

New European Guidelines for Cardiopulmonary Resuscitation 2021.

The main changes from 2015 Guidelines

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The European Resuscitation Council (ERC) has recently published the new Guidelines 2021 for cardiopulmonary resuscitation. Every year in Europe, we have more than 400,000 people suffering a cardiac arrest. Though we estimate that 33% of cases have a return of spontaneous circulation (ROSC), the number of people who will be released from the hospital is not more than 8% of all cases. The percentage of people who witness a cardiac arrest and intervene with life-saving manoeuvres is on average 58% (range 13-83%). Automated External Defibrillators (AEDs) are used in only 28% of cases. Since the previous guidelines of 2015, some scientific aspects of resuscitation have gained further importance. For example, knowledge on epidemiology and concepts of prevention (life-saving system) of cardiac arrest has increased a lot. So, in the guidelines of 2021 we have new topics (i.e., Systems Saving Lives) referring to aspects that in previous guidelines were only a part of a topic. In this article we will cover an overview of the most important ECR Guidelines 2021 changes of adult advanced life support (ALS), peri-arrest arrhythmias, cardiac arrest in special circumstances and post-resuscitation care.

ERC Guidelines 2021 provide updates from a clinical perspective, but also useful information for health policy makers. The development and use of National Cardiac Arrest Registries, the implementation of new technologies for citizen involvement, and mandatory CPR training in schools are some of the most emphasised elements of the new guidelines that add effectiveness to clinical practice in the management of cardiac arrest. Today, 29 countries are collaborating in European Registry of Cardiac Arrest

(EuReCa). About 70% of European countries have registries for out-of-hospital cardiac arrest (OHCA), but the completeness of data collection varies greatly. The global incidence of in-hospital cardiac arrest in adults has not been well described. There is limited evidence to support clinical decision-making. An increased awareness with regard to optimizing clinical care and new research might improve outcomes. The chapter also discusses post-arrest rehabilitation services, which are currently insufficient in all countries.

The importance of community: Systems-building saves lives

'Systems Saving Lives' is a new section for Guidelines 2021. The Systems Saving Lives Guidelines describe a number of system-level factors that can improve the management of cardiac arrest patients. The intended audience includes: governments, managers of health and education systems, healthcare professionals, teachers, students and members of the public. The topics covered include chain of survival, measuring performance of resuscitation, social media and smartphone apps for engaging community, European Restart a Heart Day, World Restart a Heart, KIDS SAVE LIVES campaign, lower-resource setting, European Resuscitation Academy and Global Resuscitation Alliance, early warning scores, rapid response systems and medical emergency team, cardiac arrest centers and role of dispatcher. These guidelines emphasize the importance of the connections between the different people involved along the Chain of Survival, and the importance of measuring and improving the performance of resuscitation systems. The goal of saving more lives relies not only on solid and high-quality science but also effective education of both members of the public and healthcare professionals. Also the guidelines mentioned that smartphone apps can be used by members of the public, first responders (trained and untrained members of the public, firefighters, police officers, and off-duty healthcare professionals) or local ambulance

services to improve their response to a cardiac arrest with a Mobile Positioning System (MPS) or Text Message (TM)-alert system and to increase early CPR and early defibrillation and thereby improving survival.

In Systems Saving Lives, everyone and everything is an important link to survival – we are moving from the classical four-link chain of survival to a multitude of links encompassed in the new System Saving Lives concept. Every single step in this complex system is important.

The most important changes in adult patients:

- Equivalence of amiodarone and lidocaine in cases of Ventricular Fibrillation (VF) / Ventricular tachycardia (VT).
- Intravenous access preferred to Intraosseous infusion (IO).
- The algorithm in the presence of tachycardia is slightly modified.
- Downgrading in the role of Point-of-Care Ultrasound (POCUS). Reserved for experts, due to potential cardiopulmonary resuscitation pauses.
- The algorithm in case of hyperkalemia has been modified.

There are no major changes in the adult advanced life support (ALS) guidelines. The five key points of the adult advanced life support (ALS) 2021 procedures are:

1. Chest compressions (focus on high quality compressions always with minimal interruptions) - Early defibrillation (for in – hospital Cardiac Arrest <3min) – Treat the reversible causes the sooner possible.
2. Warning signs of cardiac arrest, (there is a greater acknowledgement that patients with cardiac arrest have warning signs and that many of these arrests are preventable)
3. Endotracheal intubation, use of adrenaline (With regard to the airway, endotracheal intubation is only recommended if the person applying it

is experienced in performing the procedure (high success rate)).

