N02: Adult Cardiac Arrest

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Updated: June 24, 2024
Reviewed: May 01, 2024

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 and EMRs/FRs 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 chest compressions:
  - Paramedics, emergency medical responders, and first responders should use a ratio of 30:2 for compressions and ventilations when ventilating with a pharyngeal airway and bag-valve mask only
  - Continuous compressions may be used when an advanced airway is in place (i.e., supraglottic airway or endotracheal tube)
- Early rhythm analysis & defibrillation if indicated
- Appropriate airway management
- Recognition & correction of reversible causes:
  - Hypovolemia
  - Hypoxia
  - Hydrogen ion (acidosis)
  - Hypo/Hyperkalemia
  - Hypothermia (→ I01: Hypothermia)
  - Tension pneumothorax
  - Tamponade, cardiac
  - Toxins (including 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, R02: Discontinuing Resuscitation 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 conveyance 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 $EtCO_2$ or signs of life are better indicators of a 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
  - For vascular access in cardiac arrest:
    - A proximal IV is the preferred vascular access site for cardiac arrest resuscitation
    - Tibial IO is the only available site for PCP placement
    - ACP 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.
  - Special consideration must be given to hypothermic patients without a pulse. As hypothermia progresses, the patient's respiratory and heart rate slow significantly. For this reason, breathing and pulse checks must be sufficiently long (60 seconds) to register very slow rates.
    - "Circum-rescue collapse" is a term that describes a death that occurs shortly before, during, or soon after rescue from exposure to a cold environment, usually cold water immersion. It often presents as an apparently stable, conscious patient who suffers ventricular fibrillation and cardiac arrest shortly thereafter.
    - A patient with a core body temperature below 30°C will most likely develop arrhythmias with progression to ventricular fibrillation.
    - Medications are more slowly metabolized in hypothermic patients; limit vasopressors to a maximum of 3 doses; refer to → I01: Hypothermia for additional information
  - Refer to N03: Return of Spontaneous Circulation for additional details on post-cardiac arrest care.

Interventions

First Responder

- Initiate high quality CPR:
  - Rate (100-120/min), **30:2 compression:ventilation ratio**
  - Depth: at least 5 cm (2 inches)
  - 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
  - Administer high-flow O_2 to patients requiring CPR
  - Consider appropriate airway adjunct
  - → A07: Oxygen Administration
  - → B01: Airway Management

Emergency Medical Responder – All FR interventions, plus:

- CliniCall consultation required, when possible, to discuss treatment plan.
- See also → R02: Discontinuing Resuscitation for additional information on resuscitation decision-making

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

- Consider placement of supraglottic airway when appropriate
  - → PR08: Supraglottic Airway
  - If required, the airway should be managed using an iGel with a viral filter pre-connected before insertion or 2 person bag-valve mask ventilation using a viral filter and a tight mask seal
  - Primary Care Paramedics are now permitted to use a modified approach to the in-built suction port available on all iGel supraglottic devices to provide pharyngeal suction during cardiac arrest
  - Where possible, do not interrupt chest compressions to enable placement of a supraglottic airway
  - With supraglottic airway in place, switch to continuous chest compressions where practical (ventilate every 6 seconds)
- Vascular access: Consider IV or IO access when appropriate
  - → D03: Vascular Access
  - → PR12: Intraosseous Cannulation

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

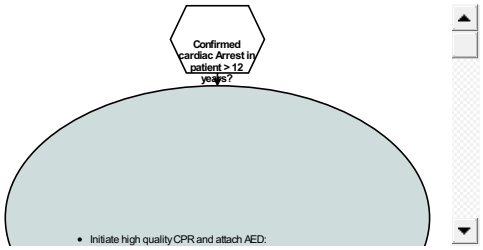
- CPR quality: Quantitative waveform capnography
  - If $ETCO_2$ < 10 mmHg, attempt to improve CPR quality
- Advanced airway: Consider advanced airway or front of neck access (FONA) if appropriate
  - Where possible, do not interrupt chest compressions to enable placement of a supraglottic airway
  - Waveform capnography or capnometry to confirm and monitor ETT placement
  - With endotracheal tube or supraglottic airway in place, switch to continuous chest compressions where practical (ventilate every 6 seconds)
- 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 Care

Supportive

- ACDC
- ACLS
- BCLS
- Bystander CCC
- Dispatch assisted CCC
- EMS provided CCC
- ETCO2 to determine ROSC
- Impedance Threshold Device
- ITD and ACDC
- NaHCO3-after long arrest
- Standard CPR
- Bystander CPR
- Continuous Oxymetry Monitoring
- Critical care life support
- Early epinephrine
- ETCO2 evaluation of ventilation
- ETCO2 for compression evaluation
- Family Involvement in Resuscitation
- Passive Oxygen Administration
- POCUS
- Redirect to ECMO facility

- Team based resuscitation
- Termination Resuscitation ALS
- Termination Resuscitation BLS
- Fluid Resuscitation

Neutral

- Chest Compression devices
- Compressions directly after Defib
- CPR feedback device
- Epinephrine
- Fibrinolysis
- High Dose Epi.
- Hypertonic Saline
- Intra-Arrest Cooling
- NaHCO3
- PAI-CPR/Defib
- Vasopressin
- ECG
- Precordial Thump
- Transport to an ECMO capable facility
- IV access
- Mechanical Intraosseous Insertion
- Prehospital Lactate

Against

- ETT Drug Admin.
- Manual Intraosseous Insertion

References

1. American Heart Association. 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. 2015. [Link]
2. American Heart Association. 2020 American Heart Association guidelines for CPR and ECC. 2020. [Link]

Practice Updates

- 2023-12-19: removed COVID-related restrictions; reintroduced continuous chest compressions