Automated External Defibrillation - 2021




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Contents

In the preparation of these notes full acknowledgement is given to:-
Resuscitation Council (UK) -The 2021 Resuscitation Guidelines

aid training

General Course Objectives

The purpose of this course is to orientate the First Responder to the initial assessment, and management of cardiac arrest using an Automated External Defibrillator (AED).

The theoretical content of the course, and the practical skills acquired during it, are designed to enable the student to provide the first aid skills needed to give immediate care. The course represents the minimum level of training necessary to manage the casualty before more experienced help is available.

Upon completion of the course the student will be able to:

- **Understand the principles of resuscitation**
- **Provide effective management at a suspected cardiac arrest**
- **Establish immediate care priorities**
- **Initiate the primary care necessary within the first few minutes of a life threatening emergency**
- **Safely and effectively operate an AED**

Course Knowledge and Performance Evidence

Unit 1 Adult Cardiopulmonary Resuscitation

Establish the need for and carry out CPR on an adult.

Knowledge evidence:

- **Potential sources of danger**
- **Causes of unconsciousness**
- **Common causes of cardiopulmonary arrest**
- **Importance of correct hand position on sternum for chest compressions**

Performance evidence:

The candidate shall perform CPR, as a lone rescuer, in a simulated incident on an appropriate resuscitation manikin. The manikin shall be assumed to be an unconscious adult who is not breathing and has no signs of a circulation. The performance of CPR must last for at least three minutes.

Unit 2 Use of an Automated External Defibrillator on an Adult

Demonstrate safe and appropriate practise when using an AED in line with current protocols.

Knowledge evidence

- **Basic understanding of ventricular fibrillation**
- **The importance of early defibrillation**
- **What makes a victim suitable/unsuitable for defibrillation**
- **Maintenance requirements of AEDs**
- **Appropriate record keeping relating to the use of AEDs**

Performance evidence

The candidate is required to demonstrate, as a lone rescuer, the assessment of an unconscious, non-breathing victim. This is to be followed by a demonstration of how to use an AED and perform CPR. An appropriate resuscitation manikin and training AED should be used. The following situations should be simulated:

- **Victim in ventricular fibrillation -"Shock advised"**
- **"No shock advised"**

Each simulation should last about 10 minutes

Course Assessment Criteria

In order to successfully complete the course the student must:

- **Attend the entire course**
- **Pass practical assessments in:**
  - ***o*** **Establishing the need for and carrying out CPR on an adult.**
  - ***o*** **Demonstrate safe and appropriate practise when using an AED in line with current protocols**
- **A student failing one of these elements will fail to complete the course**

Introduction

In the UK approximately 30,000 people sustain cardiac arrest outside hospital and are treated by emergency medical services (EMS) each year. Electrical defibrillation is well established as the only effective therapy for cardiac arrest caused by ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT). The scientific evidence to support early defibrillation is overwhelming; the delay from collapse to delivery of the first shock is the single most important determinant of survival. If defibrillation is delivered promptly, survival rates as high as 75% have been reported. The chances of successful defibrillation decline at a rate of about 10% with each minute of delay; basic life support will help to maintain a shockable rhythm but is not a definitive treatment. The Resuscitation Council (UK) recommends strongly a policy of attempting defibrillation with the minimum of delay in victims of VF/VT cardiac arrest.

The Circulatory System

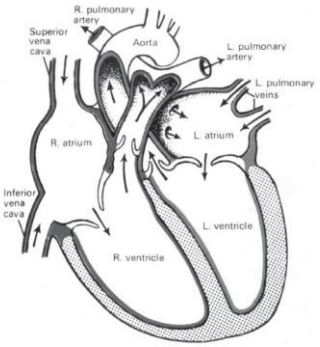
The main purpose of the circulatory system is to provide all the cells of the body with oxygen and nutrients in order to function. It also transports waste products, such as carbon dioxide, from the cells to be expelled from the body.

It consists of the heart, veins, capillaries and arteries.

