Resuscitation Council UK

Adult advanced life support Guidelines

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Key points

- There are no major changes in the 2021 Adult ALS Guidelines.
- High-quality chest compressions with minimal interruption and early defibrillation remain priorities.
- There is a greater recognition that patients with both in- and out-of-hospital cardiac arrest have premonitory signs, and that many of these arrests may be preventable.
- During CPR, start with basic airway techniques and progress stepwise according to the skills of the rescuer until effective ventilation is achieved. If an advanced airway is required, only rescuers with a high tracheal intubation success rate should use tracheal intubation. The expert consensus is that a high success rate is over 95% within two attempts at intubation.
- When adrenaline is used, it should be used as soon as possible when the cardiac arrest rhythm is non-shockable, and after 3 defibrillation attempts for a shockable cardiac arrest rhythm.

- The guidelines recognise the increasing role of point-of-care ultrasound (POCUS) in peri-arrest care for diagnosis, but emphasises that it requires a skilled operator, and the need to minimise interruptions during chest compression.
- The guidelines reflect the increasing evidence for extracorporeal CPR (eCPR) as a rescue therapy for selected patients with cardiac arrest when conventional ALS measures are failing and to facilitate specific interventions (e.g. coronary angiography and percutaneous coronary intervention (PCI), pulmonary thrombectomy for massive pulmonary embolism, rewarming after hypothermic cardiac arrest) in settings in which it can be implemented.
- These guidelines have followed European and international guidelines for the treatment of peri-arrest arrhythmias.

Introduction

Guidelines 2021 are based on the International Liaison Committee on Resuscitation 2020 Consensus on Science and Treatment Recommendations for Advanced Life Support and the European Resuscitation Council Guidelines for Resuscitation (2021) Advanced Life Support. Refer to the ERC guidelines publications for supporting reference material.

Management of cardiac arrest in patients with known or suspected COVID-19 is not specifically included in these guidelines, but is covered within the separate COVID-19 guidance which is accessible from the RCUK website.

The process used to produce the Resuscitation Council UK Guidelines 2021 is accredited by the National Institute for Health and Care Excellence (NICE). The guidelines process includes:

- systematic reviews with grading of the certainty of evidence and strength of recommendations. This led to the International Liaison Committee on Resuscitation (ILCOR) Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations.
- the involvement of stakeholders from around the world including members of the public and cardiac arrest survivors.
- Details of the guidelines development process can be found in the Resuscitation Council UK Guidelines Development Process Manual.

Guidelines

Prevention of in-hospital cardiac arrest

- RCUK supports shared decision making and advanced care planning which integrates resuscitation decisions with emergency care treatment plans to increase clarity of treatment goals and also prevent inadvertent deprivation of other indicated treatments, besides CPR. These plans should be recorded in a consistent manner (See Ethics section).
- Hospitals should use a track and trigger early warning score system for the early identification of patients who are critically ill or at risk of clinical deterioration.
- Hospitals should train staff in the recognition, monitoring and immediate care of the acutely ill patient.
- Hospitals should empower all staff to call for help when they identify a patient at risk of physiological deterioration. This includes calls based on clinical concern, rather than solely on vital signs.
- Hospitals should have a clear policy for the clinical response to abnormal vital signs and critical illness. This may include a critical care outreach service and/or emergency team (e.g. medical emergency team, rapid response team).
- Hospital staff should use structured communication tools to ensure effective handover of information.
- Patients should receive care in a clinical area that has the appropriate staffing, skills, and facilities for their severity of illness.
- Hospitals should review cardiac arrest events to identify opportunities for system improvement and share key learning points with hospital staff.

Prevention of out-of-hospital cardiac arrest

- Symptoms such as syncope (especially during exercise, while sitting or supine), palpitations, dizziness and sudden shortness of breath that are consistent with an arrhythmia should be investigated.
- Apparently healthy young adults who suffer sudden cardiac death (SCD) can also have signs and symptoms (e.g. syncope/pre-syncope, chest pain and palpitations) that should alert healthcare professionals to seek expert help to prevent cardiac arrest.
- Young adults presenting with characteristic symptoms of arrhythmic syncope should have a specialist cardiology assessment, which should include an electrocardiogram (ECG) and in most cases echocardiography and an exercise test.

