NICOLAE TESTEMIŢANU STATE UNIVERSITY
OF MEDICINE AND PHARMACY

DEPARTMENT OF EMERGENCY MEDICINE

AUTOMATED EXTERNAL DEFIBRILLATOR

Emilian Bernaz, Associate Professor, PhD

Chișinău 2023

DISCIPLINE AND RESULTS

24.03

	Grupa M2253 Nume, Prenume, Patronimic		
1	Agipriya Prasennan	✓	
2	Antony Louis Ann Catharine Antony	✓	
3	Badalyan Albert Artak	✓	

Today you lie me, tomorrow you will lie someone else and so on. Do you want to have a friend who lies you??

How do you think who will want to hire you in the future for any job if they will know that you are a dishonest person???

Now think about your future !!!

Everyone will trust you if you will demonstrate by the facts that you are honest person !!!

11	Shanavas Jabbar Aasim Abdul Jabbar	✓	
12	Suresh Kavya Gangadharan	✓	
13	Thamalloor Anilkumar Haripriya Anil		
14	Thangal Basiq Ahmed Noorudin T.	✓	
15	Varier Sahithya Madhusoodanan Madhusoodanan Cheruvalloor Variem	✓	
	Chief		

9 present or 15 students ????

9

DISCIPLINE AND RESULTS

	Grupa M2256 Nume, Prenume, Patronimic	
1	Anilkumar Akash Anil	P
2	Gautham Krishna Rameshkumar	P

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11	Saji Thekkemali Albert Paul	P
12	Shania Elizabeth Shibu Shibu T. K.	P
13	Siji Hannah Siji	P
14	Thekkumpurathu Prakash Abhikanth T K Jayaprakash	P
	Zainab Shaukat Ali Nooral Ghori	P
	Chief tel. nr.	

7 present or 14 students ????

7 present

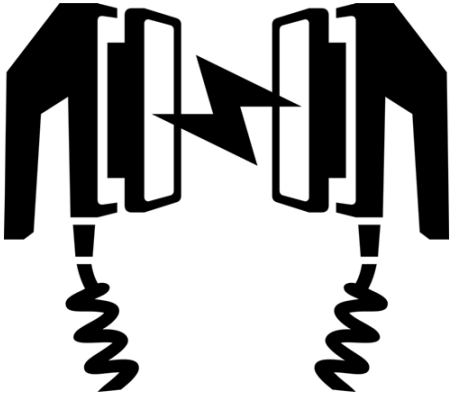
Definition:

- **Defibrillation is the application of an electric shock to the myocardium to achieve simultaneous depolarization of all or most of the myocardial fibers and allow the prolongation of control by the natural impulse-generating structures.**

Defibrillation is defined as "termination of fibrillation" or, more precisely, the absence of ventricular fibrillation/pulseless ventricular tachycardia (VF/VT) five seconds after shock delivery; however, the purpose of the defibrillation attempt is to restore an organized rhythm and spontaneous circulation.

Pathophysiological mechanisms of defibrillation

- **Defibrillation represents the passage of an electric current through the myocardial mass, of sufficient magnitude to depolarize a "critical mass" in the myocardium, thus making it possible to resume coordinated electrical activity.**
- **Defibrillation is an electrical therapy maneuver, which is applied in the context of cardiorespiratory resuscitation in patients with cardiorespiratory arrest, through pulseless VF/VT.**
- **Defibrillation is a key element in the chain of survival and one of the effective interventions in improving the survival rate after cardiac arrest through VF/VT.**



Pathophysiological mechanisms of defibrillation

- As a mechanism of action, the crossing of the heart by an electric current is followed by bringing the entire myocardium to the same resting membrane potential.
- This is equivalent to entering the refractory period for an interval of 1-2 seconds of the myocardium, including the ectopic centers responsible for VF.
- Thus, the centers with the greatest natural automatism are the first to emerge from this refractory period, taking control of the electrical activity of the heart.
- Defibrillation is indicated by pulseless VF and VT. In the presence of the indication, there are no contraindications to defibrillation, except for cases when the safety of defibrillation cannot be ensured.

Defibrilation

- Mechanical defibrillation
- Electrical defibrillation
- Chemical defibrillation

Mechanical defibrillation

- **The precordial strike is the application of a blow with the ulnar part of the fist to the lower half of the sternum, from about 20 cm away from the chest, followed by the immediate withdrawal of the fist, which creates a stimulus equivalent to an electrical impulse. The reason for applying the precordial shock is that the mechanical energy of the shock will be transformed into electrical energy (approximately 30-40J) which may be sufficient for defibrillation.**

Mechanical defibrillation

- **The indication for the application of the precordial shot is represented by the installation of the cardio-respiratory arrest (CRA) in the presence of the rescuer and in the absence of the defibrillator. The situation is frequently encountered in monitored patients. Although the chances of success are small, the precordial blow is most often crowned with success in the case of a VT.**

Mechanical defibrillation

- It is very unlikely to convert a VF with the help of a precordial blow. All cases of successful VF “defibrillation” by precordial shock were reported when applied within the first 10 minutes of VF placement.

TYPES OF DEFIBRILLATORS

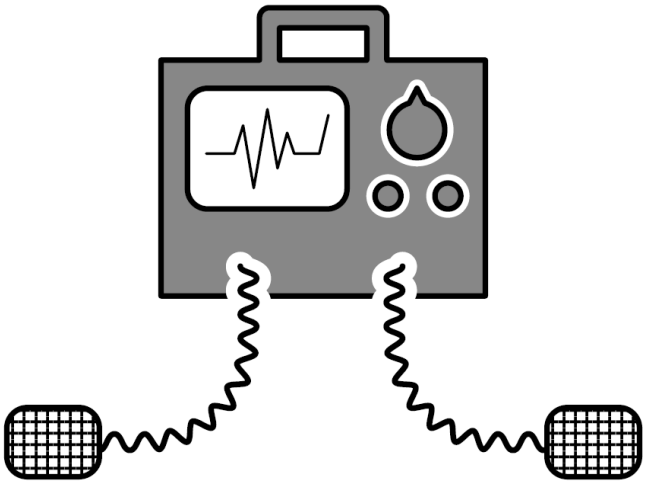
- Manual external defibrillators
- Internal manual defibrillators
- Automated External Defibrillators (AEDs)
- Semi-automatic external defibrillators
- Implantable Cardioverter Defibrillators (ICDs)
- Wearable cardiac defibrillator