The Heart:

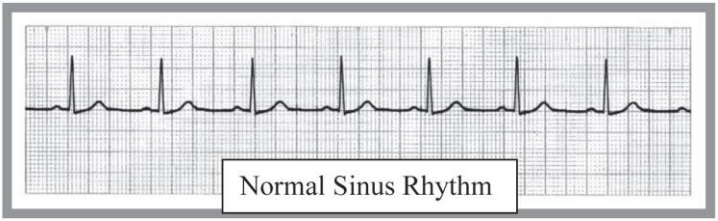
Contains four chambers, the right and left atrium and the right and left ventricles. The left ventricle has a thicker muscular layer because it has to pump blood around the whole of the body. The right side of the heart contains blood that is low in oxygen. The left side contains oxygenated blood. It beats in a co-ordinated way to pump oxygenated blood to the body, at an average rate of 60-80 bpm, in an adult.

Blood Flow Through the Heart



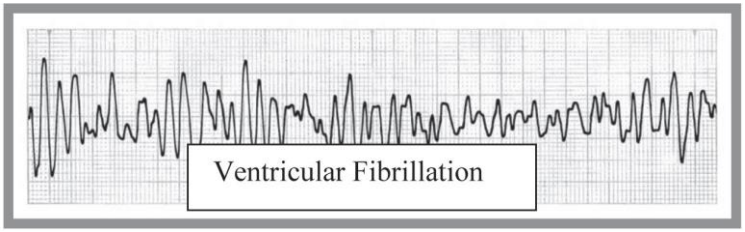
Basic Rhythms of the Heart

When working correctly the heart is said to be in Normal Sinus Rhythm.

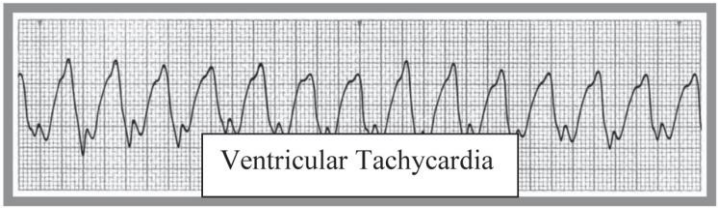


If the heart is damaged in some way, it often develops an irregular electrical conduction, called an "arrhythmia". Arrhythmias can often cause a decrease in the pumping action of the heart, and if severe enough may lead to the heart's inability to pump blood. This is known as cardiac arrest.

In approximately 75% of cases the heart will be in a rhythm called Ventricular Fibrillation (VF). This arrhythmia is caused by a total disruption of the heart's electrical conduction system, leading to uncoordinated pumping and therefore no cardiac output. This rhythm is the most amenable to defibrillation.



Another rhythm that is amenable to defibrillation is Pulseless Ventricular Tachycardia. This occurs in approximately 2% of cardiac arrest victims and is characterised by a heartbeat greater than 150 beats per minute.



Asystole is another common rhythm, this occurs when all electrical activity in the heart has ceased. This is a serious condition treatable only by advanced cardiac life support.

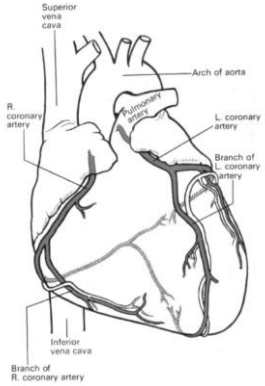
Cardiac Conditions

The heart:

As previously described the heart is a very specialised pump whose muscle (the myocardium) beats continuously usually in a co-ordinated manner, controlled by an electrical impulse.

The heart muscle has its own blood supply via the coronary arteries. These arteries may become occluded (blocked) due to a thrombus or narrowed due to a build up of plaque deposits-Arteriosclerosis. When this occurs blood supply, and therefore oxygen, to the heart becomes diminished and the patient starts to develop chest pains along with other signs and symptoms. Thus heart attack is often referred to as a "Coronary" but the correct term is "Myocardial Infarction" or death of the muscle tissue of the heart. The following conditions may be present depending on how severely the arteries are blocked.

