survival or neurological recovery. Evidence does demonstrate that large infusions of cool normal saline can adversely affect outcomes.
- Hypothermia below 35°C has a negative effect on the clotting cascade and therefore should be avoided in ROSC following a traumatic cardiac arrest.
- The clamshell can be an excellent tool in extricating the non-traumatic post arrest patient. Once the patient has been extricated to the stretcher, the clamshell should be removed to allow 30° head up positioning.

## Interventions

### First Responder

- OPA/BVM/O<sub>2</sub> as required
  - → [A07: Oxygen and Medication Administration](#)

### Emergency Medical Responder – All FR interventions, plus:

- Oxygenation and ventilation
  - OPA/BVM/O<sub>2</sub> as required to maintain SpO<sub>2</sub> ≥94%
    - → [A07: Oxygen and Medication Administration](#)
    - → [B01: Airway Management](#)
- Head up 30° on cot
- Passive cooling
- Rapid transport
- Refer to [Post Arrest Checklist](#)

### Primary Care Paramedic – All FR and EMR interventions, plus:

- Oxygenation and ventilation
  - Consider Supraglottic Airway (SGA)
    - → [PR08: Supraglottic Airway](#)
- Hypotension
  - Establish IV access and give fluid bolus
    - → [D03: Vascular Access](#)
- Refer to [Post Arrest Checklist](#)

### Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- Oxygenation and ventilation
  - Consider intubation early if not already done

- Target SpO<sub>2</sub> to 92%-98%
- End tidal CO<sub>2</sub> monitoring (EtCO<sub>2</sub>): 35-45 mmHg
- Hypotension
  - Push dose [EPINEPHrine](#)
    - Target systolic blood pressure > 90 mmHg
    - Target mean arterial pressure > 65 mmHg
    - Refer to push dose vasopressor guideline
- Dysrhythmia
  - Treat as per appropriate CPG
- Perform 12-Lead ECG (minimum 10 minutes post-ROSC)
  - → [PR16: 12-Lead ECG](#)
- Refer to [Post Arrest Checklist](#)

## Evidence Based Practice

[Post-Cardiac Arrest Care](#)

## References

1. Ambulance Victoria. Clinical Practice Guidelines: Ambulance and MICA Paramedics. 2018. [[Link](#)]
2. Callaway CW, et al. Part 8: Post-cardiac arrest care: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. 2015. [[Link](#)]
3. Stub D et al. Post cardiac arrest syndrome: A review of therapeutic strategies. 2011. [[Link](#)]

## N04: Traumatic Cardiac Arrest

Adam Greene and Scott Haig

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### Introduction

A traumatic cardiac arrest is a cardiac arrest that occurs secondary to either blunt or penetrating trauma. The most common cause of traumatic cardiac arrest is hemorrhage; other causes include tension pneumothorax, cardiac tamponade, and hypoxemia. Although traumatic cardiac arrest has a high mortality rate, the neurological outcomes are better in those who survive compared to other causes of cardiac arrest; patients who have some signs of life upon the arrival of paramedics, or who initially present in pulseless electrical activity, and who subsequently achieve a return of spontaneous circulation have the greatest probability of survival to hospital discharge.

Successful resuscitation requires simultaneous attention to assessment, airway management, and control of hemorrhage.

### Essentials

- Consider underlying medical causes of the cardiac arrest
- Prioritize treatment of reversible causes over chest compressions, and in order of clinical need
- Simultaneously attempt to identify and treat
  - Hypovolemia
  - Hypoxemia
  - Tension pneumothorax
- Consider special circumstances
- Consult with CliniCall to discuss treatment plan or early transport options
- Consider discontinuing resuscitation efforts if interventions do not result in a return of spontaneous circulation