TYPES OF DEFIBRILLATORS

- MONOFAZIC
- BIFAZIC

Monophasic manual external defibrillator
Manual external biphasic defibrillator

Defibrillator components



- The energy source
- Condenser
- WIRES

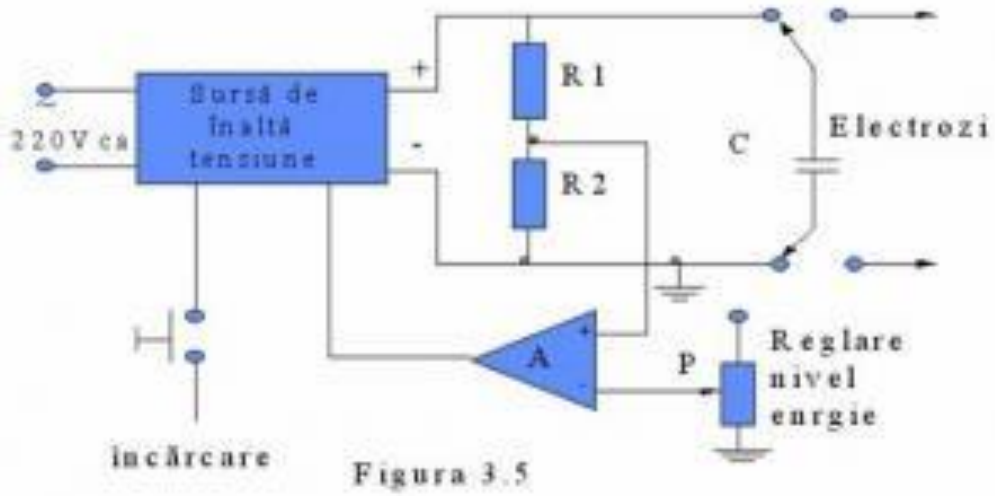
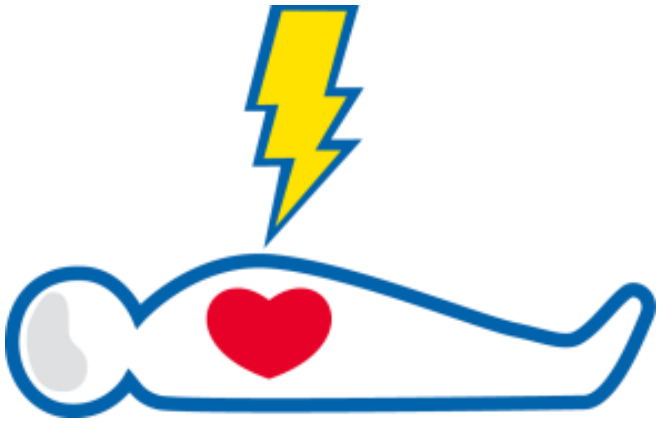


Figura 3.5

Defibrillation success is influenced:



A. Factors related to the patient:

- transthoracic impedance
- the metabolic status of the myocardium
- pre-existing medication
- pH
- electrolyte imbalances

B. Factors related to the defibrillator:

- the position of the electrodes
- time and level of energy released
- reload speed

Transthoracic impedance

It depends on:

- the size of the electrodes
- electrode - skin contac
- the pressure at the contact point
- breathing phase
- sequential shocks

FACTORS THAT INFLUENCE THE SUCCESS OF DEFIBRILLATION

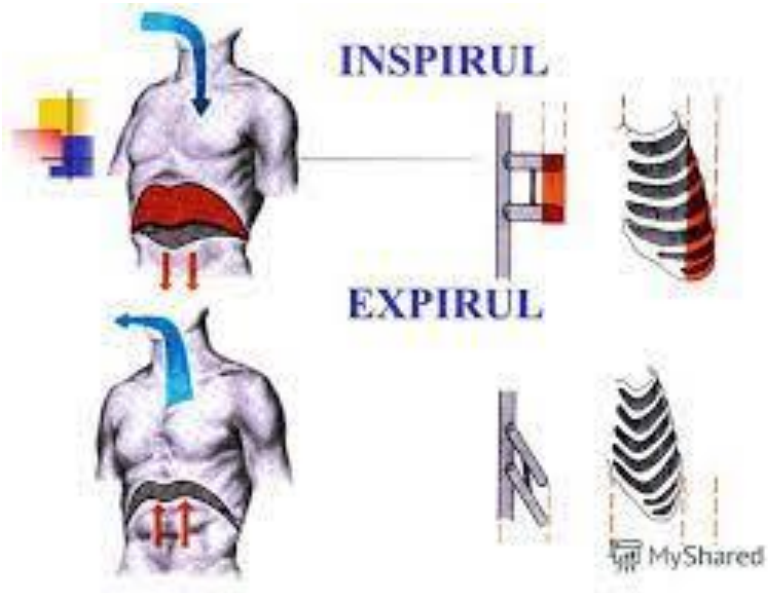
- **Transthoracic impedance.** Optimal defibrillation involves the delivery of a transmyocardial electric current in the presence of minimal transthoracic impedance. In adults, the transthoracic impedance is influenced by numerous factors, among which the most important factor is body mass.

- The optimal technique for defibrillation aims to deliver the current through the myocardial mass in fibrillation, under conditions of minimal transthoracic impedance. Transthoracic impedance differs from the techniques described below, aiming to place the external electrodes (pads or self-adhesive electrodes) in an optimal position that minimizes transthoracic impedance.

FACTORS THAT INFLUENCE THE SUCCESS OF DEFIBRILLATION

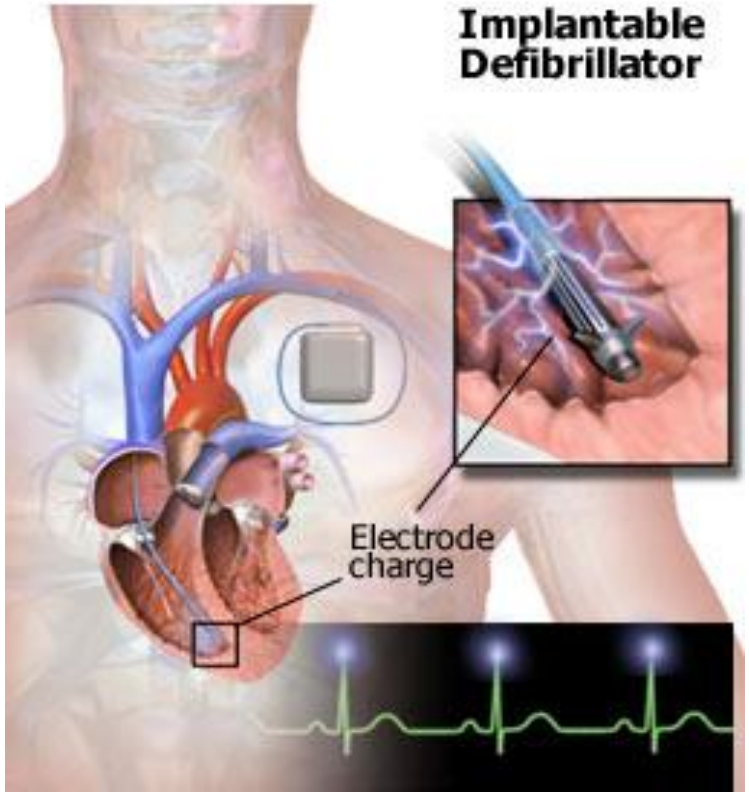
- **Thoracic pilosity.** In patients with excessive pilosity, there is "sequestration" of air under the pads and imperfect contact between the electrodes and the skin. They produce an increase in transthoracic impedance, a reduction in defibrillation efficiency and the risk of electrical arcs (sparks) between the electrode and the skin, which can often lead to burns in the chest. It may be necessary to quickly remove hair by shaving the area where the electrodes will be placed, but if the shaver is not at hand, the defibrillation will not be delayed for this reason. Hair removal by itself reduces transthoracic impedance too little, so it is recommended in case of scheduled cardioversions.

