Medical Emergencies – Heart Disease and Cardiopulmonary Resuscitation Procedures

Recommended Subject

Aims: To give an overview of the heart and its functions, the types of heart disease which may increase a patients' risk of a medical emergency in the dental surgery and to discuss cardiopulmonary resuscitation procedures.

Learning Outcomes: On completion of this verifiable CPD article the participant will be able to demonstrate, through completion of a questionnaire, the ability to:

- Identify the anatomy of the heart.
- Identify the function of the heart.
- Identify some types of heart disease.
- Demonstrate knowledge of how to manage the patient with Angina in the dental surgery.
- Demonstrate knowledge of how to deal with a cardiac arrest should one occur in the dental surgery.
- Have knowledge of guidance by the Resuscitation Council regarding Covid-19.

Introduction

The function of the heart is to maintain a constant circulation of blood throughout the body. The cardiovascular system comprises of the heart, arteries, veins and capillaries. The major functions of the cardiovascular system are to deliver oxygen, nutrients, hormones, and other metabolic products to tissues and cells of the body. Waste products and carbon dioxide are also transported by the cardiovascular system for removal from the body.[1] The heart beats approximately 100,000 times a day and pumps about 5,000 gallons of blood around the body.[2]

Cardiovascular disease (CVD) - also known as heart and circulatory disease, has been described as the biggest killer in the UK.[2] Nearly 175,000 deaths each year due to CVD an average of 460 each day or one death every 3 minutes.[3]

This article will outline the structure and flow of blood through the heart and some of the types of heart disease. In addition, this article will discuss the management of angina and cardiac arrest in the dental surgery.

The Structure of the Heart

The heart is a cone-shaped, muscular organ approximately 4" (10cm) long. A popular way to describe its size is to say it is as large as the owner's closed fist. It weighs approximately 225g in women and is heavier in men (300-350g).

The heart is situated in the thoracic cavity in a space known as the middle mediastinum. The mediastinum lies between the lungs (figure 1). It lies obliquely, a little more to the left than the right and presents a base above and an apex below.

The apex of the heart is about 3" (9cm) to the left of the midline at the level of the fifth intercostal space (i.e. a little below the nipple and slightly nearer the midline).

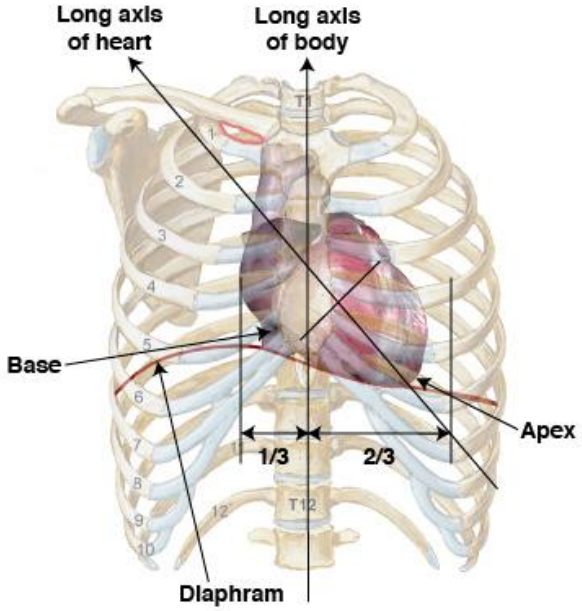


Figure 1. This illustration demonstrates an anterior view of the thoracic cavity, highlighting the position of the heart in relationship to the ribs and diaphragm. In the majority of cases, 2/3 of the heart is positioned to the left of midline with the inferior aspect resting on the diaphragm.[4]

The heart is composed of four chambers and the walls are essentially composed of three layers (figure 2). These layers are:

1) The Pericardium

The pericardium is made up of two sacs. The outer sac consists of fibrous tissue and the inner sac a double layer of serous membrane. The thin film of serous lubricating fluid between the two sacs allows smooth movement between them when the heart beats.