The Coronary Arteries



Angina:

Describes a temporary disturbance affecting the blood and oxygen supply to the heart muscle due to narrowing or spasm of the coronary arteries. The chest pain usually occurs when patients are exerting themselves, for example climbing stairs, carrying heavy bags, or on a cold day. This is known as stable angina. However, in severe cases it can occur at any time, even at rest, and is therefore known as unstable angina.

Signs and symptoms: are very similar to heart attack (see below) except the symptoms usually subside with rest:

- **Chest pain**
- **Shortness of breath**
- **Sweating**
- **Nausea**
- **Feeling of weakness**
- **Anxiety**

Treatment: the aim is to ease the strain on the heart

- **Put the casualty at rest**
- **Reassure**
- **Assist them to administer GTN - a vasodilator**
- **Summon the emergency services quickly**
- **If pain persists suspect a heart attack**
- **Be prepared to resuscitate**

Heart attack:

Occurs when a portion of the myocardium is deprived of oxygen and dies. The severity of the heart attack will depend on how much myocardium has been deprived of oxygen and what part of the heart is affected.

Signs and symptoms:

- **Sudden crushing, vice like central chest pain, which may radiate to the jaw, left and right arms. Some casualties may also describe the pain as indigestion or as though a heavy weight was placed on their chest**
- **Cold clammy skin - ashen in colour**
- **Shortness of breath**
- **Feeling faint or possible collapse**
- **Nausea and/or vomiting**
- **Possible hiccups**
- **Impending sense of doom**

Treatment:

- **Put the patient at ease**
- **Minimise the work of the heart**
- **Position - half sitting, head and shoulders raised, knees bent**
- **Seek urgent medical help**
- **Monitor**
- **Be prepared to resuscitate**

Cardiac arrest:

Cardiac arrest occurs when the heart stops beating efficiently. The heart may stop beating altogether a condition called cardiac standstill or asystole. Alternatively, the heart may not work properly because of uncoordinated electrical activity a condition known as ventricular fibrillation (VF).

Possible causes include:

- **Heart attack**
- **Blood loss**
- **Suffocation**
- **Electric shock**
- **Drug overdose**
- **Hypothermia**

Recognition:

- **Unresponsive**
- **Absent or abnormal breathing**

Treatment:

- **Call an ambulance**
- **Commence C.P.R**
- **Defibrillate as soon as possible**
- **Seek urgent medical help**

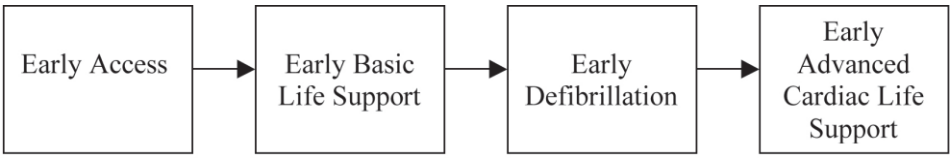
Cardiopulmonary Resuscitation

This is more commonly known as Basic Life Support and is a frightening situation with which the first aider will be expected to deal with.

There are many reasons why a person stops breathing and their heart stops beating. If you approach this situation calmly and remember all the skills taught to you, you will have provided both the casualty and the emergency services with the best possible start from which they can continue more advanced treatments.

It is important to understand that Basic Life Support forms only one link in the casualty's treatment. This treatment has four component parts and is generally referred to as:

"The Chain of Survival"



Early Access to the emergency services

Early Basic Life Support to buy time

Early Defibrillation to "restart" the heart

Early Advanced Cardiac Life Support to stabilise the casualty

"The Chain of Survival" is only as strong as its weakest link.

Remember don't let your Basic Life Support skills get rusty - they may save somebody's life, possibly a relative or friend.