FACTORS THAT INFLUENCE THE SUCCESS OF DEFIBRILLATION



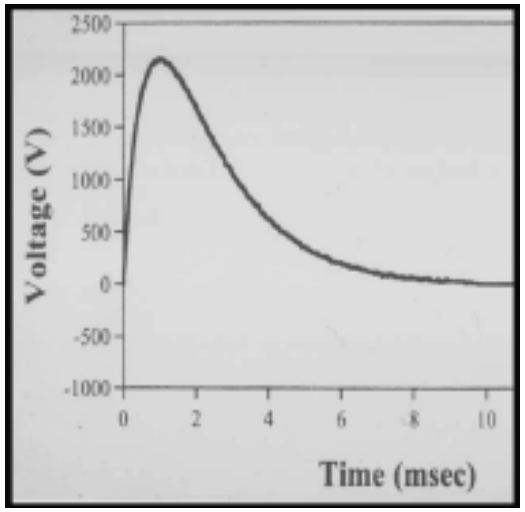
- **Respiratory phase.** Transthoracic impedance varies with breathing, being minimal at the end of exhalation. If possible, defibrillation should be done during this phase of the respiratory cycle. PEEP (positive end expiratory pressure) increases transthoracic impedance, so it should be decreased during defibrillation. Auto-PEEP may be increased in asthmatics, requiring the use of higher energies.

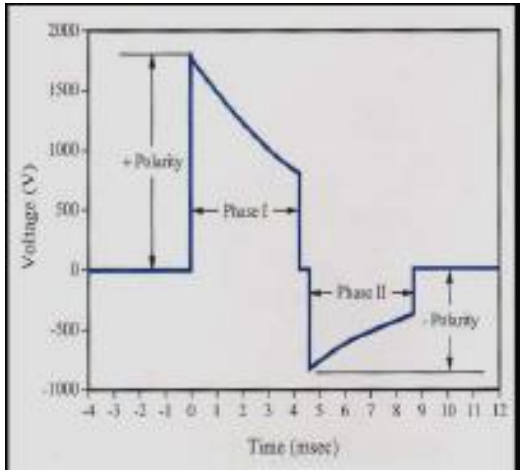
FACTORS THAT INFLUENCE THE SUCCESS OF DEFIBRILLATION



- More and more patients present with implanted medical devices (eg, permanent pacemaker, implantable cardioverter defibrillator (ICD)). "Medical Alert" bracelets are recommended for this type of patient.
- Such devices can be damaged during defibrillation if the shock is delivered through electrodes placed directly over them.

Wave types

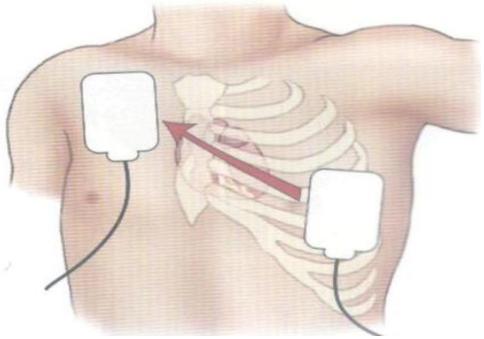




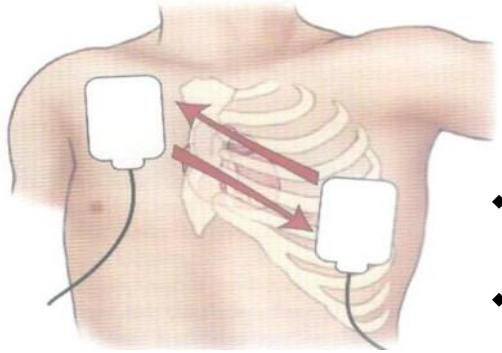
- **Monophasic wave -** monophasic defibrillators are no longer manufactured, although many remain in use.

- **Biphasic wave** – was developed for implantable defibrillators and is currently used in all AEDs and manual defibrillators

Wave types



- When using monophasic waves, the delivered current is unipolar, the flow of current passes through the heart in one direction. Monophasic defibrillators are no longer manufactured, being replaced by biphasic defibrillators.



- When using biphasic waves the intensity of the current changes its polarity in the approximately 10-15 milliseconds while the electric shock is delivered and is bidirectional.
- The myocardium in biphasic shocks is less affected.
- Defibrillation is more effective at lower energies.
- The success rate of rhythm restoration after the first shock is 60% in monophasic shock and 90% in biphasic shock

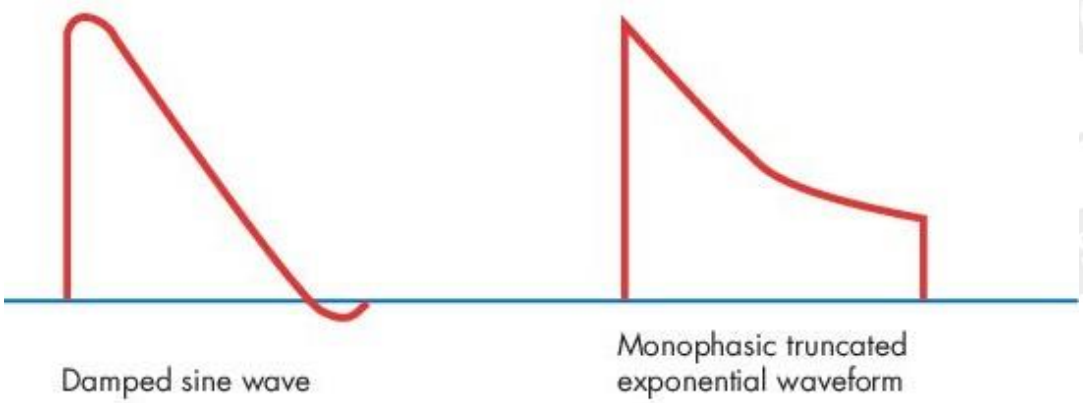
Monophasic wave

Starting from the 70s, monophasic wave type defibrillators were used.

