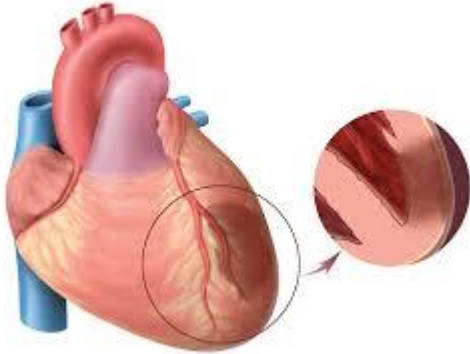


# Myocardial Infarction



**A** heart attack (myocardial infarction) is usually caused by a blood clot, which stops the blood flowing to a part of your heart muscle. You should call for an ambulance immediately if you develop severe chest pain. Treatment with a clot-busting medicine or an emergency procedure to restore the blood

flow through the blocked blood vessel is usually done as soon as possible. This is to prevent or minimize any damage to your heart muscle. Other treatments help to ease the pain and to prevent complications. Reducing various risk factors can help to prevent a myocardial infarction.

## **Understanding the heart and coronary arteries**

The heart is mainly made of special muscle (myocardium). The heart pumps blood into arteries (blood vessels) which take the blood to every part of the body. Like any other muscle, the heart muscle needs a good blood supply. The coronary arteries take blood to the heart muscle. The main coronary arteries branch off from the aorta (the large artery which takes oxygen-rich blood from the heart chambers to the body.) The main coronary arteries divide into smaller branches which take blood to all parts of the heart muscle.

## **What happens to your heart with a myocardial infarction?**

If you have a myocardial infarction (heart attack), a coronary artery or one of its smaller branches is suddenly blocked. The part of the heart muscle supplied by this artery loses its blood (and oxygen) supply if the vessel is blocked. This part of the heart muscle is at risk of dying unless the blockage is quickly removed. When a part of the heart muscle is damaged it is said to be infarcted. The term myocardial infarction (MI) means damaged heart muscle.

If a main coronary artery is blocked, a large part of the heart muscle is affected. If a smaller branch artery is blocked, a smaller amount of heart muscle is affected. After an MI, if part of the heart muscle has died, it is replaced by scar tissue over the next few weeks.

### **Some newer terms used by doctors**

A heart attack and myocardial infarction (MI) are commonly used terms, and mean the same thing. However, the term MI is used less often now by doctors. This is because there are actually a range of conditions that can be caused by a sudden reduction in blood flow in a coronary artery. This range of conditions has an overall term called acute coronary syndrome (ACS). Two main sub types of ACS can be diagnosed by what is seen on your heart tracing (ECG). The two main types are called ST-elevation MI (STEMI) and non-ST-elevation MI (NSTEMI). NSTEMI can also include unstable angina. (The ST elevation refers to a section on the ECG tracing.) In STEMI, the artery supplying an area of the heart muscle is completely blocked. However, in NSTEMI, the artery is only partly blocked, so only part of the heart muscle supplied by the affected artery is affected. Your treatment can depend upon which type you have - STEMI or NSTEMI.

### **What causes a myocardial infarction?**

Blood clot (thrombosis) - the cause in most cases

The most common cause of an MI is a blood clot (thrombosis) that forms inside a coronary artery, or one of its branches. This blocks the blood flow to a part of the heart.

Blood clots do not usually form in normal arteries. However, a clot may form if there is some atheroma within the lining of the artery. Atheroma is like fatty patches or plaques that develop within the inside lining of arteries. (This is similar to water pipes that get furred up.) Plaques of atheroma may gradually form over a number of years in one or more places in the coronary arteries. Each plaque has an outer firm shell with a soft inner fatty core.

What happens is that a crack develops in the outer shell of the atheroma plaque. This is called plaque rupture. This exposes the softer inner core of the plaque to blood. This can trigger the clotting mechanism in the blood to form a blood clot. Therefore, a build-up of atheroma is the root problem that leads to most cases of ACS / MI. (The diagram below shows four patches of atheroma as an example. However, atheroma may develop in any section of the coronary arteries.)