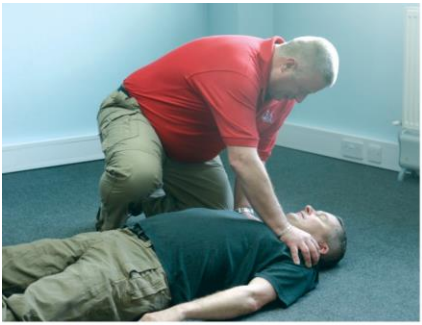
Adult Basic Life Support

Danger	
Unresponsive?	Shake and Shout
Shout for Help	
Open the Airway	Head tilt/chin lift
Absent or abnormal breathing	Check for max 10 seconds
30 Chest Compressions	
2 Rescue Breaths **30 Chest Compressions**	Hands placed in the centre of the chest

Notes on Basic Life Support:

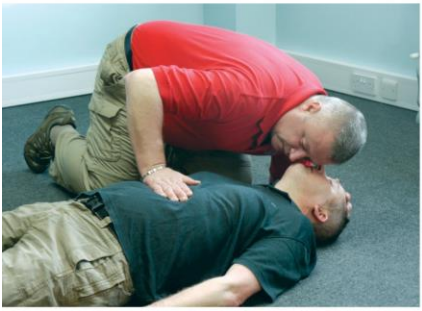
- The diagnosis of cardiac arrest is made if the victim is unresponsive and breathing is absent or abnormal
- Each rescue breath should take one second
- The ratio of compressions to ventilations is 30:2. This ratio should also be used on children when a "lay person" is responding
- The rate of compressions is 100 - 120 per minute
- The chest should be compressed by between 5 – 6 cm
- If two people are responding one should carry out 30:2 while the other rests and they should change over completely approximately every two minutes
- If a rescuer is unwilling, or unable, to do rescue breaths they should give chest compressions only at a continuous rate of 100 -120 per minute
- Do not stop to check the victim or discontinue CPR unless the victim starts to show signs of regaining consciousness, such as coughing, opening the eyes, speaking or moving purposefully AND starts to breathe normally

Basic Life Support



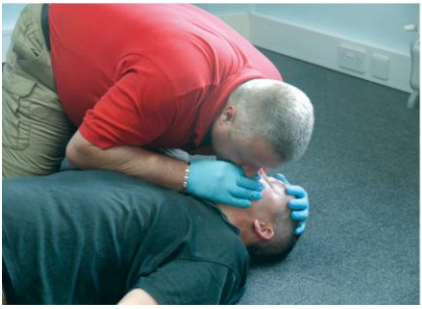
1.Check for danger then 'shake and shout'

2. Shout for 'help' then open airway



3. Check breathing for a maximum of 10 seconds

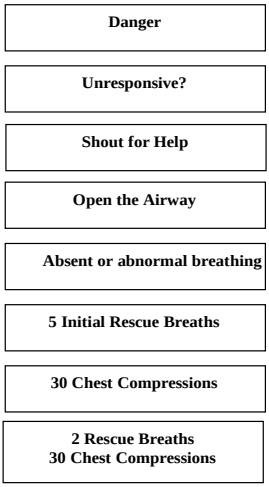
4. If not breathing normally call 999/ ensure an AED is on the way and commence 30 chest compressions



5. Followed by 2 rescue breaths

6. Continue with 30 compressions followed by 2 breaths

Child Basic Life Support



Shake and Shout

Head tilt/chin lift

Check for max 10 seconds

Hands placed in the centre of the chest

Sending for Help:

- If two people are responding one should call 999 immediately that the child is found to be not breathing normally
- If one person is responding they should carry out one minutes CPR/BLS before calling 999

Notes on Basic Life Support:

- An infant is considered to be under one year old
- A child is > one until 18 years of age
- Each rescue breath should take one second
- The ratio of compressions to ventilations is 30:2
- The rate of compressions is 100 - 120 per minute
- The chest should be compressed by at least a third of the depth of the chest wall (4cm for an infant and 5cm) for a child using two fingers for infants and one/two hands for a child.
- If two people are responding one should carry out 30:2 while the other rests and they should change over completely approximately every two minutes
- If a rescuer is unwilling, or unable to do rescue breaths they should give chest compressions only at a continuous rate of 100 – 120 per minute