Although still in use, these defibrillators are no longer manufactured. Monophasic defibrillators deliver unipolar current, with only one direction of current flow.

There are two main types of monophasic waves:

- ✓ **with an approximately sinusoidal wave (monophasic damped sinusoidal waveform) - the most used,**
- ✓ **with monophasic truncated exponential waveform.**

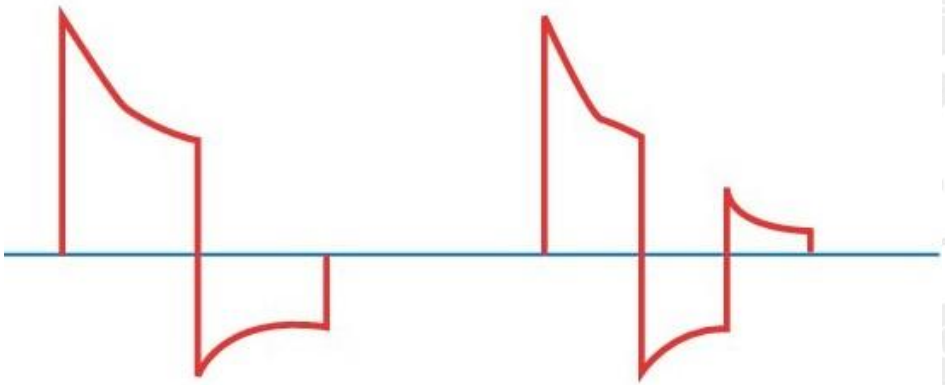


Monophasic wave

Biphasic defibrillators have been introduced in the last 10 years. With this type of defibrillators, the intensity of the current changes its polarity in the approximately 10-15 milliseconds when the electric shock is delivered.

Biphasic defibrillators also generate two types of waves:

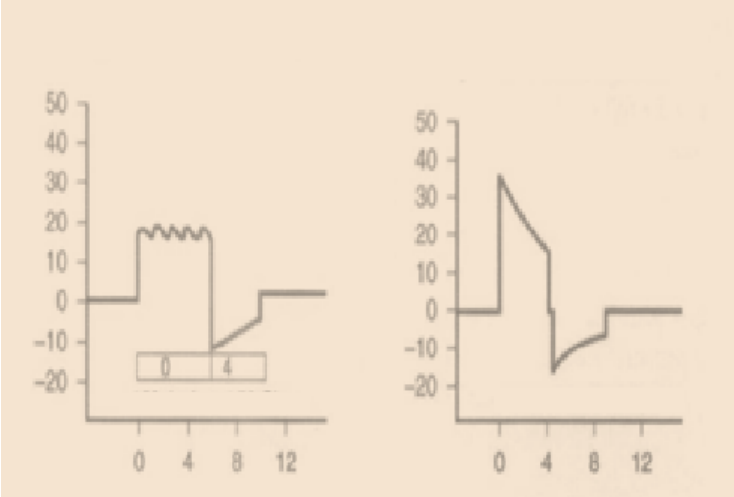
- ✓ **biphasic truncated exponential, biphasic rectilinear (rectilinear biphasic).**



Biphasic truncated exponential waveform

Triphasic truncated exponential waveform

Biphasic wave

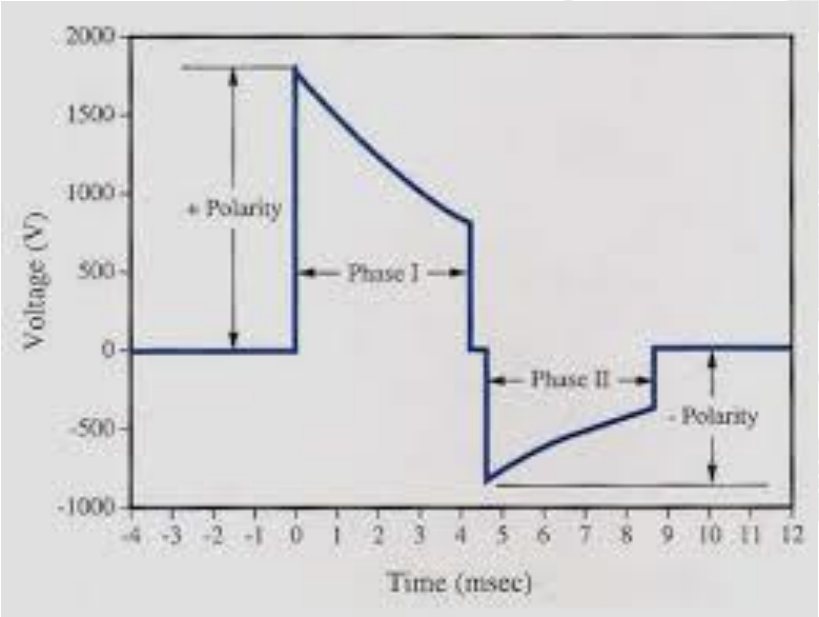


Two main types of biphasic waveforms. A. Biphasic rectilinear wave (BRL). B. Biphasic exponential truncated wave (BET).

- **Biphasic defibrillators compensate for wide variations in transthoracic impedance by electronically adjusting the duration and magnitude of the waveform, so as to ensure an optimal current delivered to the myocardium, regardless of the patient's mass.**

The advantages of the biphasic wave

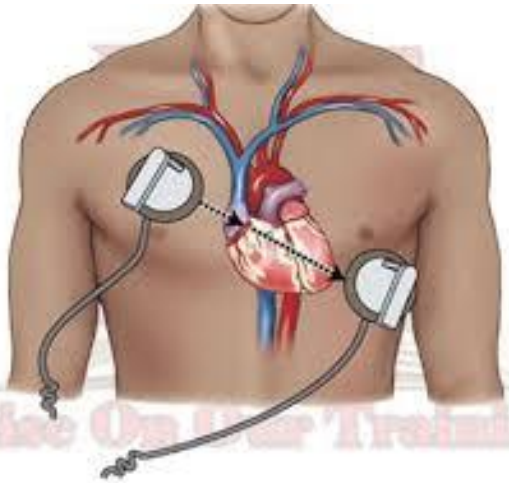
- Biphasic electrical external shock (EES) of 120-200J has the same effectiveness (90%) as monophasic electric shock of 200-360J.
- Post-resuscitation myocardial function is significantly better when using the biphasic wave.
- The risk of VF recurrence is significantly lower for the biphasic wave because it reduces the risk of post-shock arrhythmias.



