Réanimation cardio-pulmonaire de l’adulte

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Resuscitation Guidelines

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# Epidemiology

- Cardiac arrest (out-of-hospital)
  - 0.38/1000
  - 0.17/1000 ventricular fibrillation
  - 10.7 % survivors
  - X2 if ventricular fibrillation


- 25-50% VF


- 76 % VF

The chain of survival
Early recognition and call for help

- Before victim collapses
- To arrive sooner

- Early recognition
- Unresponsiveness
- Not breathing normally
Early bystander CPR

- Immediate initiation of CPR can double or quadruple survival after cardiac arrest

Early defibrillation

- 3 – 5 min of collapse
- 50 – 70% survival rates

- AEDs
- Public access
Early advanced life support and standardised post-resuscitation care

- Airway management
- Drugs
- Correcting causal factors
Critical need for bystanders to act

• Median time to medical service arrival is 5 – 8 min

• 8 – 11 min for the firsts shock

• Victim’s survival depend bystander and use an AED
Adult BLS sequence
Trained provider

- Unresponsive and not breathing normally
  - Call Emergency Services
  - Give 30 chest compressions
  - Give 2 rescue breaths
  - Continue CPR 30:2
  - As soon as AED arrives - switch it on and follow instructions
SAFETY
Make sure you, the victim and any bystanders are safe.

RESPONSE
Check the victim for a response.
Gently shake his shoulders and ask loudly: “Are you all right?”
If he responds leave him in the position in which you find him, provided there is no further danger; try to find out what is wrong with him and get help if needed; reassess him.

BREATHING
Look, listen and feel for normal breathing.
In the first few minutes after cardiac arrest, a victim may be barely breathing, or taking infrequent, slow and noisy gasps.
Do not confuse this with normal breathing. Look, listen and feel for no more than 10 seconds to determine whether the victim is breathing normally.
If you have any doubt whether breathing is normal, act as if it is they are not breathing normally and prepare to start CPR.
<table>
<thead>
<tr>
<th><strong>UNRESPONSIVE AND NOT BREATHING NORMALLY</strong></th>
<th></th>
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<tbody>
<tr>
<td>Alert emergency services</td>
<td>Activate speaker function on phone to aid communication with dispatcher</td>
</tr>
<tr>
<td>Ask a helper to call the emergency services (112) if possible otherwise call them yourself</td>
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<tr>
<td>Stay with the victim when making the call if possible</td>
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**SEND FOR AED**

| Send someone to get AED | Send someone to find and bring an AED if available. If you are on your own, do not leave the victim, start CPR |

**CIRCULATION**

<table>
<thead>
<tr>
<th>Kneel by the side of the victim</th>
<th>Place the heel of one hand in the centre of the victim's chest</th>
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<tbody>
<tr>
<td>Place the heel of your other hand on top of the first hand</td>
<td>Interlock the fingers of your hands and ensure that pressure is not applied over the victim's ribs</td>
</tr>
<tr>
<td>Keep your arms straight</td>
<td>Do not apply any pressure over the upper abdomen or the bottom end of the bony sternum (breastbone)</td>
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</table>
Position yourself vertically above the victim's chest and press down on the sternum at least 5 cm but not more than 6 cm.

**IF TRAINED AND ABLE**

**Combine chest compressions with rescue breaths**

After 30 compressions open the airway again using head tilt and chin lift.

Pinch the soft part of the nose closed, using the index finger and thumb of your hand on the forehead. Allow the mouth to open, but maintain chin lift.

**IF UNTRAINED OR UNABLE TO DO RESCUE BREATHS**

Give chest compressions only CPR (continuous compressions at a rate of 100-120 min⁻¹).