2) The Myocardium

The myocardium is composed of specialised cardiac muscle tissue which is only found in the heart. Each cardiac cell (fibre) connects with another and adjacent cells. The

joins are known as 'intercalated discs'. Because of these connections the cells do not need a separate nerve supply and the cells have the ability to transmit a nerve impulse which spreads from cell to cell over the entire 'sheet' of muscle.

3) The Endocardium

This forms a lining to the myocardium and is a thin, smooth, glistening layer consisting of flattened epithelial cells. It forms the inner lining of the heart.

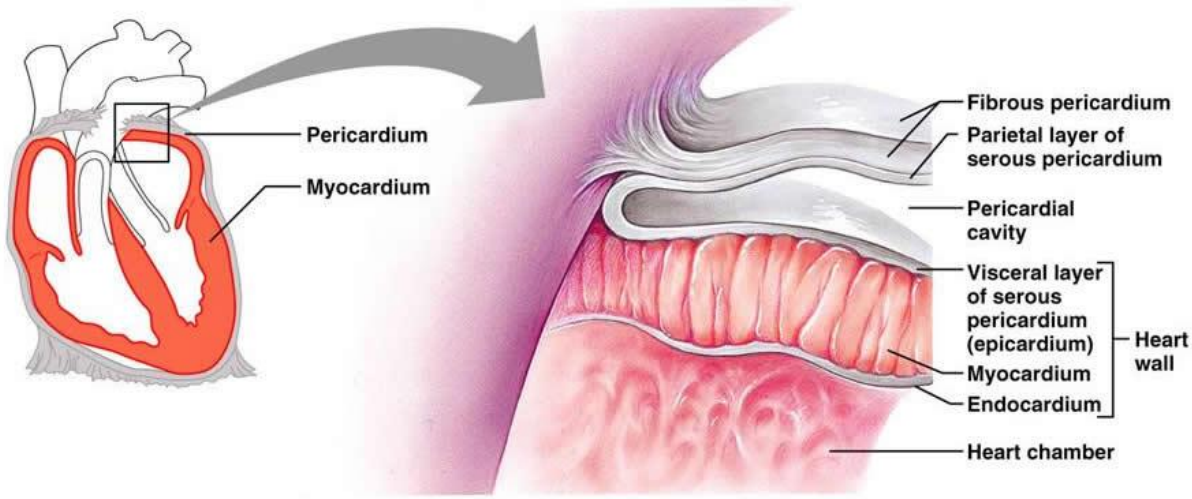


Figure 2. The Heart is made up of three layers [5]

The Heart Valves and Flow of Blood Through the Heart

Figure 3 shows a diagram of the heart. We know that:

- The heart is divided into a right and left side by a fibrous septum. Each side is in turn is divided by an atrioventricular valve into an upper chamber, the atrium and a lower chamber, the ventricle.

- The right atrioventricular valve, known as the tricuspid valve has three flaps or 'cusps' and the left atrioventricular valve, known as the mitral valve has two flaps or 'cusps'. The valves between the atria and the ventricles open and close when pressure in the chambers change.

- During ventricular systole (contraction) the pressure in the ventricles rises to a higher level than that in the atria, closing the valves and preventing backward flow of the blood. The valves do not open upwards into the atria because their movement is limited by tendonous cords.

- Veins carry blood to the heart. The two largest are the inferior vena cava and the superior vena cava which empty blood into the right atrium. There are also four pulmonary veins that return oxygenated blood from the lungs to left atrium.

- This deoxygenated blood passes via the tricuspid valve into the right ventricle, and from there it is pumped into the pulmonary artery (the only artery in the body that carries deoxygenated blood).

- The vessels carrying blood away from the heart are arteries. The opening of the pulmonary artery is guarded by the pulmonary valve (also known as the semi-lunar valve). After leaving the heart the pulmonary artery divides into the left and right pulmonary arteries which carry the venous blood to the lungs where the interchange of gases takes place. Carbon dioxide is excreted, and oxygen is absorbed.

- The atrial or oxygenated blood is carried from the lungs by four pulmonary veins that empty their contents into the left atrium. It then passes through the mitral valve into the left ventricle, and from here it is pumped into the aorta, the first artery of general circulation. The opening of the aorta is guarded by the aortic valve.