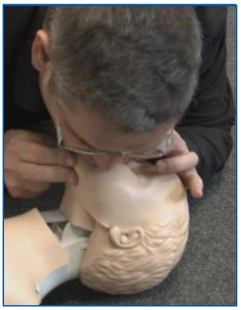
Child Basic Life Support

1.If unresponsive shout for help

2.Check breathing for a maximum of 10 seconds

3.If no sign of breathing Administer 5 rescue breaths

4.Give 30 chest compressions

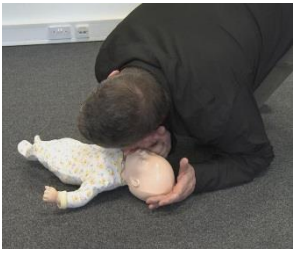


5.Give 2 rescue breaths

Baby Basic Life Support

1.Check for response

2.If unresponsive shout for help and open the airway



3.Check for breathing for a maximum of 10 seconds

4.If not breathing normally give 5 rescue breaths

5.Give 30 chest compressions

6.Followed by 2 rescue breaths

The Recovery Position

The recovery position may be used for unconscious casualties who are breathing and who are going to be left alone for any period of time, for example while the first aider goes for assistance. In addition, any casualty who has an airway that may be at risk should be placed in this position. Care should be taken when rolling casualties with major injuries and in cases of suspected spinal trauma.

The recovery position:

- Helps prevent the tongue from blocking the throat
- Aids drainage

The following sequence should be followed:

1. Remove glasses, and any sharp objects from pockets.
2. Place the arm closest to you in the “how” position.
3. Bring the arm furthest away from you and hold the back of the casualty’s hand against their nearest cheek.
4. With your other hand pull up the far leg just above the knee, keeping the foot flat on the ground.
5. Keeping the casualties hand pressed against the cheek (supporting their head) pull on the far leg rolling the casualty towards you.
6. Use your knees to support the casualty to prevent them rolling too far onto their face.

The Recovery Position

7. Tilt the head backwards ensuring an open airway.
8. Ensure the furthest hand is under their cheek.
9. Adjust the upper leg so that the hip and knee are bent at right angles.
10. Call for the emergency services.
11. Monitor airway, breathing and circulation constantly
12. Monitor the circulation in the lower arm. If they are in the position for longer than 30 minutes consider rolling them on to the opposite side, injuries permitting, to restore the circulation into the lower arm

The Recovery Position

1. The nearest hand is placed in the “how” position, the other hand is across the face supporting the head

2. Bend the opposite leg and roll the casualty towards you.

3. Ensure an open airway

4. Check for breathing

5. Bring the leg up to support the casualty

6. It is now safe to leave the casualty if you have to get help

Automated External Defibrillation

The Automated External Defibrillator (AED)

AEDs are sophisticated, reliable, safe, computerised devices that deliver electric shocks to victims of cardiac arrest when the ECG rhythm is one that is likely to respond to a shock. Simplicity of operation is a key feature: controls are kept to a minimum, voice and visual prompts guide rescuers. Modern AEDs are suitable for use by both lay rescuers and healthcare professionals.

All AEDs analyse the victim's ECG rhythm and determine the need for a shock. The semi-automatic AED indicates the need for a shock, which is delivered by the operator, while the fully automatic AED administers the shock without the need for intervention by the operator. Some semi-automatic AEDs have the facility to enable the operator (normally a healthcare professional) to override the device and deliver a shock manually, independently of prompts.

There are many makes of defibrillator on the market, all of which differ slightly. However, most AED units are normally about the size of a small brief case, and weigh approximately 3.5kg. They normally have a carrying handle and come stored in a case that contains other necessary equipment. This equipment would normally consist of a razor, paramedic shears and spare electrodes. The units are powered by battery and most AEDs now have 5 year maintenance free lithium batteries, although rechargeable batteries are also available.