Treatment with clot-busting medication or a procedure called angioplasty (see below) can break up the clot and restore blood flow through the artery. If treatment is given quickly enough this prevents damage to the heart muscle, or limits the extent of the damage.

### **Uncommon causes**

Various other uncommon conditions can block a coronary artery. For example: inflammation of the coronary arteries (rare); a stab wound to the heart; a blood clot forming elsewhere in the body (for example, in a heart chamber) and travelling to a coronary artery where it gets stuck; taking cocaine, which can cause a coronary artery to go into spasm; complications from heart surgery and some other rare heart problems. These are not dealt with further in this leaflet.

The rest of this leaflet deals only with the common cause - thrombosis over an atheroma plaque.

### **Who is at risk of having a myocardial infarction / heart attack?**

MI is common. About 146,000 people in the UK have an MI every year. Most occur in people aged over 50 and it becomes more common with increasing age. Sometimes younger people are affected.

MI is three times more common in young men than in young women. However, after the menopause, the female hormones no longer protect the heart so the risk is then the same for men and women.

MI may occur in people known to have heart disease, such as people with angina. It can also happen out of the blue in people with no previous symptoms of heart disease. This is because atheroma often develops without any symptoms at first.

Certain risk factors increase the risk of more atheroma forming. This can lead to ACS / MI. See separate leaflet called Preventing Cardiovascular Diseases which discusses these in more detail.

Briefly, risk factors that can be modified and may help to prevent MI include:

Smoking. If you smoke, you should make every effort to stop.

High blood pressure. If your blood pressure is high it can be treated.

If you are overweight, losing some weight is advised. Losing weight will reduce the amount of workload on your heart and also help to lower your blood pressure.

A high cholesterol. This should usually be treated if it is high.

Inactivity. You should aim to do some moderate physical activity on most days of the week for at least 30 minutes - for example, brisk walking, swimming, cycling, dancing, gardening, etc.

Diet. You should aim to eat a healthy diet.

Diabetes. People with diabetes have a higher risk of having ACS. This risk can be reduced by ensuring your blood pressure, cholesterol levels and glucose levels are well controlled.

Family history. Your risk is increased if there is a family history of heart disease or a stroke that occurred in your father or brother aged below 55, or in your mother or sister aged below 65.

Ethnic group. Certain ethnic groups - for example, British Asians - have a higher risk of developing cardiovascular diseases.

### **What are the symptoms of a myocardial infarction?**

The most common symptom is severe chest pain, which often feels like a heavy pressure feeling in your chest. The pain may also travel up into your jaw and down your left arm or down both arms. You may also sweat, feel sick and feel

faint. You may also feel short of breath. The pain may be similar to angina, but it is usually more severe and lasts longer. (Angina usually goes off after a few minutes. MI pain usually lasts more than 15 minutes - sometimes several hours.)

However, some people have only a mild discomfort in their chest. The pain can sometimes feel like indigestion or heartburn.

Occasionally, an MI happens without causing any pain. This is usually diagnosed when you have an electrocardiogram (ECG, or heart tracing) at a later stage.

Some people collapse and die suddenly, if they have a large portion of heart muscle damaged. This is not very common.

### **What should I do if I think I am having a myocardial infarction?**

Call for an ambulance immediately.

Then, if you have some, take one aspirin tablet (see below for the reason for this). You will normally be admitted straight to hospital.

### **How is a myocardial infarction diagnosed and assessed?**

Many people develop chest pains that are not due to an MI. For example, you can have quite bad chest pains with heartburn, gallbladder problems or with pains from conditions of the muscles in the chest wall. Therefore, tests are usually done to confirm an MI. These are:

An ECG. There are typical changes to the normal pattern of the heart tracing in MI. Patterns that occur include things called pathological Q waves and ST elevation. However, it is possible to have a normal ECG even if you have had an MI.