Both atria contract at the same time and this is followed by simultaneous contraction of both ventricles.

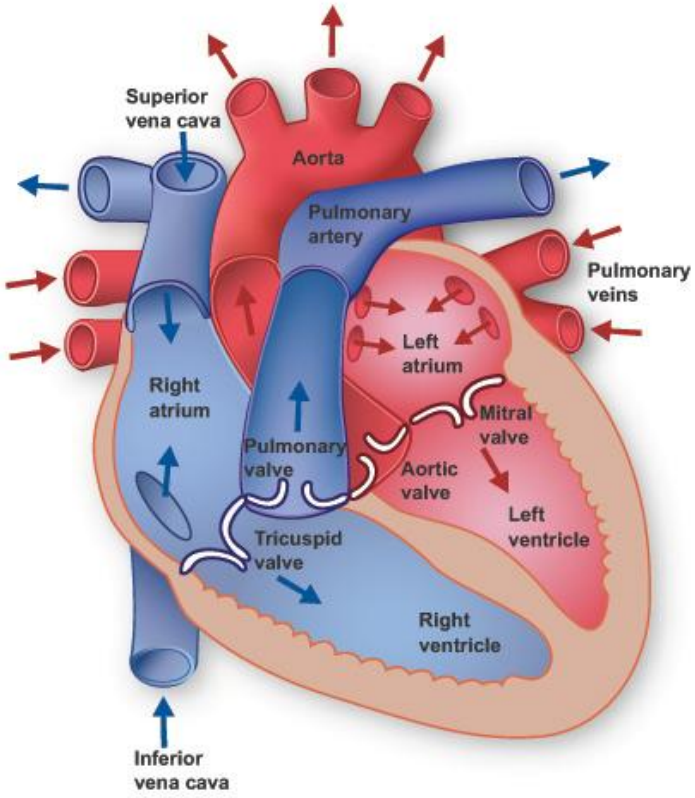


Figure 3. The Heart[6]

The Conducting System of the Heart

There are small groups of specialised neuromuscular cells in the myocardium which initiate and conduct impulses of contraction over the heart. Of these specialised cells, the sinoatrial node is the most important because it is the heart's normal pacemaker. It is situated in the roof of the right atrium.

Nerve Supply to the Heart

The heart is influenced by nerves originating in the cardiac centre of the medulla oblongata which reach it through the autonomic nervous system. These are the parasympathetic (decreases rate and force of the heartbeat) and the sympathetic (increases rate and force of the heartbeat) nerves and they are antagonistic to one another.

Adrenaline, a hormone secreted by the medulla of the adrenal glands, has the same effect as sympathetic stimulation. Noradrenaline, another hormone, depresses the heartbeat.

The rate at which the heart beats is the result of a fine balance of sympathetic and parasympathetic effects.

The Cardiac Cycle

The heart acts as a pump and its action consists of a series of events known as the cardiac cycle.

The normal number of cardiac cycles per minute ranges from 60-80. Taking 74 as an example, each cycle lasts about 0.8 of a second and consists of:

Atrial Systole - Contraction of the atria (0.1 second).

Ventricular Systole - Contraction of the ventricles (0.3 seconds).

Complete Cardiac Diastole - Relaxation of the atria and ventricles (0.4 seconds).

In relation to blood pressure, the first stage systole is the top number of the blood pressure, and the second stage diastole is the bottom number.

Cardiovascular Disease

Cardiovascular disease includes several specific diseases. These conditions either affect the blood vessels (the veins and arteries), or the heart muscle. Research suggests that women who have cardiovascular disease tend to develop forms which affect blood vessels, while men develop conditions that involve the heart muscle itself.[1]

Cardiovascular disease can include numerous problems, many of which are related to atherosclerosis. Atherosclerosis can occur over a period of time when the arteries naturally begin to harden and get narrower. This process can be accelerated by

plaque buildup (cholesterol, fatty substances) in the inner linings of artery.[3] This may lead to a diagnosis of coronary artery disease which may lead to chest pain, heart arrhythmias, heart failure and heart attacks.

