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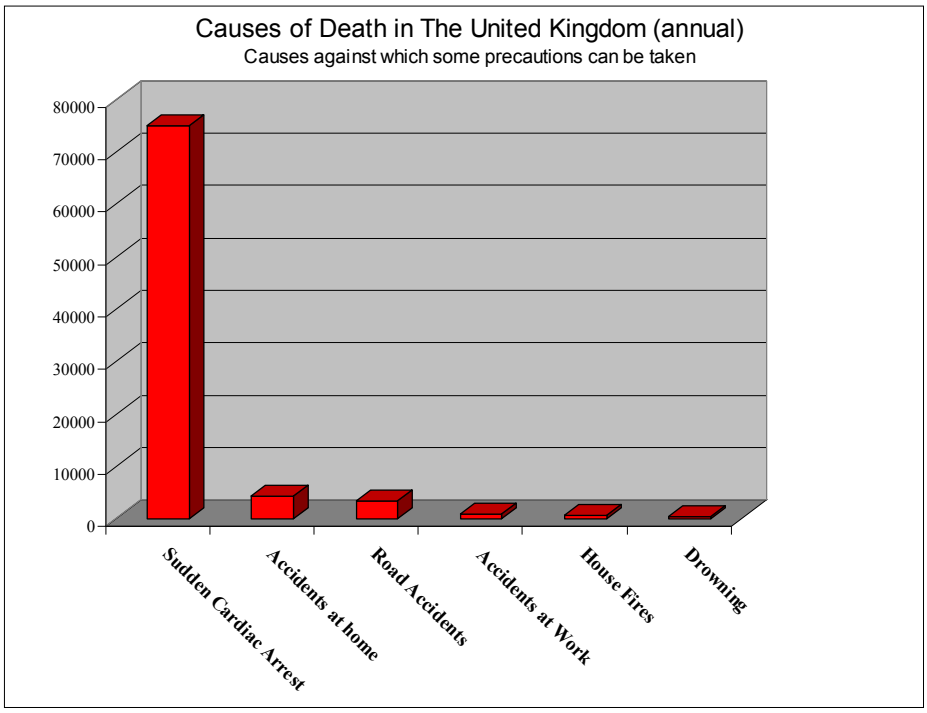
Information Note
Sudden Cardiac Arrest

Introduction

This information note is intended to provide members of the public with some more in depth information about sudden cardiac arrest (SCA).

Sudden Cardiac Arrest (SCA)

Sudden cardiac arrest (SCA) or sudden cardiac death (SCD) as it is sometimes known, is a major cause of death in the United Kingdom. It is estimated that 70 to 80 THOUSAND people per year suffer SCA and the survival rate is believed to be around 2 to 5 percent. It is now well accepted by the medical community that the survival rate from SCA could be significantly improved with improvements in public awareness of the problem, some simple training and easy availability of Automatic External Defibrillators. The scale of the problem can be illustrated by considering the number of people who die in the UK from causes against which we can take some precautions:



We all typically take precautions against drowning, house fires, road accidents etc. for example by buying and installing smoke alarms, fire extinguishers and fire blankets or using lifejackets and life rafts on a boat. Your car is full of safety devices such as seat belts, air bags and crumple zones which may add thousands of pounds to the cost of the car. But what precautions do you take against sudden cardiac arrest?

To understand more about Sudden Cardiac Arrest we need to have a basic understanding of how the heart works:

The Heart Explained

The heart is a muscular pump, approximately the same size as its owner's fist, and is located behind and slightly to the left of the breastbone. Its function is to pump oxygen-rich blood from the lungs to the brain and other parts of the body, and to pump the de-oxygenated blood from the tissues back to the lungs to take on more oxygen. The heart pumps about 7,000 litres of blood around the body every day.

The Heart's Mechanical Action

The heart has four chambers and four "one way" valves. When the upper chambers (called "Atria") contract, they push the blood through valves into the relaxed lower chambers (called "Ventricles"). When the ventricles contract, the right ventricle pumps blood through the pulmonary valve into the lungs. The left ventricle pumps blood through the aortic valve to the body, including the heart (through coronary arteries). It is the pressure of the blood reflected on the walls of the arteries which is felt as a pulse.