Take another normal breath and blow into the victim's mouth once more to achieve a total of two effective rescue breaths. Do not interrupt compressions by more than 10 seconds to deliver two breaths. Then return your hands without delay to the correct position on the sternum and give a further 30 chest compressions.
<table>
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<th>WHEN AED ARRIVES</th>
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| Switch on the AED and attach the electrode pads | As soon as the AED arrives: Switch on the AED and attach the electrode pads on the victim’s bare chest  
| (image) | If more than one rescuer is present, CPR should be continued while electrode pads are being attached to the chest  
| Follow the |  
| If no shock is indicated, continue CPR | Immediately resume CPR. Continue as directed by the voice/visual prompts  
| (image) |  
| deliver shock | Push shock button as directed (fully automatic AEDs will deliver the shock automatically)  
| (image) | Immediately restart CPR 30:2  
| Continue as directed by the voice / visual prompts | (image) |
IF NO AED IS AVAILABLE CONTINUE CPR

Continue CPR

Do not interrupt resuscitation until:
- a health professional tells you to stop
- the victim is definitely waking “up”, moving, opening eyes and breathing normally
- you become exhausted

IF UNRESPONSIVE BUT BREATHING NORMALLY

If you are certain the victim is breathing normally but is still unresponsive, place in the recovery position (see First aid chapter).

It is rare for CPR alone to restart the heart. Unless you are certain the person has recovered continue CPR

Signs the victim has recovered
- waking up
- moving
- opens eyes
- normal breathing

Be prepared to restart CPR immediately if patient deteriorates
Chest Compressions

• Priority chest compressions Vs ventilation

• « In the centre of the chest »

• Compress to a depth of at least 5 cm but not more than 6 cm

• Rate of 100 - 120 min / Few interruptions

• Allow the chest to recoil completely after each compression
Hand Positions

• Better haemodynamic responses => lower half of the sternum

• Simplified way: “place the heel of your hand in the centre of the chest with the other hand on top”

• Side of the victim

• Over-the-head when it is not possible on the side
Compression depth

• Better: 4.5 – 5.5 cm


• High survival rest: 46 mm


• Chest compression depth of approximately 5 cm but not more than 6 cm
Compression rate

• Two studies found higher survival among patients who received chest compressions at a rate of 100–120min⁻¹


• More faster = declining chest compression
Minimising pauses

- Pre and post-shock pause < 10 sec
- Chest compressions fractions > 60 %

=> Improved outcomes
• Firm surface

• Use of backboards is equivocal

• Chest wall recoil
  • Better venous return in chest
  • Improve the effectiveness of CPR
Rescue breaths

- 500 – 600 mL

- Maximum 1 seconde

- Two breaths should not exceed 10 s
Compression – Ventilation ratio

30 : 2
Compression only CPR

• Equivalence of chest-compression-only CPR and chest compressions combined with rescue breaths in adults?
  • Very-low quality evidence
  • Cardiac arrest

• If possible CRP and rescue breaths

• Children and asphixial cardiac arrest ++
Use of an automated external defibrillator

• AEDs are safe and effective

• Defibrillate before professional help

• Minimal interruption of chest compression

• Following the voice

• Children older than 8 years
  • Paediatrics pads
  • Paediatric mode
Interval between rhythm checks

• Pause chest compressions every 2min to assess the cardiac rhythm.
Adult advanced life support
In-hospital Resuscitation

Collapsed / sick patient

Shout for HELP & assess patient

Signs of life?

Call resuscitation team

CPR 30:2 with oxygen and airway adjuncts

Apply pads/monitor
Attempt defibrillation if appropriate

Advanced Life Support when resuscitation team arrives
The unresponsive patient

• Depend on the training of staff
  • Breath
  • Pulse

  *Moule P. Checking the carotid pulse: diagnostic accuracy in students of the healthcare professions. Resuscitation 2000;44:195–201*

• Agonal breathing


• Cardiac arrest can cause an initial short seizure-like episode that can be confused with epilepsy

The unresponsive patient

- Shout for help

- Open airway / check breathing

- Look, listen and feel < 10 s

- Signs of a circulation
  - If doubt : start CPR
ALS

• All cardiac arrests

• Additional interventions may be indicated for cardiac arrest caused by special circumstances

• Improved survival
  • BLS
  • Early defibrillation

• Use of adrenaline don’t improve survival

• The use of advanced airway interventions during ALS remains limited
Unresponsive and not breathing normally?