Although it can be attributed to other causes, coronary heart disease refers to the heart's inability to provide sufficient circulation to surrounding tissues and the cardiac muscle. Conditions caused by coronary heart disease are myocardial Infarction (heart attack) and angina pectoris.[1]

Other Types of Cardiovascular Disease

Other types of cardiovascular disease and problems affecting the heart and circulation include:

- Aortic Aneurysm
- Cardiomyopathy
- Dilated Cardiomyopathy
- Hypertrophic Cardiomyopathy
- Congenital Heart Disease
- Congestive Heart Failure
- Heart Murmurs
- Peripheral Vascular Disease
- Hypertensive Heart Diseases
- Inflammatory Heart Disease
- Valvular Heart Disease

Medical Emergency

Managing Angina Pectoris in the Dental Surgery

It is estimated that in the UK 2 million men and 900,000 women are living with chronic angina.[7]

Signs and Symptoms of Angina Include:

- Chest pain
- A feeling of pressure or heaviness in the chest
- Pain can extend into the stomach, back or jaw
- Sweating
- Nausea
- Breathlessness

If there is a history of angina the patient will probably carry glyceryl trinitrate spray or tablets (or isosorbide dinitrate tablets) and should be allowed to use them. Hospital admission is not necessary if symptoms are mild and resolve rapidly with the patient's own medication.

Arrhythmias may lead to a sudden reduction in cardiac output with loss of consciousness. Medical assistance should be summoned.

The pain of myocardial infarction is similar to that of angina but generally more severe and more prolonged. [8]

Medical Emergency

Managing a Myocardial Infarction in the Dental Surgery

Symptoms and signs of myocardial infarction:

- Progressive onset of severe, crushing pain across front of chest; pain may radiate towards the shoulder and down arm, or into neck and jaw
- Skin becomes pale and clammy
- Nausea and vomiting are common
- Pulse may be weak and blood pressure may fall
- Breathlessness

Initial management of myocardial infarction:

- ✓ Call immediately for medical assistance and an ambulance, as appropriate.

Allow the patient to rest in the position that feels most comfortable; in the presence of breathlessness this is likely to be sitting position, often an intermediate position (dictated by the patient) will be most appropriate. **Oxygen may be administered**.