- Systematic evaluation in a clinic specialising in the care of those at risk for SCD is recommended in family members of young victims of SCD or those with a known cardiac disorder resulting in an increased risk of SCD.
- Identification of individuals with inherited conditions and screening of family members can help prevent deaths in young people with inherited heart disorders.
- Follow current European Society of Cardiology (ESC) guidelines for the diagnosis and management of syncope.

Treatment of in-hospital cardiac arrest

- Hospital systems should aim to recognise cardiac arrest, start CPR immediately, and defibrillate rapidly (<3 minutes) when appropriate.
- All hospital staff should be able to rapidly recognise cardiac arrest, call for help, start CPR and defibrillate (attach an AED and follow the AED prompts, or use a manual defibrillator).
- Hospitals should use a standard “Cardiac Arrest Call” telephone number (2222).
- Hospitals should have a resuscitation team that immediately responds to in hospital cardiac arrest (IHCA).
- The hospital resuscitation team should include team members who have completed an accredited RCUK adult ALS course.
- Resuscitation team members should have the key skills and knowledge to manage a cardiac arrest including manual defibrillation, advanced airway management, intravenous access, intra-osseous access, and identification and treatment of reversible causes.
- The resuscitation team should meet at the beginning of each shift for introductions and allocation of team roles.
- Hospitals should standardise resuscitation equipment.

ALS considerations for out-of-hospital cardiac arrest

- Start ALS as early as possible.
- Emergency medical systems (EMS) should consider implementing criteria for the withholding and termination of resuscitation (TOR) taking into consideration specific local legal, organisational and cultural context (see the Ethics Guidelines).
- Systems should define criteria for the withholding and termination of CPR, and ensure criteria are validated locally (see the Ethics Guidelines).

- Emergency medical systems (EMS) should monitor staff exposure to resuscitation and low exposure should be addressed to increase EMS team experience in resuscitation.
- Adult patients with non-traumatic OHCA should be considered for transport to a recognised centre of care for appropriate specialist treatment, according to local protocols. There is no evidence to express a preference for a policy of primarily transporting via ambulance (using bypass protocols) or one of secondary inter-hospital transfer.
- Adult patients with a cardiac arrest of presumed primary cardiac aetiology should be transported directly to a hospital with 24/7 coronary angiography capability.

Manual defibrillation

Defibrillation strategy

- Continue CPR while a defibrillator is retrieved, and pads applied.
- Give a shock as early as possible when appropriate.
- Deliver shocks with minimal interruption to chest compression and minimise the pre-shock and post-shock pause.
- This is achieved by continuing chest compressions during defibrillator charging, delivering defibrillation with an interruption in chest compressions of less than 5 seconds and then immediately resuming chest compressions.
- Immediately resume chest compressions after shock delivery. If there is a combination of clinical and physiological signs of return of spontaneous circulation (ROSC) such as waking, purposeful movement, arterial waveform or a sharp rise in end-tidal carbon dioxide ($ETCO_2$), consider stopping chest compressions for rhythm analysis, and if appropriate a pulse check.

Safe and effective defibrillation

- Minimise the risk of fire by taking off any oxygen mask or nasal cannulae and place them at least 1 m away from the patient’s chest. Ventilator circuits should remain attached.
- Antero-lateral pad position is the position of choice for initial pad placement. Ensure that the apical (lateral) pad is positioned correctly (mid-axillary line, level with the V6 ECG electrode position) i.e. below the armpit.
- In patients with an implantable device, place the pad > 8 cm away from the device, or use an alternative pad position. Also consider an alternate pad position when the patient is in the prone position (bi-axillary), or in a refractory shockable rhythm (see below).

- A shock can be safely delivered without interrupting mechanical chest compression.
- During manual chest compressions, ‘hands-on’ defibrillation, even when wearing clinical gloves, is a risk to the rescuer.

Energy levels and number of shocks

- Use single shocks where indicated, followed by a 2 minute cycle of chest compressions.
- The use of up to three-stacked shocks may be considered only if initial ventricular fibrillation/pulseless ventricular tachycardia (VF/pVT) occurs during a witnessed, monitored cardiac arrest with a defibrillator immediately available e.g. during cardiac catheterisation or in a high-dependency area.
- A range of defibrillation energy levels have been recommended by manufacturers and previous guidelines, ranging from 120-360 J. In the absence of any clear evidence for the optimal initial and subsequent energy levels, any energy level within this range is acceptable for the initial shock, followed by a fixed or escalating strategy up to maximum output of the defibrillator.

