Management of Cardiac Arrest

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Cardiac arrest is a condition in which there is circulatory collapse due to a pulseless heart. Therefore, a patient in cardiac arrest should not have a pulse. The four cardiac rhythms that are known to produce a pulseless cardiac arrest are ventricular fibrillation, rapid ventricular tachycardia, pulseless electrical activity, and asystole.

Definition

Cardiac arrest is the sudden loss of heart function in a person with or without known cardiac disease. The entity must be differentiated from a heart attack that refers to the compromised blood supply to the heart musculature

Important Principles Related to the Management of Cardiac Arrest

Before we talk about the different medications, algorithms and systematic approaches available for the treatment of cardiac arrest, it is important to emphasize that **basic cardiopulmonary resuscitation and early defibrillation for shockable cardiac arrest rhythms are of profound importance for survival.** The survival from a cardiac arrest is dependent on the prompt and early application of basic life support and advanced cardiovascular life support algorithms.

Once cardiopulmonary resuscitation is initiated, and defibrillation has been attempted, intravenous access should be established. This can be central or peripheral, and we will discuss the advantages and disadvantages of both lines in the coming section. Administration of drugs can be attempted at this stage.

Note: “ABC” is not used for patients in cardiac arrest. When there are no signs of life, think “CAB”!

Circulation first	Airway/Breathing second
Does the patient have a pulse? • The duration of a carotid pulse check must take less than 10 seconds! • If there is no pulse, or you are uncertain then start with CPR!	Is respiratory effort present? • Observe for signs of breathing during pulse check. • Patients in an arrest may have agonal respiration or gasping.

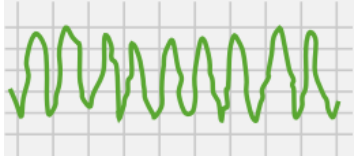
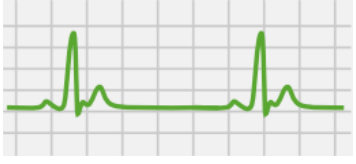
If normal breathing is present, check the pulse again—it´s not a cardiac arrest!

Central versus Peripheral Intravenous Access

Central line access is not needed in most patients. Before considering a central line, one should attempt to **insert a large peripheral venous catheter** for the infusion of drugs.

The establishment of a central line usually requires the interruption of cardiopulmonary resuscitation, which explains why a peripheral venous line is favorable to a central line in the case of cardiac arrest. A central line refers to the introduction of a flexible tube into the large vessels that drain directly into the heart. This allows infusion of large amounts of supplements and electrolytes but also posses a great danger to the easy introduction of infection to the body.

Cardiac Arrest Rhythms

Ventricular fibrillation/tachycardia	Pulseless electrical activity	Asystole
 Ventricular fibrillation/tachycardia. Image by Lecturio.	 Pulseless electrical activity. Image by Lecturio.	 Asystole. Image by Lecturio.
Disorganized or deranged electrical activity originating in the ventricles.	Absence of clinical perfusion despite the presence of organized electrical activity in the heart.	Absence of electrical activity in the heart.

Ventricular fibrillation/tachycardia

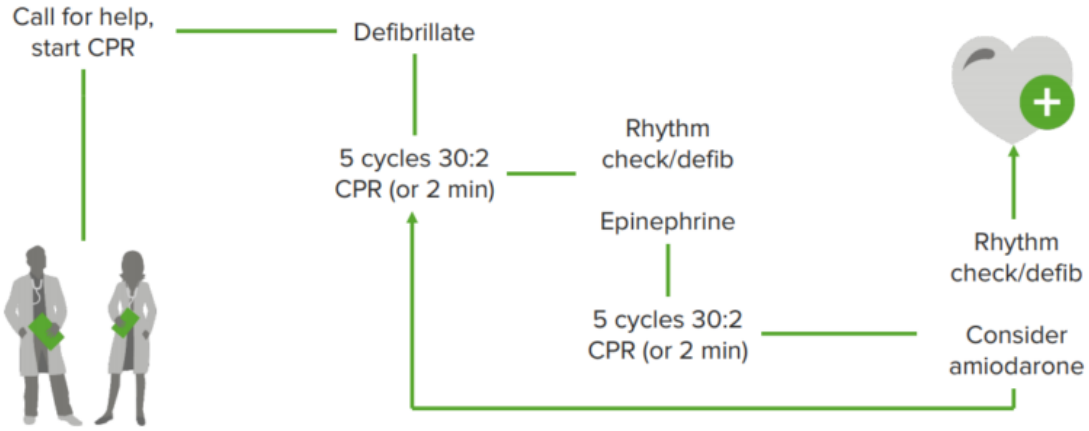
- Usually caused by primary cardiac disease, most commonly ischemia.
- Can also be caused by structural heart disease or channelopathies.