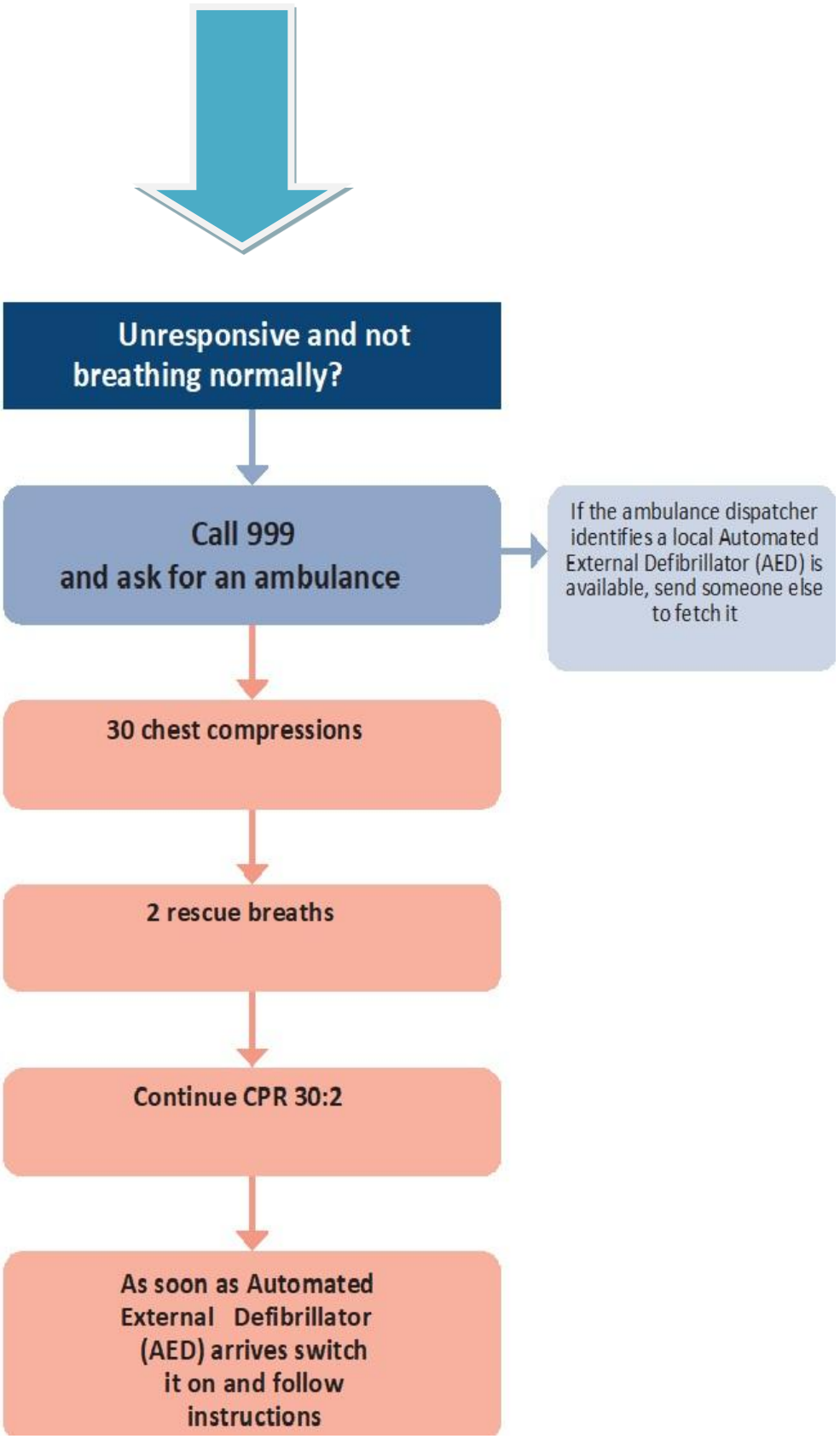
Sublingual glyceryl trinitrate may relieve pain. Intramuscular injection of drugs should be avoided because absorption may be too slow (particularly when cardiac output is reduced) and pain relief is inadequate. Intramuscular injection also increases the risk of local bleeding into the muscle if the patient is given a thrombolytic drug.

Reassure the patient as much as possible to relieve further anxiety. If available, aspirin in a single dose of 300 mg should be given unless contraindicated. A note (to say that aspirin has been given) should be sent with the patient to the hospital.

If the patient collapses, loses consciousness, and is not breathing at all or not breathing normally (i.e. agonal breathing) attempt standard resuscitation measures.[8]

CPR Procedure

The following flow chart outlines the Resuscitation Council guidelines for adult CPR[8]


Unresponsive and not breathing normally?
Call 999 and ask for an ambulance
If the ambulance dispatcher identifies a local Automated External Defibrillator (AED) is available, send someone else to fetch it
30 chest compressions
2 rescue breaths
Continue CPR 30:2
As soon as Automated External Defibrillator (AED) arrives switch it on and follow instructions