They generally have two modes of prompt, voice and an LCD screen. The machine is operated by pushing buttons of which there may be anything from one to three. Typically these buttons are "on/off", "analyse" and "shock".

There will also be a port for attaching the disposable electrodes. The electrodes come wrapped in a foil pack and will only fit on to the AED in one way. The foil pack normally has a diagram indicating the normal positioning of the electrodes on the casualty. It is acceptable to have the electrodes attached to the AED during storage to save time during a resuscitation attempt.

Who Can Use an AED

An AED can be used safely and effectively without previous training. Therefore, the use of an AED should not be restricted to trained rescuers. However, training should be encouraged to help improve the time to shock delivery and correct pad placement.

Defibrillator Safety

The following points should be borne in mind before and during the use of an AED:

- Nobody should be in contact with the casualty during the shock process - all CPR must stop
- The casualty should not be touching any metal
- The casualty should be dry – see next paragraph
- There should be no free flowing gases, normally during resuscitation oxygen will be in use – see below
- No GTN patches which may catch fire or cause the current to arc
- No jewellery around or near the electrodes

Defibrillation if the Victim is Wet

As long as there is no direct contact between the user and the victim when the shock is delivered, there is no direct pathway that the electricity can take that would cause the user to experience a shock. Dry the victim's chest so that the adhesive AED pads will stick and take particular care to ensure that no one is touching the victim when a shock is delivered.

Defibrillation in the Presence of Supplemental Oxygen

There are no reports of fires caused by sparking where defibrillation was delivered using adhesive pads. If supplemental oxygen is being delivered by a face mask, remove the face mask and place it at least one metre away before delivering a shock. Do not allow this to delay shock delivery.

Placement of AED Pads

Place one AED pad to the right of the sternum (breast bone), below the clavicle (collar bone). Place the other pad in the left mid-axillary line, approximately over the position of the V6 ECG electrode. It is important that this pad is placed sufficiently laterally and that it is clear of any breast tissue.

Although most AED pads are labelled left and right, or carry a picture of their correct placement, it does not matter if their positions are reversed. It is important to teach that if this happens 'in error', the pads should not be removed and replaced because this wastes time and they may not adhere adequately when re-attached.

The victim's chest must be sufficiently exposed to enable correct pad placement. Chest hair will prevent the pads adhering to the skin and will interfere with electrical contact. Shave the chest only if the hair is excessive, and even then spend as little time as possible on this. Do not delay defibrillation if a razor is not immediately available.

Sequence of Actions When Using an Automated External Defibrillator

The following sequence applies to the use of both semi-automatic and automatic AEDs in a victim who is found to be unconscious and not breathing normally.

1. **Follow the adult BLS sequence as described in the basic life support chapter. Do not delay starting CPR unless the AED is available immediately.**

2. **As soon as the AED arrives:**

- If more than one rescuer is present, continue CPR while the AED is switched on. If you are alone, stop CPR and switch on the AED
- Follow the voice / visual prompts
- Attach the electrode pads to the patient's bare chest
- Ensure that nobody touches the victim while the AED is analysing the rhythm

3A. If a shock is indicated:

- Ensure that nobody touches the victim
- Push the shock button as directed (fully-automatic AEDs will deliver the shock automatically)
- Continue as directed by the voice / visual prompts
- Minimise, as far as possible, interruptions in chest compression

3B. If no shock is indicated:

- Resume CPR immediately using a ratio of 30 compressions to 2 rescue breaths
- Continue as directed by the voice / visual prompts

4. **Continue to follow the AED prompts until:**

- qualified help arrives and takes over OR
- the victim starts to show signs of regaining consciousness, such as
- coughing, opening his eyes, speaking, or moving purposefully AND starts to
- breathe normally OR
- you become exhausted

Combining BLS and Defibrillation

Provide good quality CPR while the AED is brought to the scene. Continue CPR whilst the AED is turned on, then follow the voice and visual prompts. Giving a specified period of CPR, as a routine before rhythm analysis and shock delivery, is not recommended.