- Call Resuscitation Team

CPR 30:2
Attach defibrillator/monitor
Minimise interruptions

Assess rhythm

Shockable (VF/Pulseless VT)
- 1 Shock
Minimise interruptions
- Return of spontaneous circulation

Non-shockable (PEA/Asystole)
Assess rhythm

**Shockable (VF/Pulseless VT)**
- 1 Shock
- Minimise interruptions
- Immediately resume CPR for 2 min
- Minimise interruptions

**Non-shockable (PEA/Asystole)**
- Return of spontaneous circulation

**IMMEDIATE POST CARDIAC ARREST TREATMENT**
- Use ABCDE approach
- Aim for $\text{SaO}_2$ of 94-98%
- Aim for normal $\text{PaCO}_2$
- 12 Lead ECG
- Treat precipitating cause
- Targeted temperature management

Immediately resume CPR for 2 min
Minimise interruptions
**DURING CPR**
- Ensure high quality chest compressions
- Minimise interruptions to compressions
- Give oxygen
- Use waveform capnography
- Continuous compressions when advanced airway in place
- Vascular access (intravenous or intraosseous)
- Give adrenaline every 3-5 min
- Give amiodarone after 3 shocks

**TREAT REVERSIBLE CAUSES**
- Hypoxia
- Thrombosis – coronary or pulmonary
- Hypovolaemia
- Tension pneumothorax
- Hypo-/hyperkalaemia/metabolic
- Tamponade – cardiac
- Hypothermia/hyperthermia
- Toxins

**CONSIDER**
- Ultrasound imaging
- Mechanical chest compressions to facilitate transfer/treatment
- Coronary angiography and percutaneous coronary intervention
- Extracorporeal CPR
Shockable rhythms

• Biphasic waveforms : 150 J

• Minimise pre and post-shock pauses ( < 10 s)

• 2 min CPR after shock and after assess rhythm

• Adrenaline every 3-5 min (after 3 shock)

• Amiodaron after 3 shock ( 300 mg) and 5 ( 150 mg)
Shockable Rhythme

• Waveform capnography

• If you are a rhythm => do you feel a pulse?

• Sign of life / increase EtCO2 / rhythm / Pulse => post resuscitation care
Airway and ventilation

• Tracheal intubation
  • Healthcare provider trained
  • Experience with technique

• Not delay defibrillation

• Without stopping chest compression
• Brief pause < 5 s

• May be deferred: No RCTs have shown that tracheal intubation increases survival after cardiac arrest

• After IOT: 10 breaths min
Intravenous access and drugs

• Peripherous access is easier, quicker, safer than central venous access

• If peripherous access isn’t possible => Intra-osseous infusion

• IO : same plasme concentration in a same time
Non-shockable rhythm

• Pulseless electrical activity (PEA)
  • Electrical activity without pulse
• Asystole

• 30:2
• Adrenalin as soon is possible

• Pulse => Post-resuscitation care

• If doubt between asystole and very fine VF => CPR / No defibrillation
Non-shockable rhythm

- 2-min cycle of CPR
- 3 – 5 min for adrenaline
Use of ultrasound imaging during advanced life support

- Studies show that the use of ultrasound don’t improve outcome
- Potential to detect reversible cause
- Require considerable training
Monitoring during advanced life support

- Clinical signs
  - Rhythm and pulse check

- Pulse
  - Resuscitation
  - Effectiveness?

- Monitoring thought pads, paddles or ECG

- Capnography

- Blood samples
  - Reversible cause
Waveform capnography

• Real-time EtCO2

• During CPR, EtCO2 are low

• No evidence of improve outcome but
  • Tracheal tube placement
  • Greater depth of chest compression will increase the EtCO2
  • Identifying ROSC during CPR


• Prognostication

Extracorporeal Cardiopulmonary resuscitation

- Rescue therapy

- Initial measures are unsuccessful
  - But needing rapid decision

- Facilitate specific intervention
  - Coronary angiography
  - Pulmonary thrombectomy

- Unclear ..
Defibrillation

- Minimising duration of pre-shock and post-shock pauses

- Continue chest compressions during defibrillator charging
  - Interruption < 5 s for shock

- Self-adhesive defibrillation pads

- Biphasic waveforms: 150 J
  - Second and subsequent: 150 – 360 J
Strategies for minimising the pre-shock pause

• The pre-shock pause reduce the chances of the shock being successful ( > 10 s )