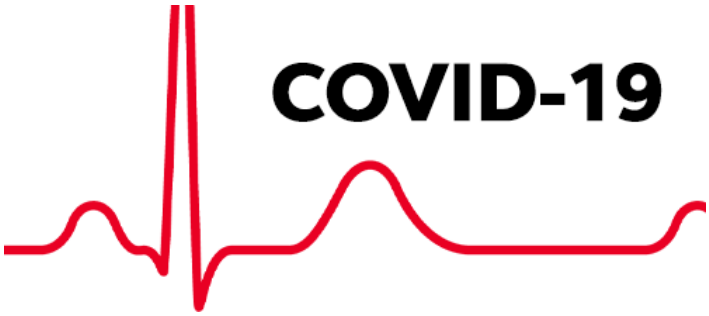
BLS/AED DETAILED SEQUENCE OF STEPS

SEQUENCE	Technical description
SAFETY	**Make sure you, the victim and any bystanders are safe**
RESPONSE	**Check the victim for a response** • Gently shake their shoulders and ask loudly: “Are you all right?" If he responds leave him in the position in which you find him, provided there is no further danger; try to find out what is wrong with him and get help if needed; reassess him regularly
AIRWAY	**Open the airway** • Turn the victim onto their back • Place your hand on their forehead and gently tilt their head back; with your fingertips under the point of the victim's chin, lift the chin to open the airway
BREATHING	**Look, listen and feel for normal breathing for no more than 10 seconds** In the first few minutes after cardiac arrest, a victim may be barely breathing, or taking infrequent, slow and noisy gasps. Do not confuse this with normal breathing. If you have any doubt whether breathing is normal, act as if it is they are not breathing normally and prepare to start CPR
DIAL 999	**Call an ambulance (999)** • Ask a helper to call if possible, otherwise call them yourself • Stay with the victim when making the call if possible • Activate the speaker function on the phone to aid communication with the ambulance service
SEND FOR AED	**Send someone to get an AED if available** If you are on your own, do not leave the victim, start CPR
CIRCULATION	**Start chest compressions** • Kneel by the side of the victim • Place the heel of one hand in the centre of the victim’s chest; (which is the lower half of the victim’s breastbone (sternum)) • Place the heel of your other hand on top of the first hand • Interlock the fingers of your hands and ensure that pressure is not applied over the victim's ribs • Keep your arms straight • Do not apply any pressure over the upper abdomen or the bottom end of the bony sternum (breastbone)

SEQUENCE	Technical description
	• Position your shoulders vertically above the victim's chest and press down on the sternum to a depth of 5–6 cm • After each compression, release all the pressure on the chest without losing contact between your hands and the sternum; • Repeat at a rate of 100–120 min^{-1}
GIVE RESCUE BREATHS	**After 30 compressions open the airway again using head tilt and chin lift and give 2 rescue breaths using a bag-valve-mouth device or supraglottic airway device** • Pinch the soft part of the nose closed, using the index finger and thumb of your hand on the forehead • Allow the mouth to open, but maintain chin lift • Take a normal breath and place your lips around their mouth, making sure that you have a good seal • Blow steadily into the mouth while watching for the chest to rise, taking about 1 second as in normal breathing; this is an effective rescue breath • Maintaining head tilt and chin lift, take your mouth away from the victim and watch for the chest to fall as air comes out • Take another normal breath and blow into the victim's mouth once more to achieve a total of two effective rescue breaths. Do not interrupt compressions by more than 10 seconds to deliver two breaths. Then return your hands without delay to the correct position on the sternum and give a further 30 chest compressions Continue with chest compressions and rescue breaths in a ratio of 30:2 If you are untrained or unable to do rescue breaths, give chest compression only CPR (i.e. continuous compressions at a rate of at least 100–120 min^{-1})
IF AN AED ARRIVES	**Switch on the AED** • Attach the electrode pads on the victim's bare chest • If more than one rescuer is present, CPR should be continued while electrode pads are being attached to the chest • Follow the spoken/visual directions • Ensure that nobody is touching the victim while the AED is analysing the rhythm **If a shock is indicated, deliver shock** • Ensure that nobody is touching the victim • Push shock button as directed (fully automatic AEDs will deliver the shock automatically)

SEQUENCE	Technical description
	• Immediately restart CPR at a ratio of 30:2 • Continue as directed by the voice/visual prompts **If no shock is indicated, continue CPR** • Immediately resume CPR • Continue as directed by the voice/visual prompts
CONTINUE CPR	**Do not interrupt resuscitation until:** • A health professional tells you to stop • You become exhausted • The victim is definitely waking up, moving, opening eyes and breathing normally It is rare for CPR alone to restart the heart. Unless you are certain the person has recovered continue CPR
RECOVERY POSITION	**If you are certain the victim is breathing normally but is still unresponsive, place in the recovery position** • Remove the victim's glasses, if worn • Kneel beside the victim and make sure that both their legs are straight • Place the arm nearest to you out at right angles to their body, elbow bent with the hand palm-up • Bring the far arm across the chest, and hold the back of the hand against the victim's cheek nearest to you • With your other hand, grasp the far leg just above the knee and pull it up, keeping the foot on the ground • Keeping their hand pressed against their cheek, pull on the far leg to roll the victim towards you on to their side • Adjust the upper leg so that both the hip and knee are bent at right angles • Tilt the head back to make sure that the airway remains open • If necessary, adjust the hand under the cheek to keep the head tilted and facing downwards to allow liquid material to drain from the mouth • Check breathing regularly **Be prepared to restart CPR immediately if the victim deteriorates or stops breathing normally**