Recurrent or refractory VF

- Consider escalating the shock energy, after a failed shock and for patients where refibrillation occurs.
- For refractory VF, consider using an alternative defibrillation pad position (e.g. anterior- posterior).
- Do not use dual (double) sequential defibrillation for refractory VF outside of a research setting.

Airway and ventilation

- During CPR, start with basic airway techniques and progress stepwise according to the skills of the rescuer until effective ventilation is achieved.
- If an advanced airway is required, only rescuers with a high tracheal intubation success rate should use tracheal intubation.
- The expert consensus is that a high success rate is over 95% within two attempts at intubation.
- Aim for less than a 5 second interruption in chest compression for tracheal intubation.
- Use direct or video laryngoscopy for tracheal intubation according to local protocols and rescuer experience.

- Use waveform capnography to confirm tracheal tube position.
- Give the highest feasible inspired oxygen during CPR.
- Give each breath over 1 second to achieve a visible chest rise.
- Once a tracheal tube or a supraglottic airway (SGA) has been inserted, ventilate the lungs at a rate of 10 min^{-1} and continue chest compressions without pausing during ventilations. With a SGA, if gas leakage results in inadequate ventilation, pause compressions for ventilation using a compression-ventilation ratio of 30:2.

Drugs and fluids

Vascular access

- Attempt intravenous (IV) access first to enable drug delivery in adults in cardiac arrest.
- Consider intraosseous (IO) access if attempts at IV access are unsuccessful or IV access is not feasible.

Vasopressor drugs

- Give adrenaline 1 mg IV (IO) as soon as possible for adult patients in cardiac arrest with a non-shockable rhythm.
- Give adrenaline 1 mg IV (IO) after the 3rd shock for adult patients in cardiac arrest with a shockable rhythm.
- Repeat adrenaline 1 mg IV (IO) every 3-5 minutes whilst ALS continues.

Antiarrhythmic drugs

- Give amiodarone 300 mg IV (IO) for adult patients in cardiac arrest who are in VF/pVT after three shocks have been administered.
- Give a further dose of amiodarone 150 mg IV (IO) for adult patients in cardiac arrest who are in VF/pVT after five shocks have been administered.
- Lidocaine 100 mg IV (IO) may be used as an alternative if amiodarone is not available or a local decision has been made to use lidocaine instead of amiodarone. An additional bolus of lidocaine 50 mg can also be given after five defibrillation attempts.

Thrombolytic drugs

- Consider thrombolytic drug therapy when pulmonary embolus is the suspected or confirmed as the cause of cardiac arrest.
- Consider CPR for 60-90 minutes after administration of thrombolytic drugs.

Fluids

- Give IV (IO) fluids only where the cardiac arrest is caused by or possibly caused by hypovolaemia.

Waveform capnography during advanced life support

- Use waveform capnography to confirm correct tracheal tube placement during CPR.
- Use waveform capnography to monitor the quality of CPR.
- An increase in $ETCO_2$ during CPR may indicate that ROSC has occurred. However, chest compression should not be interrupted based on this sign alone.
- Although high and increasing $ETCO_2$ values are associated with increased rates of ROSC and survival after CPR, do not use a low $ETCO_2$ value alone to decide if a resuscitation attempt should be stopped.

Use of ultrasound imaging during advanced life support

- Only skilled operators should use intra-arrest point-of-care ultrasound (POCUS).
- POCUS must not cause additional or prolonged interruptions in chest compressions.
- POCUS may be useful to diagnose treatable causes of cardiac arrest such as cardiac tamponade and pneumothorax.
- Right ventricular dilation in isolation during cardiac arrest should not be used to diagnose massive pulmonary embolism.
- Do not use POCUS for assessing contractility of the myocardium as a sole indicator for terminating CPR.

Mechanical chest compression devices

- Consider mechanical chest compressions only if high-quality manual chest compression is not practical or compromises provider safety.
- When a mechanical chest compression device is used, minimise interruptions to chest compression during device use by using only trained teams familiar with the device.