Blood tests. A blood test that measures a chemical called troponin is the usual test that confirms MI. This chemical is present in heart muscle cells. Damage to heart muscle cells releases troponin into the bloodstream. In MI the blood level of troponin increases within 3-12 hours from the onset of chest pain, peaks at 24-48 hours, and returns to a normal level over 5-14 days.

A rough idea as to the severity of the MI (the amount of heart muscle that is damaged) can be gauged by the degree of abnormality of the ECG and the level of troponin in the blood. Another chemical that may be measured in a blood test is called creatine kinase. This too is released from heart muscle cells during MI.

Your heart tracing will be monitored for a few days to check on the heart rhythm. Various blood tests will be done to check on your general well-being.

Other tests may be done in some cases. This may be to clarify the diagnosis (if the diagnosis is not certain) or to diagnose complications such as heart failure if this is suspected. For example, an echocardiogram (an ultrasound scan of the heart) or a test called myocardial perfusion scintigraphy may be done.

Also, before discharge from hospital, you may be advised to have tests to assess the severity of atheroma in the coronary arteries. For example, an ECG taken whilst you exercise on a treadmill or bike (exercise tolerance test). An angiography of the coronary arteries may also be performed. In this test a dye is injected into the coronary arteries. The dye can be seen by special X-ray equipment. This shows up the structure of the arteries (like a road map) and can show the location and severity of any atheroma.

### **What is the treatment for a myocardial infarction?**

The following is a typical situation and mentions the common treatments that are usually offered. However, each case is different and treatments may vary depending on your situation.

#### **Aspirin and other antiplatelet medicines**

As soon as possible after MI is suspected you will be given a dose of aspirin. Aspirin reduces the stickiness of platelets. Platelets are tiny particles in the blood that trigger the blood to clot. It is the platelets that become stuck on to a patch of atheroma inside an artery that go on to form the clot.

Other antiplatelet medicines called clopidogrel or ticagrelor may be given. They work in a different way to aspirin and help reduce platelet stickiness.

### **Injections of heparin or a similar medicine**

These are usually given for a few days to help prevent further blood clots from forming.

### **Pain relief**

A strong painkiller such as morphine is given by injection into a vein to ease the pain.

### **Treatment to restore blood flow in the blocked coronary artery**

The part of the heart muscle starved of blood does not die immediately. If blood flow is restored within a few hours, much of the heart muscle that would have been damaged and die will survive. This is why MI is a medical emergency, and treatment is given urgently. The quicker the blood flow is restored, the better the outlook.

There are two treatments that can restore blood flow back through the blocked artery:

**Emergency angioplasty.** Ideally this is the best treatment if it is available and can be done within a few hours of symptoms starting. In this procedure a tiny wire with a balloon at the end is put into a large artery in the groin or arm. It is then passed up to the heart and into the blocked section of a coronary artery, using special X-ray guidance. The balloon is blown up inside the blocked part of the artery to open it wide again. A stent may be left in the widened section of the artery. A stent is like a wire mesh tube which gives support to the artery and helps to keep the artery widened. See separate leaflet called Angioplasty for details.

An injection of a clot-busting medicine is an alternative to emergency angioplasty. It can be given easily and quickly in most situations. Some ambulance crews are trained to give this.

**Note:** a common clot-busting medicine used in the UK is called streptokinase. If you are given this medicine you should not be given it again if you have another MI in the future. This is because antibodies develop to it and it will not work so well a second time. An alternative clot-busting medicine should be given.

Both the above treatments usually work well to restore blood flow and greatly improve the outlook. The most crucial factor is the speed that one or other treatment is given after symptoms started.

### **A beta-blocker medicine**

Beta-blocker medicines block the action of certain hormones such as adrenaline (epinephrine). These hormones increase the rate and force of the heartbeat. Beta-blocker medicines have some protective effect on the heart muscle and they also help to prevent abnormal heart rhythms from developing. Beta-blocker medicines will also help to prevent having another MI.