The source that controls this mechanical activity is electrical stimulation. This continuous cycle of synchronised contractions is driven by the heart's electrical system.

The Heart's Electrical System
The heart's electrical system causes the heart to beat, controls the heart rate (the number of beats per minute) and has special pathways (conduction pathways) that carry the electrical signals throughout the lower heart chambers (ventricles) for each heartbeat.

When heart cells in the upper heart chambers (atria) receive an electrical signal, they contract (pump) and then relax. The blood from the atria is pumped into the relaxed lower heart chambers (ventricles) and then pass down the separating tissue to the ventricles, causing them to contract and pump blood to the body. On completion of the contraction of the ventricles, the electrical impulses cease, and the heart muscle relaxes.

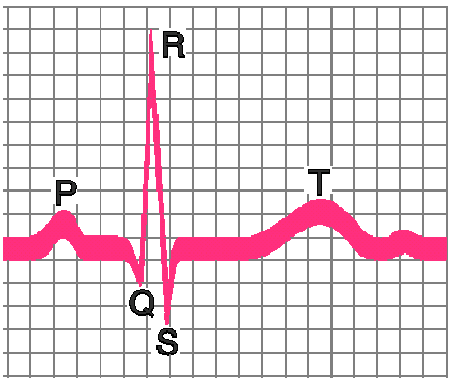
BLOOD CIRCULATION CYCLE

The blood coming from the lungs to the heart collects in the Left Atrium,. The blood coming from the rest of the body to the heart collects in the Right Atrium,. The hearts electrical system sends a small electrical signal to the walls of the atria which initiates a contraction of the walls of the atria forcing the upper Valves to open as the blood gushes into the Ventricles.

The Ventricles fill with blood and an electrical signal initiates the muscles of the Ventricles to contract which forces the upper Valves to close. On the left side of the heart the contraction also opens the Aortic Valve, and squeezes the blood from the left ventricle through the Aortic Valve and on to the body . On the right side of the heart the contraction opens the Pulmonary Valve and squeezes the blood through the Pulmonary Valve and on to the lungs

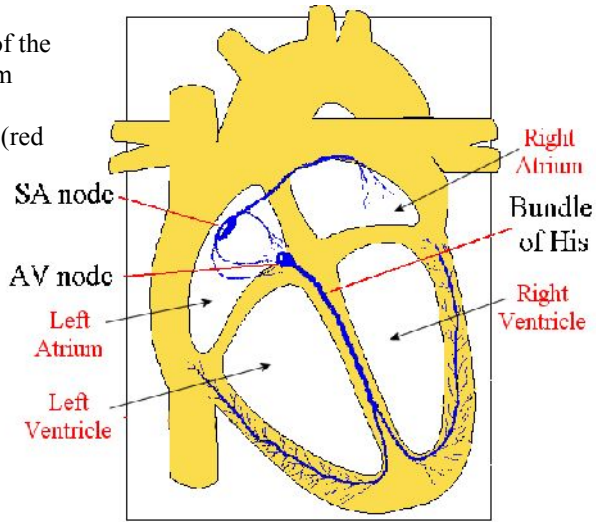
The blood coming out of the Left Ventricle to the Aorta is under high pressure. This pressure is enough to push the blood to the different parts of the body at high velocity and give its oxygen and nutrients to the body tissues. The blood comes back from the body to the right side of the heart.

The actions of the left side and right side of the heart occur simultaneously and are controlled by the electrical system of the heart. This electrical system generates a small electrical signal which can be seen on a typical ECG (Electrocardiogram) waveform which is illustrated below.