### Additional Treatment Information

- Interventions in traumatic cardiac arrests should be prioritized based on clinical relevance. Paramedics should focus initially on controlling major hemorrhage through the appropriate use of direct pressure, tourniquets, and wound packing.
- Advanced airway management should not delay transport in urban areas, where the traumatic arrest is the result of penetrating chest trauma, the presenting rhythm is PEA, and the time from loss of pulses to a trauma center is less than 15 minutes (20 minutes in the Vancouver Coastal-Urban region).
- Bilateral needle thoracentesis (or finger thoracostomy) should be performed on all traumatic arrests with blunt or penetrating chest trauma. The preferred site for needle thoracentesis is the 5<sup>th</sup> intercostal space in the mid-axillary line. An alternative site is the 2<sup>nd</sup> intercostal space on the mid-clavicular line, although this requires catheters longer than 5 cm.
- Obtain large-bore intravenous (or intraosseous) access and administer a bolus of 20 mL/kg.
- In blunt force cardiac arrest, a pelvic binder may be applied after addressing other reversible causes. If a pelvic fracture is suspected of being a significant contributing factor, the binder should be placed earlier.

### General Information

- The primary etiologies targeted by prehospital treatments include hypoxia, obstructive shock (specifically tension pneumothorax) and hypovolemia.
- Patients frequently present in an organized electrical rhythm on the monitor with no palpable pulses. It has been shown that in these situations there is often a low perfusion state due to hypovolemia or vascular and cardiac obstruction preventing adequate perfusion. Management of major hemorrhage, volume replacement with large NS bolus or bilateral chest decompression may result in ROSC.
- Traumatic cardiac arrests with an initial rhythm of asystole, or wide complex PEA of less than 40 beats per minute

are generally associated with poor survival. It is reasonable to consider early discontinuation of resuscitation if there is no response to treatment.

## Interventions

### First Responder

- Simultaneous on-scene correction of reversible causes:
  - Hypovolemia: control external hemorrhage, splint pelvis/fractures
  - Oxygenation: consider appropriate airway adjunct. Maximize oxygenation
    - → [A07: Oxygen and Drug Administration](#)
- High quality CPR when practical:
  - → [PR06: High Performance CPR](#)
  - Rate (100-120/min) Continuous Compressions
  - Depth: At least 2 inches [5cm]
  - Ensure full chest recoil
  - Minimize interruptions in compressions
  - Relieve compressor every 2 minutes, or sooner if fatigued

### Emergency Medical Responder – All FR interventions, plus:

- Consider primary medical cause – see [CPG N02: Adult Cardiac Arrest](#)
- Prioritize treatment of reversible causes over chest compressions based on clinical need
- Consider recognition of life extinct – see [CPG R03](#)

### Primary Care Paramedic – All FR and EMR interventions, plus:

- Simultaneous on-scene correction of reversible causes:
  - Hypovolemia
    - Establish vascular access, consider 20 mL/kg fluid bolus
  - Oxygenation
    - Consider supraglottic device

### Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- Simultaneous on-scene correction of reversible causes:
  - Oxygenation
    - Consider supraglottic device, endotracheal intubation, or surgical airway
  - Tension pneumothorax
    - [Bilateral needle or finger thoracostomy](#)

### Critical Care Paramedic – All FR, EMR, PCP, and ACP interventions, plus:

- Simultaneous on-scene correction of reversible causes:
  - Hypovolemia
    - Consider blood product resuscitation
    - Consider resuscitative balloon for occlusion of the aorta
  - Tension pneumothorax
    - [Bilateral needle, finger, or tube thoracostomy.](#)
  - Pericardial tamponade
    - Pericardiocentesis

## Evidence Based Practice

[Traumatic Arrest](#)

## References

1. Ambulance Victoria. Clinical Practice Guidelines: Ambulance and MICA Paramedics. 2018. [[Link](#)]
2. American College of Surgeons. Advanced Trauma Life Support Student Course Manual. 10th Edition. 2018. [[Link](#)]
3. Sinz E, et al. ACLS for Experienced Providers: Manual and Resource Text. 2015.