The advantages of the biphasic wave

- The use for defibrillation lower energies allowed the construction of smaller, lighter and cheaper defibrillators with much greater autonomy.
- Shorter duration of electrical external shock (EES) charge, shorter interruption of external cardiac massage.

The position of the paddles



- The current through the myocardium during defibrillation is maximal when the paddles are placed in such a way that the myocardium that is in fibrillation is contained between them (the ventricles in the case of pulseless VF/VT).

The position of the paddles

The position of the paddles aims to deliver the current through the myocardial mass in fibrillation.

B. Correct position.

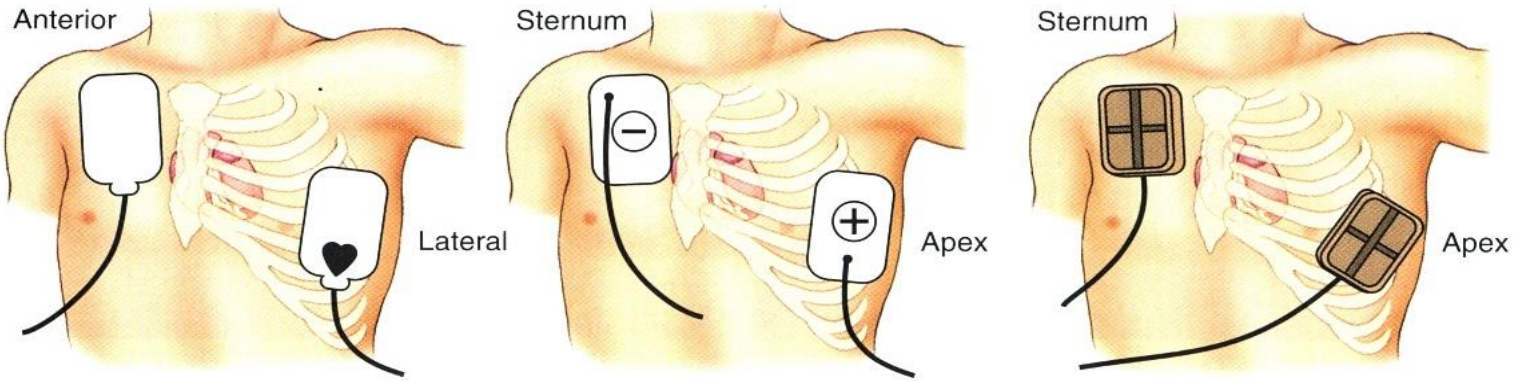
A. Incorrect position.

The current through the myocardium during defibrillation is maximal when the paddles are placed in such a way that the myocardium that is in fibrillation is contained between them (the ventricles in the case of VF/ or pulseless VT).

The position of the paddles

The standard position of the paddles (manual and stickers) is stern-apex.

The right paddle (sternum) is placed on the right side of the sternum, below the collar bone. The apical paddle is placed on the mid-axillary line, approximately the left V intercostal space, in the V6 electrode placement area of the ECG recordings or at the level of the left breast in women, but in areas without breast tissue, so it is important that paddle be positioned as lateral as possible. The electrodes will be placed at a distance from these devices (at least 8 cm) or an alternative electrode placement (antero-lateral or antero-posterior) will be used as described below.



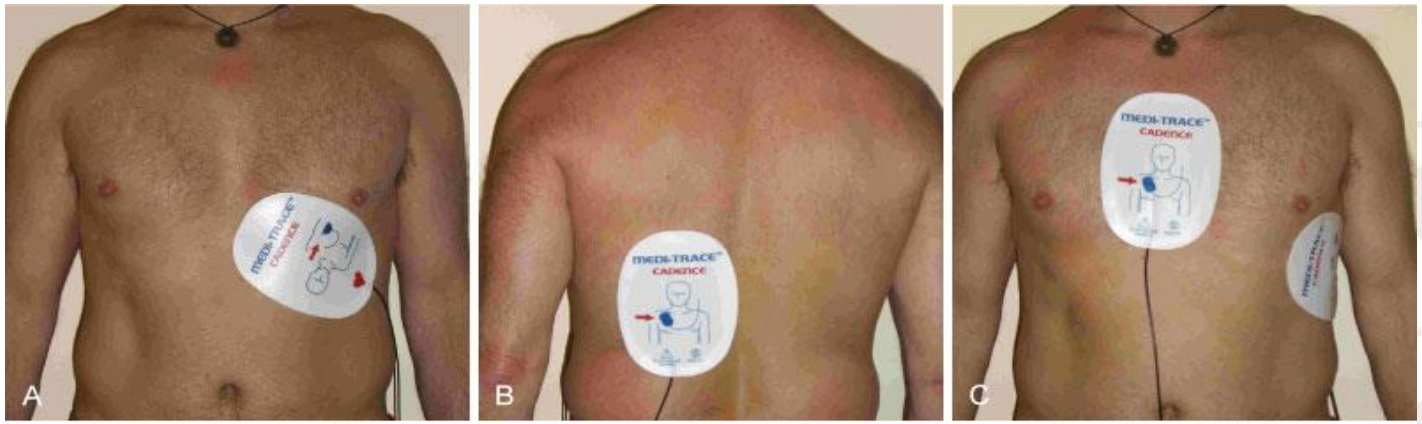
The position of the paddles

Other accepted paddle placement positions are:

the scap each paddle on the lateral chest wall, one on the right and the other on the left (biaxillary);

one paddle in the standard applied position and the other at the upper level of the posterior chest, on the left or right;

one paddle anteriorly, in the precordial area, and the other posteriorly under left ulna.