4. When adrenaline is used, it should be used as soon as possible.
5. Extracorporeal cardiopulmonary resuscitation (ECPR). (Guidelines report increasing evidence of ECPR as a treatment for selected patients under cardiac arrest when conventional measures are not effective, or to facilitate specific interventions (e.g. percutaneous transluminal coronary arteriography and angioplasty, pulmonary thrombectomy for massive pulmonary embolism, rewarming after hypothermic cardiac arrest) in settings where it can be implemented.)

Drugs and their access

- Amiodarone and lidocaine, are equivalent in Ventricular Fibrillation (VF) / Ventricular tachycardia (VT). They are administered after the third shock: amiodarone 300 mg or lidocaine 100 mg iv/io and after the fifth shock: amiodarone 150 mg or lidocaine 50 mg iv/io. There is weak evidence of worse outcomes with drug administration via intraosseous (i.o) access than with intravenous (i.v.) access. If i.v. access is not available (quickly), the procedure for i.o. access is performed.
- Adrenaline should be administered
- for non-shockable rhythms (Pulseless electrical activity or PEA, asystole): 1 mg iv/io as soon as possible, then every 4 minutes.
- for defibrillation rhythms (VF/VT): 1 mg iv/io after the third (unsuccessful) shock, then every 4 minutes.
- Thrombolytics administration, should not be administered routinely. Consider thrombolytic drug therapy only if the suspected/confirmed cause of cardiac arrest is pulmonary embolism. After administration of thrombolytic drugs, CPR manoeuvres should be continued for at least 60-90 minutes.

- No routine administration of 'large' volumes of fluid unless the cause of arrest is clearly hypovolemia (oligemia) (which for the 2021 guidelines remains as an unchanged recommendation, emphasised again this year).

Defibrillation. It is recommended to shorten the 'waiting time' until the defibrillator is charged: even a 5-10 second pause reduces the chance of a successful shock. Recommended sequence is 1. rhythm control 2. shockable rhythm 3. continue compressions until the defibrillator is charged, 4. apply shock (with the shortest possible pause). Alternatively, this is referred to as 'pre-charging'. The defibrillator can be charged already during a compression and is therefore immediately available during rhythm control (however, safety aspects need to be assessed). Use a three-shock strategy (up to 3 shocks in quick succession), only in the event of a VF/VT arrest observed on the monitor and the defibrillator is available immediately. With regard to the energy to be used, the recommendation is unchanged. In case of persistent ventricular fibrillation, there are no recommendations for dual shocks. It is recommended to check the position of the defibrillator pads, and to change their position if necessary (e.g. from sternal-apical to anterior-posterior).

Airway management. There are yet no clear indications to determine an algorithm that can hint at a preferred method for ventilation. The pros and cons of various procedures [Ambu bag (Bag valve mask), Supraglottic airway devices (SADs), endotracheal intubation] are indicated in the guidelines. For experienced teams ("high intubation success rate") there is a choice between SADs and

intubation. Less experienced teams ("low intubation success rate") should use a SAD. Unfortunately there at present no clear recommendations for videolaryngoscopy.

"Point-of-Care Ultrasound" (POCUS). The indication for the use of ultrasound is weakened because of concern that this approach leads to prolonged/multiple pauses, resulting in a worse outcome. POCUS is recommended "only" for experts to search for reversible causes of cardiac arrest. Ultrasound should not be used routinely for prognosis/resuscitation interruption (as the evidence is not robust). Emergency teams should therefore be trained in advance in the use of POCUS, the use of which is in any case limited.

Extracorporeal cardiopulmonary resuscitation (ECPR) / extracorporeal life support (ECLS) Consider ECPR in specific and selected resuscitation cases to perform therapeutic interventions (e.g. Percutaneous coronary intervention /PCI in myocardial infarction, thrombectomy in massive pulmonary embolism, rewarming in hypothermia).

Termination of Resuscitation / Cessation of CPR

No precise universal guidance is given for ending resuscitation. It is delegated to local health systems to implement criteria for suspending and terminating CPR for both in-hospital cardiac arrest (IHCA) and out-of-hospital cardiac arrest (OHCA), taking into account the specific local legal, organisational and cultural context. It is explicitly stated that the following elements should never be used alone to terminate resuscitation: pupil size/reactivity, duration of CPR, ETCO₂, comorbidities, or suicide attempt.

Peri-arrest arrhythmias Guidelines ERC 2021

Tachycardias. It is important to state that early identification and treatment of life-threatening arrhythmias may prevent cardiac arrest or its recurrence. The ERC 2021 Guidelines include evidence and algorithms useful to the non-specialist ALS provider. In stable patients, there is time to seek specialist medical attention. So, assessment and treatment of all arrhythmias are based on the fact that we have a clinically stable or unstable patient and the nature of the arrhythmia.