Extracorporeal CPR

- Consider extracorporeal CPR (eCPR) as a rescue therapy for selected patients with cardiac arrest when conventional ALS measures are failing and to facilitate specific interventions (e.g. coronary angiography and percutaneous coronary intervention (PCI), pulmonary thrombectomy for massive pulmonary embolism, rewarming after hypothermic cardiac arrest) in settings in which it can be implemented.

Peri-arrest arrhythmias

- The assessment and treatment of all arrhythmias addresses the condition of the patient (stable versus unstable) and the nature of the arrhythmia. Life-threatening features in an unstable patient include:
    - shock – appreciated as hypotension (e.g. systolic blood pressure < 90 mmHg) and symptoms of increased sympathetic activity and reduced cerebral blood flow
    - syncope – as a consequence of reduced cerebral blood flow
    - severe heart failure – manifested by pulmonary oedema (failure of the left ventricle) and/or raised jugular venous pressure (failure of the right ventricle)
    - myocardial ischaemia – may present with chest pain (angina) or may occur without pain as an isolated finding on the 12-lead ECG (silent ischaemia).

Tachycardias

- Electrical cardioversion is the preferred treatment for tachyarrhythmia in the unstable patient displaying potentially life-threatening adverse signs.
- Conscious patients require anaesthesia or sedation, before attempting synchronised cardioversion.
- To convert atrial or ventricular tachyarrhythmias, the shock must be synchronised to occur with the R wave of the electrocardiogram (ECG).
- For atrial fibrillation:
    - An initial synchronised shock at maximum defibrillator output rather than an escalating approach is a reasonable strategy based on current data.
- For atrial flutter and paroxysmal supraventricular tachycardia:
    - Give an initial shock of 70 - 120 J.
    - Give subsequent shocks using stepwise increases in energy.
- For ventricular tachycardia with a pulse:
    - Use energy levels of 120-150 J for the initial shock.

    - Consider stepwise increases if the first shock fails to achieve sinus rhythm.
- If cardioversion fails to restore sinus rhythm and the patient remains unstable, give amiodarone 300 mg intravenously over 10–20 minutes (or procainamide 10–15 mg kg^{-1} over 20 minutes) and re-attempt electrical cardioversion. The loading dose of amiodarone can be followed by an infusion of 900 mg over 24 hours.
- If the patient with tachycardia is stable (no life-threatening adverse signs or symptoms) and is not deteriorating, pharmacological treatment may be possible.
- Consider amiodarone for acute heart rate control in AF patients with haemodynamic instability and severely reduced left ventricular ejection fraction (LVEF). For patients with LVEF < 40% consider the smallest dose of beta-blocker to achieve a heart rate less than 110 min^{-1}. Add digoxin if necessary.

Bradycardia

- If bradycardia is accompanied by life-threatening adverse signs, give atropine 500 mcg IV (IO) and, if necessary, repeat every 3–5 minutes to a total of 3 mg.
- If treatment with atropine is ineffective, consider second line drugs. These include isoprenaline (5 mcg min^{-1} starting dose), and adrenaline (2–10 mcg min^{-1}).
- For bradycardia caused by inferior myocardial infarction, cardiac transplant or spinal cord injury, consider giving aminophylline (100–200 mg slow intravenous injection).
- Consider giving glucagon if beta-blockers or calcium channel blockers are a potential cause of the bradycardia.
- Do not give atropine to patients with cardiac transplants – it can cause a high-degree AV block or even sinus arrest – use aminophylline.
- Consider pacing in patients who are unstable, with symptomatic bradycardia refractory to drug therapies.
- If transcutaneous pacing is ineffective, consider transvenous pacing.
- Whenever a diagnosis of asystole is made, check the ECG carefully for the presence of P waves because unlike true asystole, this is more likely to respond to cardiac pacing.
- If atropine is ineffective and transcutaneous pacing is not immediately available, fist pacing can be attempted while waiting for pacing equipment.

Debriefing

- Use data-driven, performance-focused debriefing of rescuers to improve CPR quality and patient outcomes.

Effect of resuscitation education on patient outcome

- We suggest healthcare systems ensure staff with a duty to provide ALS receive accredited RCUK ALS provider training (See Education Guidelines)

References

ERC Guidelines 2021: https://cprguidelines.eu/

Additional resources

- Obstetric Anesthetists Association OBS QRH

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