- **Pad placement in patients with a permanent pacemaker or implantable cardioverter defibrillator (ICD). The anterior-posterior position.**

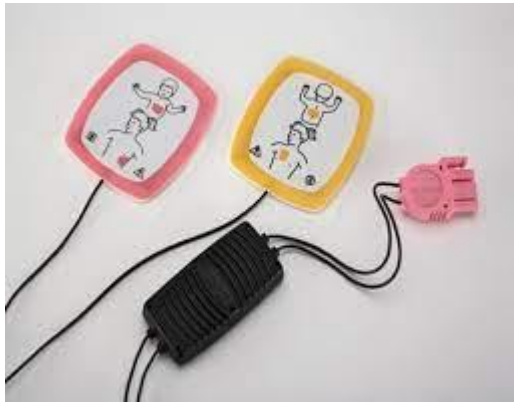
The position of the paddles

It has been observed that the transthoracic impedance is lower if the apical pad is not placed on the breast tissue. The transthoracic impedance can be decreased by asymmetric fixation of the applied paddle, in a longitudinal position, and not transverse, so that the long axis of this electrode is oriented cranio-caudal

The size of the paddles

There is a recommended minimum size for each electrode so that the combined area of the two electrodes is at least 150 cm2. Larger electrodes have lower transthoracic impedance, but very large electrodes can lead to decreased transmyocardial current flow. In the case of defibrillation of adults, both manual paddles and self-adhesive paddles, with a diameter of 8-12 cm, are successfully used. Defibrillation success may be greater when using paddles with a diameter of 12 cm compared to 8 cm.

The size of the paddles



- **Standard AEDs are suitable for children over 8 years of age.**
- **For children between 1 and 8 years old, use the pediatric paddles, with an attenuator, which reduce the released energy, or if possible, the pediatric defibrillation mode; if not, use the manual defibrillator, taking care not to overlap the paddles. AED use is not recommended for children under one year of age.**

The type of paddles

- **Self-adhesive paddles are safe and efficient, being preferred to manual ones. The use of adhesive paddles is preferred in peristop situations and in cases where access to the patient is difficult. Self-adhesive paddles have similar transthoracic impedance (thus effective) to manual ones, but their advantage is that they make it possible to defibrillate the patient from a distance, without the need to position the resuscitator above the patient (as is done in the case of manual paddles).**

Biphasic versus monophasic defibrillation

- **Biphasic waveforms are more effective for terminating ventricular arrhythmias at lower energy levels, have demonstrated increased first-shock efficacy over monophasic waveforms, and show greater first-shock efficacy for long-duration VF/VT.**
- **Biphasic waves have been shown to be superior to monophasic for elective cardioversion of atrial fibrillation, with higher overall success rates, using less cumulative energy and reducing the severity of skin burns, being the waves of choice for this procedure.**

Biphasic versus monophasic defibrillation

- They are currently recommended for resuscitation of cardiorespiratory arrest by VF or pulseless VT when using monophasic defibrillators, with a single energy level of 360 J. For biphasic defibrillators, current recommendations on the energy of electric shocks provide for levels of at least 150 J for the first shock electric and 200 J for the following shocks, if the first one was not effective.
- In fact, the optimal levels of defibrillation energy for both monophasic and biphasic waves are not known, with the current recommendations presenting a consensus based on the specialized literature.
- People using defibrillators need to know the type of defibrillation (manual, semi-automatic or automatic) and the type of wave delivered (monophasic or biphasic).

Biphasic defibrillators

- The efficacy of the first BET (biphasic truncated exponential) wave shock using 150-200 J has been reported to be 86-98%. The efficiency of the RLB (rectilinear biphasic) wave using 120 J is up to 85%. The initial biphasic shock should be no lower than 120 J for RLB (rectilinear biphasic) waves and no lower than 150 J for BET (biphasic truncated exponential) waves. Ideally, the initial biphasic shock energy should be at least 150 J for all waveforms .
- Manufacturers must display the effective wave energy range on the top of biphasic defibrillators' housings; older, single-phase models should also be clearly marked with the appropriate respective values. If the rescuer is not informed of the recommended energy settings of a defibrillator model, the higher value is used for all shocks.

Defibrillation in children

- In children, cardiac arrest is less common. The most common causes of VF in children are trauma, congenital heart disease, prolonged QT interval, drug overdose and hypothermia. VF is relatively rare, compared to cases of cardiac arrest in adults, being present in 7-15% of arrests in pediatric or adolescent patients. Rapid defibrillation of these patients may improve prognosis.

Defibrillation in children

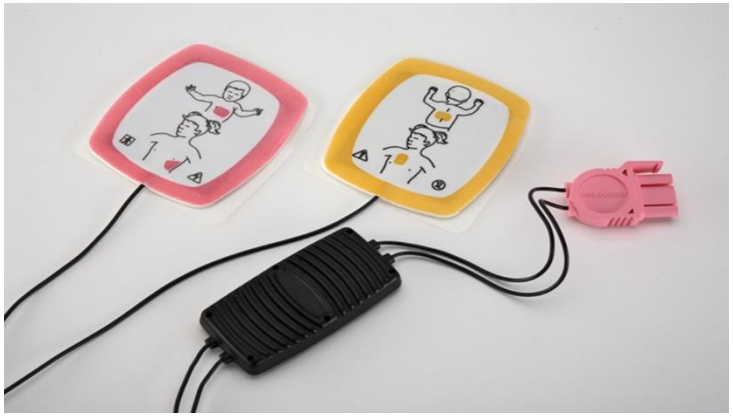
- **The optimal energy levels, waveform, or sequence of shocks are unknown, but, as in the adult, biphasic shocks appear to be as effective and less harmful than monophasic shocks. The upper limit for safe defibrillation is unknown, but previously recommended excess doses of a maximum of 4 J/kg (up to 9 J/kg) have successfully defibrillated children without significant adverse effects.**

Defibrillation in children

- **The recommended energy levels for monophasic manual defibrillation are 4 J/kg for the initial shock as well as for subsequent shocks. The same energy levels are recommended for biphasic defibrillation. As in adults, if a shockable recurrent rhythm occurs, the energies that were previously effective are used.**

- **For defibrillation in children over 8 years of age, the use of AEDs with standard electrodes using standard energy settings is acceptable. Special pediatric electrodes and energy attenuators are recommended for children between 1 and 8 years old; they reduce the energy delivered to levels approaching those recommended for manual defibrillators. When these electrodes are not available, AEDs with standard electrodes should be used.**

Defibrillation in children



- For defibrillation of children under 1 year, AED is not recommended; however, a few cases are reported describing the use of AEDs in children under 1 year of age.
- The incidence of shocking rhythms in children is very rare, except in cases of heart disease; In these rare cases, if the AED is the only defibrillator available, its use should be considered (preferably with a dose attenuator).