### **Insulin**

Some people have a raised blood sugar level when they have an MI, even if they do not have diabetes. If this occurs, then your blood sugar levels may need to be controlled with insulin. If you have diabetes then it is also likely that you will need to be treated with insulin to control your blood glucose levels when you are in hospital.

### **Oxygen**

You may be given oxygen which works to reduce the risk of damage to your heart muscle.

### **Treatment after you have had a myocardial infarction**

Normally you will be advised to take regular medication for the rest of your life. See separate leaflet called Medication After a Myocardial Infarction, which discusses this more fully.



Briefly, the following four medicines are commonly prescribed to help prevent a further MI, and to help prevent complications:

**Aspirin** - to reduce the stickiness of platelets in the blood, which helps to prevent blood clots forming. If you are not able to take aspirin then an alternative antiplatelet medicine such as clopidogrel or ticagrelor may be advised.

**A beta-blocker medicine** - to slow the heart rate and to reduce the chance of abnormal heart rhythms developing.

An angiotensin-converting enzyme (ACE) inhibitor medicine. ACE inhibitor medicines have a number of actions, including having a protective effect on the heart.

A statin medicine to lower the cholesterol level in your blood. This helps to prevent the build-up of atheroma.

Also, you will normally be advised to take the antiplatelet medicine clopidogrel or ticagrelor in addition to aspirin. However, this is usually only advised for a number of weeks or months, depending on the type and severity of your MI.

Many people recover well from an MI and have no complications. Before discharge from hospital, it is common for a doctor or nurse to advise you how to reduce any risk factors (see above). This advice aims to reduce your risk of a future MI as much as possible.

Other medicines or treatments may be needed if you develop complications.

### **How serious is a myocardial infarction?**

This often depends on the amount of heart muscle that is damaged. In many cases, only a small part of the heart muscle is damaged and then heals as a small patch of scar tissue. The heart can usually function normally with a small patch of scar tissue. A larger heart attack is more likely to be life-threatening or cause complications.

Even before treatments became available to restore blood flow, many people made a full recovery. With the help of modern treatment, particularly if you are

given treatment within a few hours to restore blood flow, a higher percentage of people now make a full recovery.

**Some possible complications include the following:**

Heart failure. If a large area of the heart muscle is damaged, then the pumping ability of the heart may be reduced. Less blood than usual is then pumped around the body, especially when extra blood is needed when you exercise. Symptoms such as breathlessness, tiredness, and swollen ankles may develop. Mild heart failure can often be treated with medication. Severe heart failure can be serious and even life-threatening.

Abnormal heart rhythms may occur if the electrical activity of the heart is affected. The main risk of this happening is within the first few hours after an MI. Sudden, chaotic, fast heartbeats may occur. This is called ventricular fibrillation and is the common cause of cardiac arrest. This needs immediate treatment with an electrical shock given by a defibrillator. Otherwise, collapse and sudden death is likely. Other less serious abnormal heart rhythms can also occur which can often be treated with medicines.

A further MI may occur sometime in the future. This is more likely if the coronary arteries are badly affected with atheroma, or further build-up of atheroma continues. If the risk of this is thought to be high then surgery may be advised to bypass or widen severely narrowed coronary arteries.

The most crucial time is during the first day or so. If no complications arise, and you are well after a couple weeks, then you have a good chance of making a full recovery. A main objective then is to get back into normal life, and to minimise the risk of a further MI.

**After having a myocardial infarction**

When recovering from an MI, it is natural to wonder if there are any dos and don'ts. In the past, well-meaning but bad advice to "rest and take it easy from now on" caused some people to become over-anxious about their hearts. Some

people gave up their jobs, hobbies, and any activity that caused exertion, for fear of straining the heart.

However, quite the opposite is true for most people who recover from an MI. Regular exercise and getting back to normal work and life are usually advised. Much can be done to reduce the risk of a further MI.

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