Stable patient with

1. Wide and irregular QRS: Atrial fibrillation with bundle branch block (treated as narrow and irregular QRS) or polymorphic ventricular tachycardia (PVT) (in case of Torsades de pointes give 2g of magnesium sulphate in 10 min).
2. Narrow or wide with regular QRS: Common vagal manoeuvres, if ineffective adenosine (6mg -12mg-18mg IV) if ineffective move according to QRS length: wide QRS → amiodarone 300mg iv in 10-60 min or procainamide 10-15mg/kg iv in 20 min; narrow QRS → verapamil, diltiazem or beta-blocker. In case of further ineffectiveness, electrical cardioversion is performed.
3. Narrow and irregular QRS: Probable atrial fibrillation (heart rate control with beta-blockers, if signs of heart failure digoxin or amiodarone, anticoagulants if duration >48 h).

Unstable patient, electrical cardioversion is performed:

R-wave-synchronous shock ("synchronised"), analgesia (absence of pain) in conscious patients. In atrial fibrillation: maximum defibrillator output. In atrial flutter/SVT (supraventricular tachycardia): 70-120 J (increase if unsuccessful). In ventricular tachycardia (with pulse): 120-150 J (increase if unsuccessful).

Bradycardias. The algorithm is practically unchanged. Unstable patient: Cardiac pacing (unchanged). Asystole: Attempt pacing only in

presence of P wave (unchanged). Unchanged medication: First atropine (500 µg iv to be repeated up to a maximum of 3 mg); if ineffective: epinephrine (2-10 µg/min) or isoprenaline (5 µg/min). No atropine for heart transplant patients. In the prehospital/early shock room phase, adrenaline can also be administered as bolus; in this case, 1 mg adrenaline in 100 ml NaCl, then 1-2 ml ev slowly (= approximately 10-20 µg).

ERC Guidelines in Special Situations

Basic and advanced life-saving manoeuvres may require modifications under certain conditions though the most important interventions to be performed are universal and follow the pattern of the chain of survival. The ERC 2021 Guidelines on cardiac arrest in special situations are divided into three parts:

1. Special causes, which deals with the treatment of potentially reversible causes of cardiac arrest, these are divided into two groups of four, according to the initial letter H or T and are therefore referred to as '4H and 4T': Hypoxia; Hypovolemia; Hypo-/hyperkalaemia and other electrolyte disorders; Hypo/hyperthermia; Thrombosis (coronary and pulmonary); Cardiac tamponade; Tension pneumothorax; and Toxic agents (poisoning).
2. Special settings, which deals with cardiac arrest in special environments, i.e., cardiac arrest in the operating room, during air travel, during sporting activity, during helicopter rescue.
3. Special patient groups, which deals with specific conditions, and those with certain chronic comorbidities, such as in asthma, COPD, obesity, pregnancy, etc.

In this article we will refer only to the modified and changed algorithms of this part of the guidelines.

Cardiac arrest due to trauma: There is a focus on reversible causes with clear indication of the role of an 'emergency department thoracotomy' (EDT). An important note is: 'Don't pump an empty heart'. The four relevant reversible causes to be

treated immediately and in parallel are: Hypoxemia, hypovolaemia, tension pneumothorax, cardiac tamponade.

Immediately perform haemostasis (i.e., tourniquet), oxygenation, bilateral mini-thoracotomy, fluid administration (or early massive transfusion and coagulation therapy) and in case of adequate situation/experience/equipment <15 min consider emergency thoracotomy.

Asthma/COPD: For the prevention of cardiac arrest in patients with asthma/COPD the following are recommended: Treat life-threatening hypoxia with high-flow oxygen. Pulse oximetry (SpO₂) monitoring and oxygen supplementation: 94-98% in asthma, 88-92% in COPD. Steroid administration: prednisolone 40-50 mg or hydrocortisone 100 mg. Asthma: Consider i.v. magnesium; Do not routinely administer i.v. theophylline or reproterol.

Hyperkalemia The algorithm for hyperkalemia is slightly modified. The main treatment goals in these cases are to protect the heart, shift potassium into cells, and remove potassium from the body. In case of cardiac arrest and hyperkalemia: Protect the heart; Shift potassium inside cells and proceed to dialysis and consider Extracorporeal Life Support (ECLS).

Reference

1. G.D. Perkins, et al., European Resuscitation Council Guidelines 2021: Executive summary, Resuscitation (2021), <https://doi.org/10.1016/j.resuscitation.2021.02.003>

Figure 1, ALS Algorithm