Automated External Defibrillation

- **Automated external defibrillators are computerized, sophisticated devices, consistently effective in quality and performance, that use verbal and visual commands to guide rescuers and healthcare professionals in safely defibrillating patients in cardiac arrest. Some AEDs combine instructions for defibrillation with instructions for properly performing chest compressions.**

Automated External Defibrillation

- **The automatic external defibrillator is a computerized device with the ability to recognize the rhythms that require an electric shock and to give indications for the application of the external electric shock in pulseless VF/VT.**
- **Automatic external defibrillators are used by trained people (paramedical personnel or with medium medical training in the prehospital and even in the hospital).**

Automatic external defibrillators (AED)
Semi-automatic external defibrillators

Defibrilator automat extern monofazic

Defibrilator automat extern bifazic

- Defibrillator technology is advancing rapidly. Rescuer-AED interaction through voice commands is already established, and future technologies will be able to make voice commands possible for more specific instructions. Automated external defibrillators were first produced in 1979.
- The concept of "Public access to defibrillation" was developed by the American Society of Cardiology and presented at the 2002 SAC Congress

Automatic defibrillation

- **Adhesive paddles are applied**
- **Follow the audio-video instructions**
- **Automatic ECG analysis is performed**
- **Charges automatically if the heart rhythm is amenable to defibrillation**

USE OF AUTOMATIC EXTERNAL DEFIBRILLATORS

- **A vital link in the chain of survival**
- **Defibrillation is a key element in the chain of survival, being also one of the effective interventions proven to improve the survival rate after VF/VT arrest. Current European Center of Resuscitation (ECR) recommendations judiciously emphasize the importance of early defibrillation with minimal delay.**
- **The probability of successful defibrillation and survival to discharge decreases rapidly with time, and the ability to perform defibrillation as early as possible is one of the most important factors in determining survival after cardiac arrest. For each minute of delay in defibrillation, survival after VF decreases by 10-12%.**

USE OF AUTOMATIC EXTERNAL DEFIBRILLATORS

- **AMU systems generally do not have the ability to perform defibrillation in the first minutes after receiving the call by medical personnel, and the widespread alternative is the intervention of persons trained to perform defibrillation using AEDs. Emergency Medical Care (EMC) systems that have reduced time to defibrillation by working with trained personnel have reported large improvements in survival to discharge, some as high as 75% if defibrillation was performed within the first three minutes of collapse.**

USE OF AUTOMATIC EXTERNAL DEFIBRILLATORS

- **This concept was for traffic stops and hospital, personal case care is trained to use AED before management was extended to medical cardiac arrest.**
- **When the rescuer (the person who assisted in placing the stop) performs CPand CR, the drop in survival rate is gradual, averaging 3% to 4% per minute of delay from collapse to defibrillation; thus, rescuer CPR and C doubles or even triples the survival rate in out-of-hospital cardiac arrest. Emergency Medical Care (EMC) service instructions help to increase the quality of CP and CR performed by the rescuer, and video instructions given over the phone can improve it even more.**

USE OF AUTOMATIC EXTERNAL DEFIBRILLATORS

- **Both automated external defibrillators (AED) and manual defibrillators are recommended for use. AEDs are safer and more effective when used by trained rescuers and allow defibrillation many minutes before qualified help arrives.**

Automatic rhythm analysis

- **AEDs are equipped with microprocessors that analyze several parameters of the EGC. Technological development will soon make it possible for AEDs to provide information on the frequency and depth of chest compressions required during CP and CR, which can improve the skill of all rescuers in performing basic life support (BLS) maneuvers.**

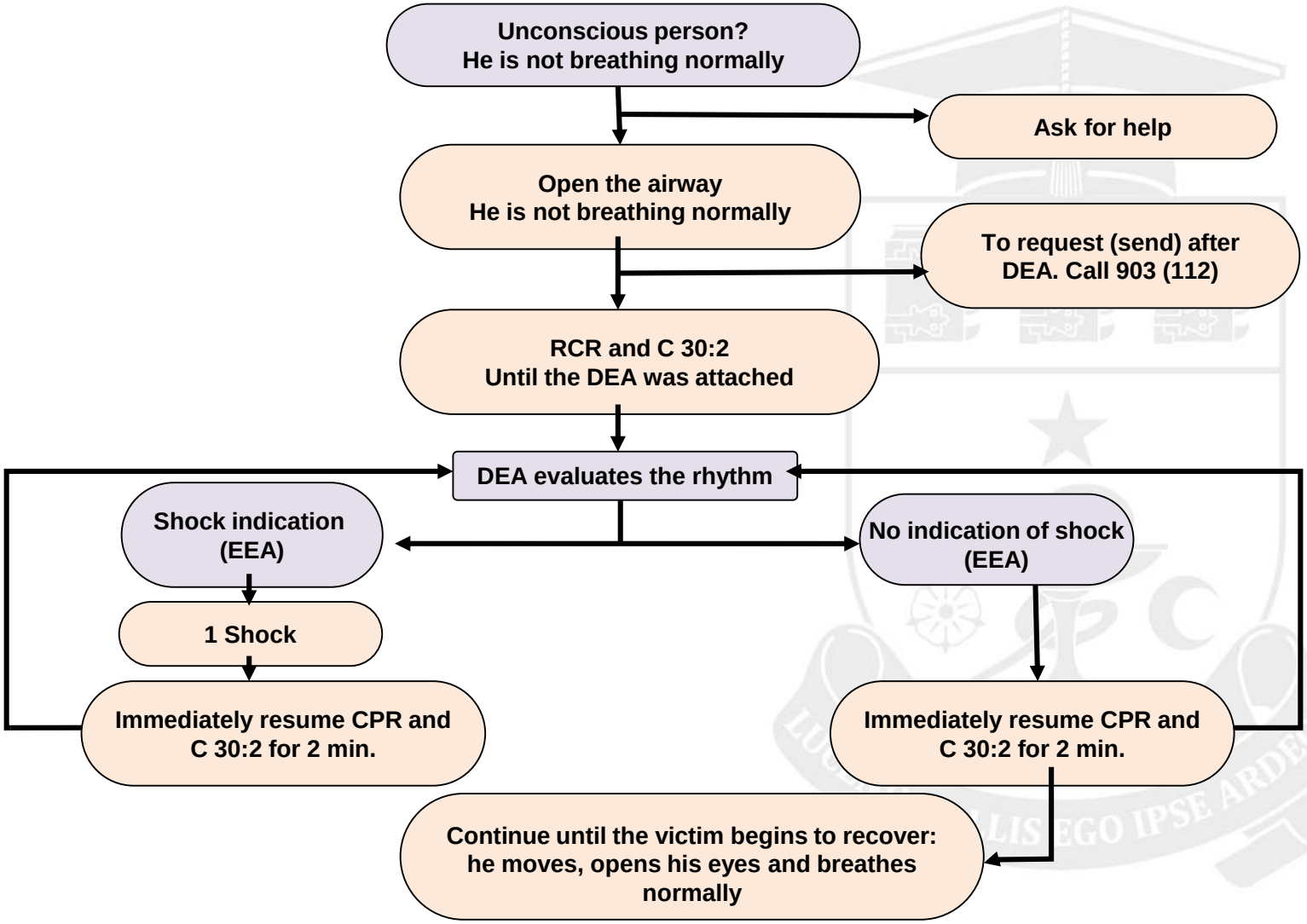
Automatic rhythm analysis

- **AEDs have been tested extensively on circadian rhythm "banks" as well as in many studies on adults and children. These devices are extremely accurate in rhythm analysis. Most AEDs require a period of time to analyze the rhythm. This results in an interruption of sternal compressions for a variable but significant time, a factor shown to have an adverse effect on post-cardiac arrest evolution. The manufacturers of these AEDs must make every possible effort to develop software that minimizes this analysis period, so that the interruption time of sternal compressions is kept to a minimum.**