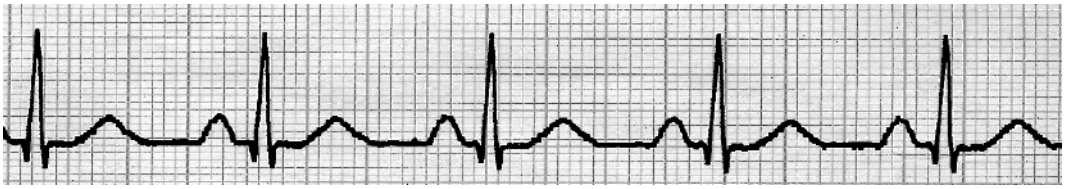
Above: The "ECG" waveform

Right: Key elements of the hearts electrical system (black text) and the chambers of the heart (red text)



The SA node is the hearts "Pacemaker" which generates a small electrical pulse at a rate of 60 to 100 pulses per minute at rest and increases this rate in response to the demands of the body for oxygen, for example during exercise . This initial small electrical pulse is seen on the ECG waveform as the "P" wave and its is this electrical signal which causes the muscles of the left and right atria to contract as described in the blood circulation cycle above.

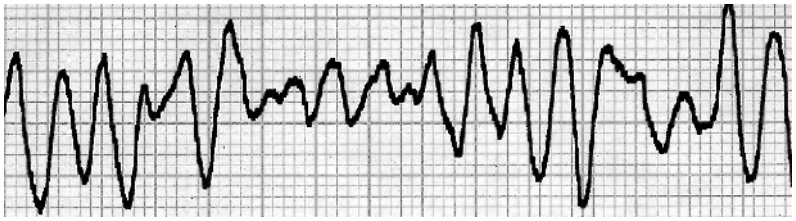
As well as causing the atria to contract this initial "P" wave is carried to the "AV Node" which acts as a sort of electrical relay. The AV node delays the electrical pulse for a fraction of a second which can be seen as the small delay on the ECG waveform between the "P" wave and the "Q" wave. After this short delay the AV Node retransmits the electrical pulse to a network of conductive fibres called "the Bundle of His" which sends the electrical signal to all parts of the left and right ventricles causing the muscles of the ventricles to contract strongly as described in the blood circulation cycle above. It is this strong contraction that is seen on the ECG waveform as the "QRS" wave. After this contraction has taken place the heart muscles relax and generate a small electrical signal which is seen on the ECG wave as the "T" wave. The whole cycle then repeats at a rate of 60 to 100 cycles per minute (at rest) and can also be felt as the bodies pulse. If you view the electrical waveform on a heart monitor or on an ECG recorder the normal rhythm will look something like this:



Understanding Sudden Cardiac Arrest and Defibrillation

What is Sudden Cardiac Arrest?

Sudden Cardiac Arrest (SCA) is due an electrical malfunction of the heart typically (but not always) associated with an abnormal heart rhythm known as "ventricular fibrillation". It is a condition in which the heart's electrical impulses suddenly become chaotic, causing an abrupt cessation of the heart's pumping action. Instead of beating in a regular coordinated manner the heart begins to "quiver" and is unable to pump blood. If you were able to view the electrical waveform of a patient suffering from Ventricular Fibrillation (VF) on a heart monitor or ECG recorder the rhythm will look something like this



Victims collapse and quickly lose consciousness, often without warning. Unless a normal heart rhythm is restored, death follows within a matter of minutes. The average survival rate is less than five percent.

What causes sudden cardiac arrest?

SCA is largely unpredictable. Many victims have no prior history or symptoms of heart disease.
One common cause (but by no means the only cause) of sudden cardiac arrest is a "heart attack". "Heart Attack" is not strictly a recognised medial term. Most doctors prefer the term "Myocardial infarction" or "MI". A Myocardial infarction occurs when you get a blockage in the small arteries that feed blood to the heart muscle itself. This usually results in the characteristic "crushing" chest pain felt by victims as the heart muscles are starved of oxygen. This oxygen starvation can sometimes trigger the chaotic heart rhythm called ventricular fibrillation described above which causes the patient to collapse and suffer a sudden cardiac arrest. Sudden cardiac arrest can often occur in the early stages of a heart attack leading to collapse and death within a few minutes.

