ADVANCED FIRST AID AND MODERN EMERGENCY RESPONSE IN CARDIAC ARREST

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Abstract. *Sudden cardiac arrest (SCA) is one of the leading global causes of death, responsible for more than 350,000 deaths annually in the United States alone. It is defined as the abrupt loss of heart function, often resulting from arrhythmias such as ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT). Immediate initiation of high-quality cardiopulmonary resuscitation (CPR) and rapid defibrillation significantly increases the chance of survival. This article reviews the latest international guidelines, evidence-based practices, and technological advancements in first aid and early emergency response to cardiac arrest.*

Keywords: *Sudden cardiac arrest, cerebral hypoxia, Hypoxia, Hypovolemia, Hypo-/Hyperkalemia, Hypothermia, Hydrogen ion (acidosis).*

Introduction

Sudden cardiac arrest (SCA) is an unexpected event that occurs when the heart suddenly stops pumping blood due to electrical malfunction. It is distinct from myocardial infarction, though a heart attack may lead to SCA. Without immediate intervention, permanent brain damage begins within 4–6 minutes, and death can occur shortly thereafter.

Global Burden

• Worldwide survival from out-of-hospital cardiac arrest (OHCA) remains low, averaging 8–10%.

• Survival increases to 30–50% with bystander CPR and early defibrillation.

Pathophysiology of Cardiac Arrest

• Electrical dysfunction → abnormal rhythm (VF, VT, asystole, or PEA)

• Mechanical failure → absence of cardiac output

• Cerebral hypoxia → neuronal death begins within 4–6 minutes

Most common arrhythmias:

• Ventricular fibrillation (VF)

• Pulseless ventricular tachycardia (pVT)

• Asystole

• Pulseless electrical activity (PEA)

Etiology (H's and T's)

A modern approach to identifying reversible causes involves the "H's and T's" mnemonic:

H's: • Hypoxia • Hypovolemia • Hypo-/Hyperkalemia • Hypothermia • Hydrogen ion (acidosis)

T's: • Tension pneumothorax • Tamponade (cardiac) • Toxins • Thrombosis (pulmonary or coronary) • Trauma

International Guidelines and Modern Protocols

2020 American Heart Association (AHA) and

2021 European Resuscitation Council (ERC) Guidelines:

• Early recognition and activation of emergency services

• High-quality CPR: rate 100–120 bpm, depth 5–6 cm

• Minimal interruption in compressions

• Use of AED as soon as available

• Emphasis on post-resuscitation care (e.g., targeted temperature management)

Basic Life Support (BLS) – Modernized Approach

Step 1: Scene Safety

• Ensure safety of both rescuer and patient.

• Use PPE if available (especially post-COVID protocols).

Step 2: Assess responsiveness and breathing

• Tap, shout, and check for normal breathing (not gasping).

• Do not spend more than 10 seconds on pulse check (if trained).

Step 3: Call Emergency Services & Retrieve AED

• Instruct bystanders to call and locate an AED.

High-Quality CPR: What's New?

Component Guideline Evidence

Rate 100–120 compressions/min Improves ROSC and survival

Depth 5–6 cm (2–2.4 inches) Avoids under/over-compression

Hands-only CPR Acceptable for untrained rescuers Increases bystander response

Compression-to-Ventilation Ratio 30:2 (if trained) Standard for adults

Allow full recoil Prevents reduction in coronary perfusion pressure Critical for effectiveness

Use of Automated External Defibrillator (AED)

AED Use Steps:

1. Turn on and follow voice prompts.
2. Apply electrode pads.
3. Stand clear — let AED analyze.
4. Deliver shock if advised, then resume CPR immediately.

Modern Insight:

• Public access to AEDs (airports, malls, schools) improves survival from VF by up to 60–70%.

• AEDs are now fully automated, reducing error by lay responders.

Special Populations

Children and Infants:

• Compression depth: ~1/3 chest depth (~4 cm for infants)

• Use rescue breaths (more likely respiratory arrest before cardiac)

• Ratio: 30:2 for single rescuer, 15:2 for two rescuers

Suspected Opioid Overdose:

• Initiate CPR and administer naloxone (Narcan®) if available.

Drowning Victims:

• Begin with 2 rescue breaths, then compressions.

Post-Resuscitation Care (Advanced Life Support Phase)

Modern systems incorporate Targeted Temperature Management (TTM) and coronary angiography for post-arrest patients with ROSC.

Post-ROSC Goals:

• Maintain $SpO_2 > 94\%$

• Monitor for hemodynamic stability

• Initiate TTM (32–36°C for 24 hours)

• Avoid hyperoxia and hypotension

• ICU-level care with possible ECMO

Public Health Initiatives & Future Directions

Stop the Bleed™ and CPR Training for All

• WHO and AHA support mass training for laypersons.

Drone-delivered AEDs

• Being piloted in rural Europe and Canada for faster AED access.

Mobile App Alerts (e.g., PulsePoint)

• Alerts trained responders in proximity to cardiac arrest victims.

Conclusion

Sudden cardiac arrest remains a major global health challenge, claiming hundreds of thousands of lives each year. Prompt recognition, immediate initiation of high-quality CPR, and rapid defibrillation are critical interventions that can dramatically improve survival outcomes.

Ongoing advances in evidence-based guidelines, first aid training, and life-saving technologies continue to strengthen early emergency response systems, offering hope for reducing the devastating impact of sudden cardiac arrest worldwide.

Early recognition, immediate CPR, and rapid defibrillation remain the cornerstones of cardiac arrest survival. Modern strategies involve:

• Hands-only CPR
• Public AED use
• Technological integration (apps, drones)
• Post-arrest critical care

Wider CPR training and the expansion of community-based response systems can dramatically reduce global mortality from cardiac arrest.

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