USE OF AUTOMATIC EXTERNAL DEFIBRILLATORS

- **Standard AEDs can be used in children over 8 years of age. For children between 1 and 8 years old, pediatric electrodes should be used together with an attenuator or pediatric working mode; if this is not possible, available AED will be used. AED use is not recommended for children under 1 year of age. The incidence of shocking rhythms in the child under one year is very low, except for the existence of a heart disease; in these rare cases, if an AED is the only defibrillator available, its use (preferably with energy attenuator) should be considered.**

The algorithm for using AED



Guide to AED use:

I. Opening/starting the device:

- **opening the device.**

II. Connecting the device:

- **connecting the device to the patient;**
- **attach the electrodes to the device;**
- **apply the self-adhesive electrodes on the patient's chest apex and right subclavicular or anteroposterior – presternal or interscapular.**

III. Analysis:

- **analyze;**
- **notify the assistance and check if the patient is in contact with another person;**
- **press the "Analyze" button.**

IV. Electric shock:

- **shock;**
- **if VF/ pulseless VT is present, the device indicates the need to apply the shock and automatically charges to 150-360 J;**
- **check that no one is in contact with the patient;**
- **press the "Shock" button after the device is charged;**
- **repeat these steps after 2 minutes of CPR and C as long as VF/pulseless VT persists.**

USE OF AUTOMATIC EXTERNAL DEFIBRILLATORS

- During defibrillation, the safety of the rescuer, the victim and those around must be ensured.
- Follow the adult Basic Life Suport algorithm:
- if the victim is unconscious and not breathing normally, call for help and send someone to get an AED if one is available;
- if you are alone, use your mobile phone to alert the emergency services - do not leave the victim unless you have no other choice.
- Begin CP and CR immediately after the Basic Life Suport algorithm for adults. If you are alone and AED is near you, apply AED first.

AED

Immediately after AED arrives:

1. Open the AED and attach the paddles directly to the patient's exposed chest.

Attaching paddles. The first paddle is placed on the left midaxillary line just below the armpit. The second paddle is placed just below the right collarbone.

AED

2. If multiple rescuers are present, CP and CR should be continued while the paddles are attached to the patient's chest.

3. Verbal or displayed commands will be followed.

4. Make sure no one touches the victim while the DEA analyzes the rhythm

While the AED is analyzing the beat, no one should touch the victim.

AED

Announce ,,On the number three I will administer a shock.

- **One, I don't touch the patient;**
- **Two, you do not touch the patient;**
- **Three, no one touches the patient"**

Ensure that no personnel are in contact with the patient and that the oxygen source is turned off and removed

When the shock button is pressed, make sure no one touches the victim.

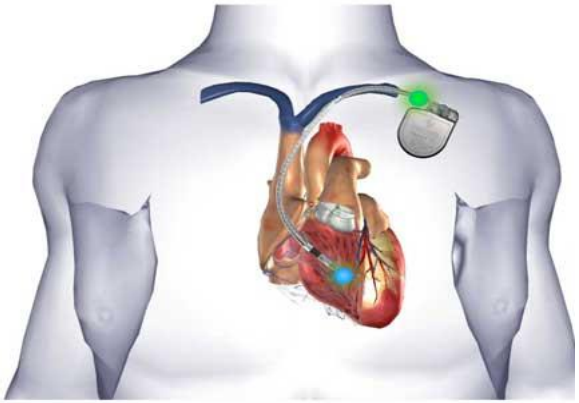
- **the rescuer will press the shock button according to the indications (fully automatic AEDs will administer the shocks directly);**
- **immediately continue CP and CR with a compression : ventilation ratio of 30:2.**

AED

- ❖ **If there is no indication of shock:**
- **immediately restart CP and CR using a ratio of 30 compressions to 2 ventilations;**
- **continue according to verbal or displayed instructions.**
- ❖ **Continue to follow DEA commands until:**
- **resuscitation is taken over by qualified personnel;**
- **the victim shows signs of life: he moves, opens his eyes and breathes normally;**
- **the rescuer is physically exhausted.**
- ❖ **CPR and C before defibrillation**

The importance of immediate defibrillation when an AED is available has always been emphasized in guidelines and during training, and is considered to have a major impact on survival after VF. There are data that have suggested that a period of CP and CR before defibrillation can improve survival in patients in whom the time interval between the time of arrest and the time of crew intervention exceeds 5 minutes. Two recent clinical studies as well as those on animals did not confirm the benefit on survival.

AED

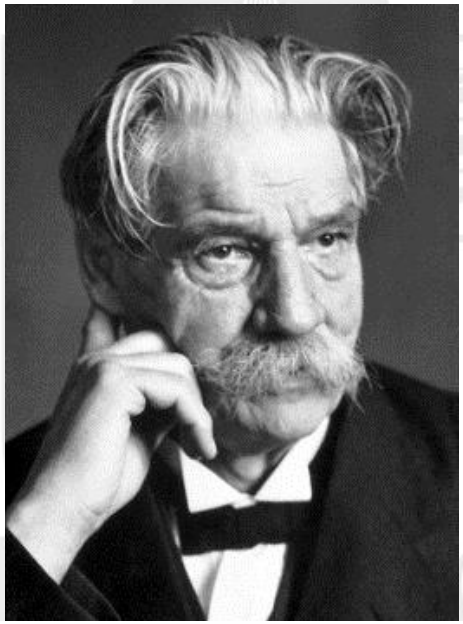


- **Automatic implantable defibrillators of different generations, from the first models to the latest small models.**

AED

- **When applying the self-adhesive pads to the patient's ribcage, press firmly starting from the edge of the pad and continuing over its entire surface to exclude the formation of air pockets.**

Thank you for your attention!



Albert Schweitzer

"Success is not the key to happiness.

Happiness is the key to success. If you like what you do, you will enjoy success."

Albert Schweitzer

QUESTIONS?