Other factors besides heart disease and heart attack can cause SCA, including respiratory arrest, electrocution, drowning, choking or trauma. SCA can sometimes be caused by physical impact on the chest over the heart (this has the medical term "commotio cordis"). SCA in young apparently healthy adults or children can also be caused by undiagnosed problems with the heart which do not manifest themselves until the patient suffers an attack of SCA, possibly during a period of intense or sporting activity.
Some people, for example those who have suffered a heart attack (Myocardial infarction) in the past may be at higher risk of SCA

How Do You Treat Sudden Cardiac Arrest?
A person who has collapsed, is unresponsive and is not breathing normally may be suffering sudden cardiac arrest and needs to be treated very quickly. If you suspect a patient is in cardiac arrest you should call the emergency services immediately. For the best chance of survival effective treatment needs to be given within the first few minutes. This treatment should include CPR (cardiopulmonary resuscitation) which consists of manual chest compressions and rescue breaths (sometimes known as "the kiss of life") and rapid defibrillation. Modern AEDs like the Philips HeartStart Home will accurately and quickly analyse the patients heart rhythm to determine if the patient is actually suffering from sudden cardiac arrest and will not allow a shock to be delivered unless the patients heart needs one.

SCA is most often caused by the heart going into "ventricular fibrillation" (VF) A heart in ventricular fibrillation must be "defibrillated". To defibrillate the heart —to stop the chaotic and unproductive quivering of VF — an electrical shock must be applied. This electrical shock passes through the heart muscle and (if successful) "resets" the hearts electrical system enabling the normal heart rhythm to become re-established.

Defibrillation administered within the first few minutes after collapse gives the patient the best chance of survival The likelihood of successful resuscitation decreases by approximately 7-10 percent with every minute that passes. After several minutes, very few resuscitation attempts are successful. Thus, the most important element in the treatment of SCA is providing rapid defibrillation therapy.

CPR on its own is essential if a defibrillator is not immediately available. Although CPR can't stop fibrillation it can extend the patients life long enough for a defibrillator to arrive. The very best chance of survival comes from a combination of a rescuer with the right basic training, good quality CPR and most importantly, rapid defibrillation within the first few minutes. The Philips HeartStart Home defibrillator gives voice instructions on CPR so even untrained users can resuscitate a victim of sudden cardiac arrest.

Does early Defibrillation guarantee survival for the patient?
Unfortunately there is no guarantee that early defibrillation will ensure a patients resuscitation and survival. It may be impossible to resuscitate the patient for a number of reasons. Also a successful resuscitation is no guarantee of longer term survival of the patient. Early defibrillation does however provide the best chance of resuscitation and survival for someone suffering sudden cardiac arrest. Defibrillation is the only treatment for sudden cardiac arrest due to fibrillation of the heart. Initiation of correct treatment, including defibrillation, within the first 2 or 3 minutes can improve survival rates to as high as 70% or more. Waiting 10 minutes before treatment can reduce survival to 3% to 5%.

What Is An Automated External Defibrillator (AED)?
An AED is a small, compact device about the size and weight of a hardback book that can read and interpret heart rhythms and deliver electrical shocks to treat sudden cardiac arrest. The new generation AEDs are very simple to operate. You don't need to interpret heart rhythms, the AED does that automatically. The Philips HeartStart Home Defibrillator uses clear, natural voice instructions that guide the user through each step. You simply pull the handle, place the pads on the patients chest and let the defibrillator do the rest! They are also very safe, only allowing a shock to be delivered if the patients' heart needs one.

Is Defibrillation Hard to Learn?
Defibrillation (delivering an electrical shock to the heart) using an AED is very easy to learn. The training takes just a short amount of time and in many cases completely untrained users can successfully use a modern AED such as the Philips HeartStart Home. AEDs are now being placed in many public places and you can also buy a Philips HeartStart Home defibrillator for you own home, ready for use at all times.

More Information
For more information on sudden cardiac arrest and resuscitation please contact the British Heart Foundation (www.bhf.org.uk) , the UK Resuscitation Council (www.resus.org.uk) or your GP or Cardiologist.