- Less commonly caused by systemic conditions (electrolyte disturbances, toxins, autoimmunity).

Ventricular fibrillation is randomly fluctuating, has no pattern and no QRS complexes. Also, there is no mechanical contraction, which means no pulse. It is incompatible with life.

Ventricular tachycardia has a rapid rate (> 100 by definition, usually > 150), wide, bizarre QRS complexes but organized and regular. It may be pulseless, stable or unstable.

Algorithm



Ventricular fibrillation/tachycardia algorithm

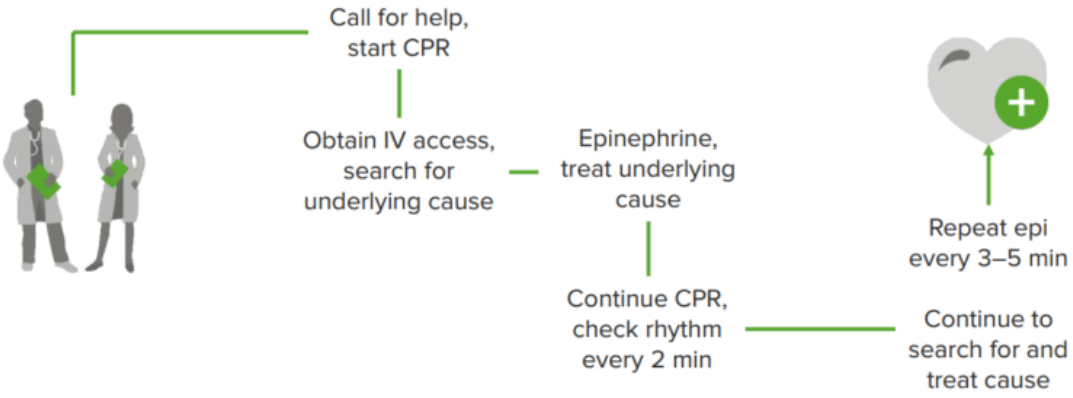
Pulseless electrical activity

Note: Electrical activity on the monitor + no pulse on exam = **PEA**

Mechanisms of PEA

"Empty heart"	Electromechanical dissociation
Electrical conduction in the heart is normal. Contraction occurs but is ineffective because the heart does not fill. Caused by hypovolemia or extracardiac obstruction to filling (e.g., tamponade, tension pneumothorax, etc.)	Electrical conduction in the heart is normal. Action potentials yield little or no cardiac myocyte contraction. Causes by systemic derangements that impair energy metabolism or directly impair myocyte function in the heart.

Algorithm



Pulseless electrical activity algorithm

Asystole

- Management is the same as PEA: CPR, epinephrine, search for and treat the cause.
- Differential diagnosis is also the same as PEA.
- Pay particular attention to oxygenation and ventilation.
- Verify asystole in at least two leads.

Note: Asystole is more commonly a confirmation of death rather than a disease to be treated. Terminate resuscitation when appropriate.

Management of Pulseless Cardiac Arrest

The management of the four arrest rhythms share a common first step which involves the following points:

- Adequately checking for a pulse in the carotid or other major arteries
- Initiation of the basic life support algorithm, call for help and starting cardiopulmonary resuscitation
- Administration of oxygen
- Attachment of a cardiac rhythm monitor and preparation of the defibrillator

The second step in the management of pulseless cardiac arrest is to **check for a shockable arrest rhythm.** The shockable rhythms include ventricular tachycardia, whereas, the not shockable rhythms are asystole and pulseless electrical activity.

If a shockable rhythm is identified, the following points should be taken into consideration as the next step in the management:

Step 1	1 shock by the defibrillator with manual biphasic 200 J, or monophasic 360 J.
Step 2	Resume cardiopulmonary resuscitation immediately
Step 3	• Five cycles of cardiopulmonary resuscitation should be given • Check again for a pulse and for a shockable rhythm.
Step 4	• The patient is still in cardiac arrest and has a shockable rhythm, another shock should be given • Resume cardiopulmonary resuscitation
Step 5	• Intravenous access line is available: vasopressor should be administered during the cardiopulmonary resuscitation • Epinephrine 1 mg IV and repeat every 3 to 5 minutes or 1 dose of vasopressin 40 U IV in place of the first or second dose of epinephrine.