When using an AED minimise interruptions in chest compression. Do not stop to check the victim or discontinue cardiopulmonary resuscitation (CPR) unless the victim starts to show signs of regaining consciousness, such as coughing, opening his eyes, speaking, or moving purposefully AND starts to breathe normally.

Interrupt CPR only when it is necessary to analyse the rhythm and deliver a shock. When two rescuers are present, the rescuer operating the AED applies the electrodes while the other continues CPR. The AED operator delivers a shock as soon as the shock is advised, ensuring that no one is in contact with the victim.

AED Use on Children

The incidence of shockable rhythms requiring defibrillation in the paediatric population is very low but can occur. The priority must always be for high quality CPR and getting expert help. However, the AED can be deployed across all age groups if this is the only available machine.

The **paediatric advanced life support guidelines 2015** state that if using an AED on a child of less than eight years, a paediatric attenuated shock energy should be used if possible. Commonly the AED will then restrict the shock energy to around 50 J. If the machine is sited in a school, a device or ability to attenuate the energy level should be available and training should be provided in the machine's use and users should always refer to the manufacturers guidance when writing local user guides.

Experience with the use of AEDs (preferably with dose attenuator) in children younger than 1 year is limited. The use of and AED is acceptable if no other option is available as on balance it is probably better to give a 50 J shock than nothing at all – the upper safe limit for dosage in this group is unknown.

Recommended Accessories

It is advisable to carry the following accessories in a case attached to the AED, so if an untrained helper gets the AED for you, they will automatically bring the accessories too.

- Spare AED pads
- Paediatric pads if deemed necessary
- Resuscitation barrier
- Paramedic shears
- Towel
- Razor
- Protective gloves