• Pre-shock pause can be reduce < 5 s continuing compression during charging

• The post-shock pause is mini- mised by resuming chest compressions immediately after shock
Adrenaline

• No studies placebo Vs adrenalin in cardiac arrest

• Recommendation is to continue the use of adrenaline during CPR
Anti-arrhythmics

• No anti-arrhythmic has been shown to increase survival

• Amiodarone has been shown to increase survival to hospital admission
  

• Lidocaine when amiodarone is unavailable

• No magnesium
Other drug therapy

• Fibrinolytic therapy
  • proven or suspected acute pulmonary embolism

• sodium bicarbonate
  • Hyperkaliema
  • Tricyclic
Intravenous fluids

• Hypovolemia is a reversible cause
  • Infuse rapidly

• Cristalloids
  • Ringer lactate
  • NaCl 0,9%

• Colloid ?
  • No advantage
Mechanical chest compression devices

• No clear advantage from routine


• Alternative in situations where sustained high-quality manual chest compressions are impractical
  • Moving ambulance
  • Prolonged CPR (hypothermic arrest)
  • CPR and procedures
Cardiac arrest in special circumstances
Hypoxia

- Consequence of asphyxia
  - non-cardiac causes of cardiac arrest

- Survival is rare
- Most of injury (neurological)
Hypo-/hyperkalaemia and other electrolyte disorders

Life-threatening arrhythmias are associated most commonly with potassium disorders, particularly hyperkalaemia.
Hypothermia

• < 35 degre

• Decreases cellular oxygen consumption 6% per 1°C
  

• At 18 °C the brain can tolerate cardiac arrest 10 times longer VS 37°C
  
  • Protective effect on heart and brain
  => intact neurological recovery

• ECLS centre
Hyperthermia

• Body’s ability to thermoregulate fails

• Organ dysfunction and cardiac arrest


• Start cooling in the prehospital

• RCP and cooling
Hypovolemic states

- Reduced intravascular volume
- Relative hypovolaemia

- Blood products and/or crystalloids
  - restore intravascular volume

- Control haemorrhage
- Treat the primary cause
Traumatic cardiac arrest

- Very high mortality
- Neurological outcome are better
  

- Chest compressions are less effective

- Lower priority of chest compressions
- Immediate treatment of reversible causes
Hypoxia
Tension pneumothorax
Tamponade
Hypovolaemia

UNLIKELY

Simultaneously address reversible causes

Start/Continue ALS

1. Control external catastrophic haemorrhage
2. Control airway and maximise oxygenation
3. Bilateral chest decompression

4. Relieve cardiac tamponade
5. Surgery for haemorrhage control or proximal aortic compression
6. Massive transfusion protocol and fluids

Elapsed time <10 min since arrest?
Expertise?
Equipment?
Environment?

Consider immediate resuscitative thoracotomy

Consider termination of CPR

Return of spontaneous circulation?
Pre-hospital:
- Perform only life-saving interventions
- Immediate transport to appropriate hospital

In-hospital:
- Damage control resuscitation
- Definitive haemorrhage control
Tension pneumothorax

• 5 % in major trauma patient

• Needle chest decompression
  • Limited value


• Simple thoracostomy
  • incision and rapid dissection
Tamponade (cardiac)

• High mortality

• Immediate decompression of the pericardium

• Thoracotomy

• Ultrasound-guided pericardiocentesis

• No guided pericardiocentesis
Pulmonary embolism

- 2–9% of all cardiac arrest
- 5-6 % in hospital

- Difficult diagnosis
  - Clinical history and assessment
  - Capnography
  - Echocardiography

- Fibrinolytic therapy

- Continue CPR 60-90 min
Coronary thrombosis

- If the initial rhythm is VF, the cause is often coronary artery disease
- Transport to catheterisation laboratory
- Ongoing CPR

- Intermittent ROSC also strongly favours a decision to transport

Toxins

- Rarely cause cardiac arrest

- Decontamination
- Enhancing elimination
- Specific antidotes


- More effective one hour after ingestion
Post resuscitation care
Post resuscitation care

- Post-cardiac arrest syndrome
  - Body ischemia
  - Subsequent reperfusion

- Multiple organ support

- Treatment influence outcome and neurological recovery

- Post resuscitation care algorithm
Return of spontaneous circulation and comatose