CPR Procedure Resusitation Council Recommendations



The current update from the Resuscitation Council regarding covid:

Cardiopulmonary resuscitation (including chest compressions and ventilations) is a critical intervention to save lives – without which many thousands of lives will be lost each year.

Throughout the COVID-19 pandemic, RCUK has regularly reviewed its guidance based on published evidence, seeking to balance the delivery of high-quality treatment to patients whilst maintaining staff/rescuer safety.

Recently published evidence suggests that COVID-19 is predominantly transmitted via the aerosol route as opposed to direct contact and via fomites. With this in mind, we have amended our guidance for health care staff to prioritise protection against the aerosol route of transmission.

The risk associated with COVID-19 has decreased because the majority of the population have been immunised, and more effective treatments and less virulent strains of COVID-19 now predominate. Widespread community testing programmes have stopped, making it less likely that members of the public will know if someone has COVID-19.

New evidence has emerged suggesting a low likelihood that airway management manoeuvres are aerosol generating, leading to the removal of airway management manoeuvres from the list of aerosol generating procedures (AGP).

We await further evidence on whether chest compressions generate aerosol. Until such evidence emerges, we remain concerned that the provision of chest compressions and the proximity of the rescuer to the patient may constitute a risk of aerosol transmission.

In the light of this new information, we recommend:

- the curriculum for training members of the public and healthcare professionals reverts to the guidance set out in our quality standards
- members of the public and healthcare professionals follow our 2021 guidelines for resuscitation
- for those working in healthcare settings, the use of FFP3 masks or respirators as well as eye protection is still recommended when performing chest compressions for patients with suspected or confirmed COVID-19. AGP PPE,

in particular FFP3 mask/respirator and eye protection, should be donned as swiftly as possible to avoid any delays in treatment.[10]

Risk Factors for Cardiovascular Disease

The risk factors of cardiovascular disease are:

- Smoking
- High Blood pressure
- High blood cholesterol
- Being physically inactive
- Diet
- Diabetes
- Being overweight or obese
- Family History of heart disease
- Ethnic background
- Gender - Men are more likely to develop CVD at an earlier age than women
- Age - The older you are, the more likely you are to develop CVD[2]

The risk factors for cardiovascular disease may be highlighted when a patient's medical history is taken.

Conclusion

This article has given an overview of the anatomy and functions of the heart as well as describing some of the types of CVD that may affect our patients. It is important that the dental nurse is familiar with the medical emergency procedures that need to be adopted should a patient have an angina attack or a myocardial infarction in the dental surgery.

Personal Development Plan and Reflective Learning

This CPD is linked to the following GDC Enhanced CPD Development Outcome:

C. Maintenance and development of knowledge and skill within your field of practice.

Reflective learning is now a requirement of the GDC Enhanced Professional Development Scheme. As such, you will now have the opportunity to answer some reflective learning questions, if you complete these now you will fulfil the requirements of the GDC. These will be:

1) What did you learn (or confirm) from the activity that was helpful or relevant to your daily work and patients?
2) Comment on any changes/updates needed in your daily work
3) How has completion of this CPD article benefitted your work as a DCP?

Examples will be provided. Please remember that you need to fill this in on completion of the exam, but you can also update this at any time from your CPD log. If you take a few moments to write your reflection on completion, you will have fulfilled the Enhanced CPD requirements.

Further Reading

Heart Disease Statistics Fact Sheet

Medicines for the Heart

References

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10 Resuscitation Council (UK) 2022. Resuscitation Council UK statement on COVID-19 for healthcare workers (HCW) in primary and community healthcare settings Available from: https://www.resus.org.uk/library/additional-guidance/guidance-covid-19 (accessed 09/01/2025)