Step 6	• 5 cycles of cardiopulmonary resuscitation should be given • The patient is still in a shockable cardiac arrest rhythm: amiodarone or lidocaine, magnesium might be considered.
Step 7	If still in a shockable rhythm, repeat this algorithm.

If the patient has a non-shockable rhythm or changes from a shockable rhythm to a not shockable rhythm, the following approach is recommended:

- Resume cardiopulmonary resuscitation immediately for 5 cycles and administer epinephrine or vasopressin.
- Consider atropine 1 mg IV for asystole or slow pulseless electrical activity rate and repeat up to 3 doses.
- If at any moment the patient converts to a shockable rhythm, the shockable rhythm algorithm should be followed.

Once the patient gets a pulse, one should start post-resuscitation care.

During cardiopulmonary resuscitation, the following should be taken into consideration:

The chest compressions should be hard and fast, compressing more than a third of the anteroposterior width of the chest and up to 100 compressions per minute. The goal of chest compression is to take up the function of the heart in pumping blood all over the body and thus ensure full chest recoil between each compression to allow for venous return. Minimize the interruptions in chest compressions. Chest compressions are more important than breaths. A cycle of cardiopulmonary resuscitation consists of 30 compressions then 2 breaths. Therefore, the duration of 5 cycles is around 2 minutes.

While checking the rhythm after 5 cycles, one should secure the airway and confirm the placement of an airway. Hyperventilation should be avoided. Once an advanced airway is placed, do not interrupt compressions. Give continuous chest compressions in addition to 8 to 10 breaths per minute and stop the compressions every 2 minutes to check the rhythm. Those responsible for the administration of the chest compressions should be rotated every 2 minutes to avoid fatigue.

The Hs and Ts that are known to be associated with cardiac arrest should be searched for and treated during the cardiopulmonary resuscitation of the patient.

They can be summarized in the following:

- Hypoxia
- Hypovolemia
- Hydrogen ion excess or acidosis
- Hypo or hyperkalemia
- Hypoglycemia
- Hypothermia
- Toxins
- Tamponade
- Tension pneumothorax
- Thrombosis of coronary or pulmonary arteries
- Trauma

Other causes of cardiac arrest may include:

- Cardiac causes such as coronary heart disease, congenital heart diseases, cardiomyopathies, and valvular heart diseases.
- Other causes such as electrocution and excessive hemorrhage.

When Should Resuscitative Efforts Stop?

This question is not an easy one. If the **patient has clearly expressed his or her decision** to not perform cardiopulmonary resuscitation, and the patient was considered as mentally competent at the time of that decision, then this should be respected.

Moreover, to think of the duration of cardiopulmonary and advanced cardiac life support as the main factor in stopping resuscitative efforts is not recommended. One should use clinical judgment, in addition to respect for human dignity when making the decision of stopping resuscitative efforts.

Image: “Chest compression” by Nicholas Garrett. License: Public Domain

Another important point to emphasize here is that if advanced cardiac life support was administered following the previously mentioned algorithms in the field of cardiac arrest, and the **patient did not recover or develop a pulse,** it might be futile to transfer the patient to the emergency department. In other words, the patient will not get any added benefit from a referral to the emergency department and he can be announced dead at the field.

Interventions that are not Supported by Evidence in the Management of Cardiac Arrest

Some common treatments for cardiac arrest should be abandoned because they are not based on good evidence like **pacing during asystole.** It is not beneficial and should not be performed routinely in patients with asystole. Also, the use of procainamide in ventricular fibrillation and pulseless ventricular tachycardia is supported by a single retrospective study of 20 patients. Therefore, it is still not recommended in the advanced cardiac life support algorithm.

Norepinephrine use in the management of cardiac arrest should be discouraged for two reasons:

1. It has no benefits
2. It has been associated with an increased risk of neurological deficits post-resuscitation

Precordial Thump for ventricular fibrillation and ventricular tachycardia might be either not beneficial, or according to some case studies harmful to the patient. It might convert

a ventricular tachycardia to ventricular fibrillation. Moreover, it can cause rib fractures.

References

http://circc.ahajournals.org/content/112/24_suppl/IV-58#sec-6

Notes