**Airway and breathing**
- Maintain SpO₂ 94 – 98%
- Insert advanced airway
- Waveform capnography
- Ventilate lungs to normocapnia

**Circulation**
- 12-lead ECG
- Obtain reliable intravenous access
- Aim for SBP > 100 mmHg
- Fluid (crystalloid) – restore normovolaemia
- Intra-arterial blood pressure monitoring
- Consider vasopressor/ inotrope to maintain SBP

**Control temperature**
- Constant temperature 32°C – 36°C
- Sedation; control shivering
Diagnosis

Likely cardiac cause?

12-lead ECG ST elevation?

Coronary angiography ± PCI

Consider Coronary angiography ± PCI

NO

YES

Consider CT brain and/or CTPA

Cause for cardiac arrest identified?

NO

YES

Treat non-cardiac cause of cardiac arrest

Admit to Intensive Care Unit
ICU management
- Temperature control: constant temperature 32°C – 36°C for ≥ 24h; prevent fever for at least 72 h
- Maintain normoxia and normocapnia; protective ventilation
- Optimise haemodynamics (MAP, lactate, ScvO₂, CO/CI, urine output)
- Echocardiography
- Maintain normoglycaemia
- Diagnose/treat seizures (EEG, sedation, anticonvulsants)
- Delay prognostication for at least 72 h

Secondary prevention
  e.g. ICD, screen for inherited disorders, risk factor management

Follow-up and rehabilitation
Post-cardiac arrest syndrome

- Brain injury
- Myocardal dysfunction
- Systemic ischaemia/reperfusion response


- Severity: duration and cause
- Can not occur

- Rapid death: cardiovascular failure
- Later death: brain injury
Post-cardiac arrest syndrome

- microcirculatory failure
- impaired autoregulation
- Hypotension
- Hypercarbia
- Hypoxaemia
- Hyperoxaemia
- Hyperglycaemia
- Hypoglycaemia
- Seizures
- Exacerbate brain injury
Post-cardiac arrest syndrome

• Myocardal dysfunction recover by 2-3 days

• Ischaemia/reperfusion activates immune and coagulation pathways contributing to multiple organ failure and increasing the risk of infection

Airway and breathing

- Saturation 94-98%

- Hypoxaemia and hypercarbia both secondary brain injury

- Hyperxaemia: supplemental oxygen therapy increased myocardial injury, recurrent myocardial infarction and major cardiac arrhythmia


- Monitoring (blood gas...)
- Ventilation to adjust carbia and saturation
Haemodynamic management

• Early echocardiography for detect and quantify the degree of myocardial dysfunction


• Often requires inotropic support

• Monitoring: blood pressure, heart rate, urine output, lactate, serial echocardiography, arterial line

• Arterial blood target: urine output (1 mL/Kg/h) / decreasing plasma lactate
Cerebral perfusion

Maintain mean arterial pressure near the patient’s normal level
Sedation

There are no high-level data to support a defined period of ventilation, sedation and neuromuscular blockade after cardiac arrest
Controle of seizures

- 1/3 patients
- 18 – 25 % myoclonus

- EEG to detect epileptic activity
- Monitor patient with continuous EEG

- Seizures may increase the cerebral metabolic rate
- Exacerbate brain injury
Glucose control

• Strong association between high blood glucose and poor neurologic outcomes
  

• blood glucose at $\leq 10$ mmol
  
  *Padkin A. Glucose control after cardiac arrest. Resuscitation 2009;80:611–2*

• No strict control (risk of hypoglycaemia)
Temperature control

• Treat hyperthermia

• Hypothermia neuroprotective and improves outcomes
  Gunn AJ, Thoresen M. Hypothermic neuroprotection. NeuroRx 2006;3:154–69

• Recent study (after cardiac arrest and VF): no difference

• Maintain a constant, target temperature between 32°C and 36°C

• Target temperature (36) for rhythm shockable
• Suggest if no rhythm shockable but unresponsive after ROSC

• If target temperature: 24 hours
Organ donation

• Achieved ROSC, criteria for death using neurological criteria


• CPR is not successful in achieving ROSC

• Local legal and ethical requirements