AED Operation

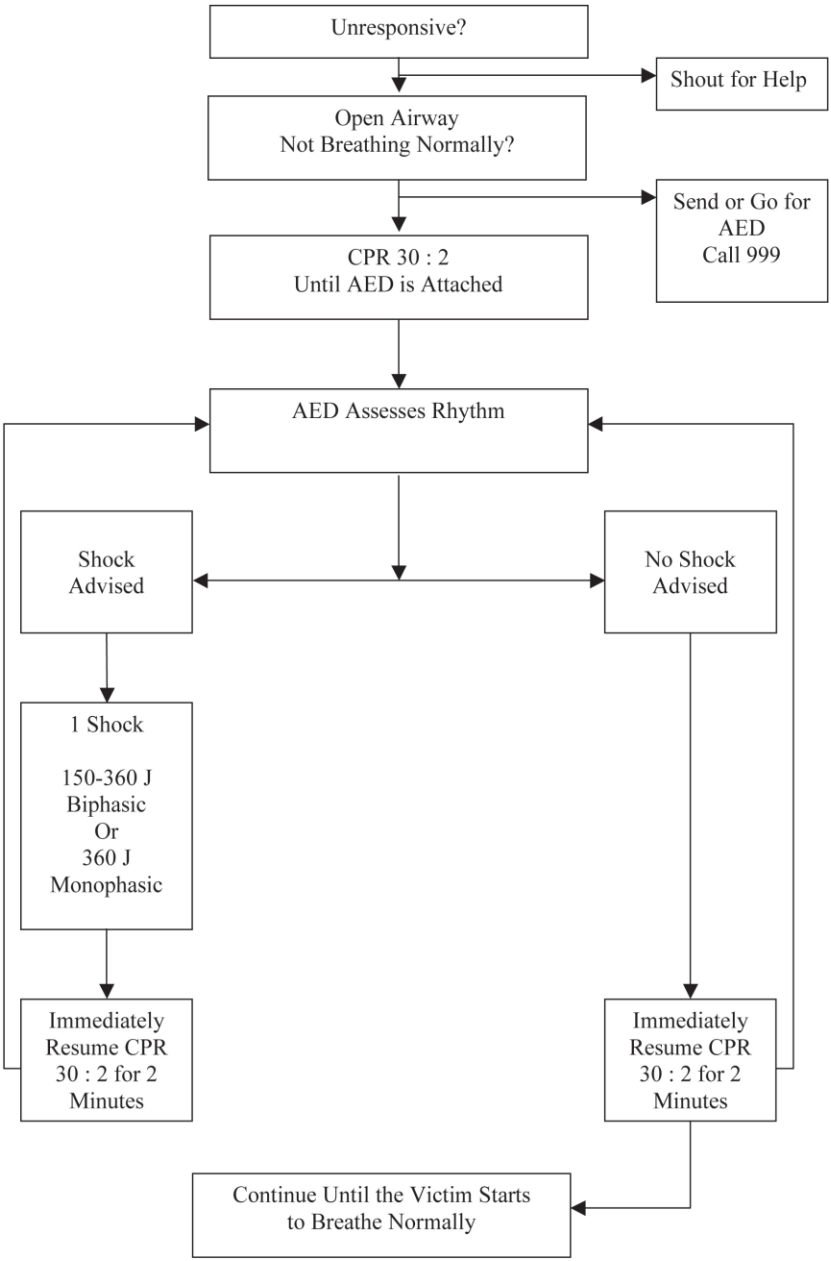
1. Prepare the casualty and set up AED

2. Try and keep BLS going if at all possible

3. Turn on the AED and follow the voice prompts

4. Don't touch the patient whilst the AED is analysing a rhythm

5. Follow the voice prompts and if necessary push the button to shock


Unresponsive?
Shout for Help
Open Airway
Not Breathing Normally?
Send or Go for
AED
Call 999
CPR 30 : 2
Until AED is Attached
AED Assesses Rhythm
Shock
Advised
No Shock
Advised
1 Shock
150-360 J
Biphasic
Or
360 J
Monophasic
Immediately
Resume CPR
30 : 2 for 2
Minutes
Immediately
Resume CPR
30 : 2 for 2
Minutes
Continue Until the Victim Starts
to Breathe Normally

Maintenance and Storage of AEDs

Maintenance

AEDs are a potential lifesaving piece of equipment, as such they should be maintained properly. Many AEDs will self-test themselves on a daily, weekly and monthly basis. They generally have a visual and audio prompt when they need operator maintenance. It is important that they are checked regularly in accordance with the manufacturer's guidelines and that these checks are recorded in a suitable logbook.

Storage

AEDs should be stored in locations that are immediately accessible to rescuers; they should not be stored in locked cabinets as this may delay deployment. Use of the UK standardised AED sign is encouraged, to highlight the location of an AED. People with no previous training have used AEDs safely and effectively. While it is highly desirable that those who may be called upon to use an AED should be trained in their use, and keep their skills up to date, circumstances can dictate that no trained operator (or a trained operator whose certificate of training has expired) is present at the site of an emergency. Under these circumstances no inhibitions should be placed on any person willing to use an AED.

After a Resuscitation Attempt

Reporting

It is very important that details relating to a resuscitation attempt are reported to the medical director under whom the AED is operated. Many AED's have the ability to record the details of the defibrillation attempt. This may be internally recorded or via a card. The information recorded will normally be the AED's rhythm recognition and what was done by the operator, but may in some cases also include a voice recording of the rescuers. This information is normally downloaded via the manufacturer's software.

Support

Taking part in a resuscitation attempt can be a very emotional and stressful experience. The medical director should ensure that appropriate support is available for all AED users. This would normally take the form of "critical incident debriefing

aid | training

Below are some of the many courses that we run either in-house or at our training venues nationwide.

First Aid

First Aid at Work - 3 day and 2 day requalification
Emergency First Aid at Work – 1 day

First Aid for Child Carers

Automated External Defibrillation

Basic Life Support training

First Responder - 5 day advanced course

Food Hygiene

Basic and Advanced

Conflict Management

Personal Safety Training

Manual Handling

Loads and People

Fire Safety

Basic Fire Safety, including practical extinguisher use

Fire Warden/Marshal

Health & Safety

Basic & Advanced

COSHH

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