How a stroke happens

Stroke *is sudden damage to nerve cells in the brain, caused by:*

BLOCKAGE of the normal blood supply to the brain

ischaemic stroke

83%

Blood BURSTING into the brain from a faulty blood vessel

haemorrhagic stroke

17%

The brain

The brain is a soft, wrinkled mass of tissue that fits snugly inside the top half of the skull. It is made up of billions of nerve cells called neurones.

Control centre

The brain is the 'control centre', like an intricate computer controlling the complex machinery of the body. The brain's nerve cells are connected to other nerve cells in all parts of the body – some of these send messages to the brain, telling it exactly what is happening throughout the body, others carry messages from the brain to instruct the various body organs and systems how to function. Brain cells can also 'talk' to each other.

Message pathways

The messages to and from the brain are in the form of tiny bursts of electrical and chemical signals, passed from one nerve cell to another in pathways up and down the body. Different areas of the brain are responsible for specific parts of the body, and each has its own set of message pathways.

Example: If the hand touches a hot stove, the nerve cells in the hand send a message to the brain, 'Too hot!' and the brain sends back a message to the arm muscles to pull the hand out of danger.

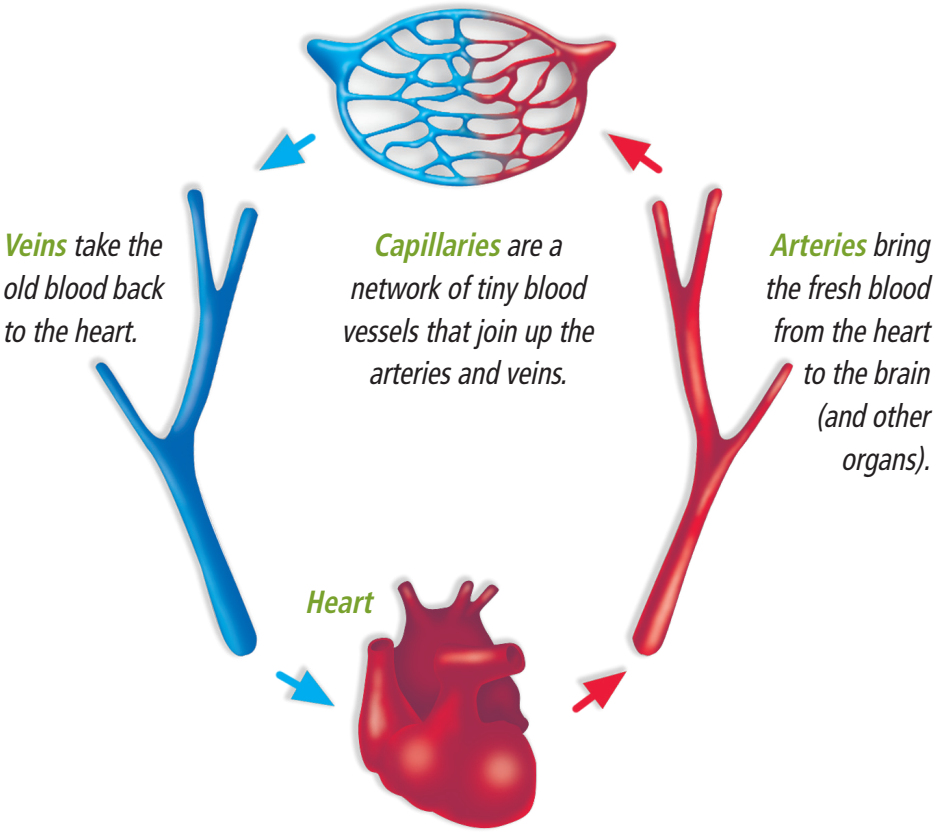
Blood supply

The brain, like the rest of the body, depends on a supply of blood which carries oxygen and the nutrients needed for cell life. This blood is pumped from the heart at every beat, and 'used' blood is taken back to the heart, with waste material filtered out in the kidneys on the way and more oxygen taken up in the lungs, ready for the next circuit round the body.

Blood vessels

The vessels that carry blood are a system of tubes of various sizes.

The blood vessels going immediately into and out of the heart are single large tubes which divide and form many branches to extend to all areas of the body. The tubes become progressively narrower with each branching. Each area of the brain has its own blood supply from one of these branches.

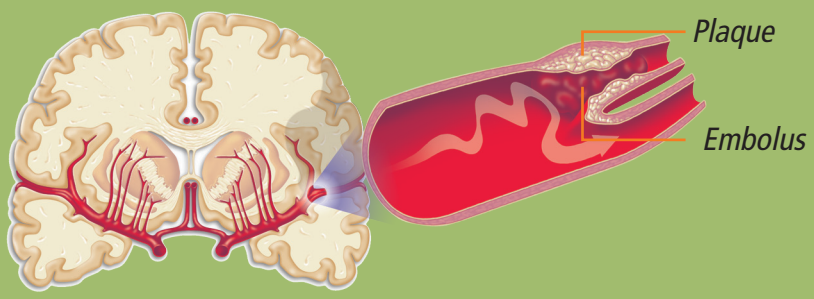

Veins take the old blood back to the heart.
Capillaries are a network of tiny blood vessels that join up the arteries and veins.
Arteries bring the fresh blood from the heart to the brain (and other organs).
Heart

Ischaemic stroke (absence or deficiency of normal blood supply)

Sometimes a tube (artery) bringing blood to a part of the brain gets blocked because:

- disease (atherosclerosis) has caused the inside walls of the tube to thicken up so the opening is too narrow for enough blood to get through
  or
- a clot of blood or piece of some other material gets stuck in the tube, eg, a clot can form in the heart, break off, and travel with the blood until it gets jammed in a small or narrowed artery in the brain.

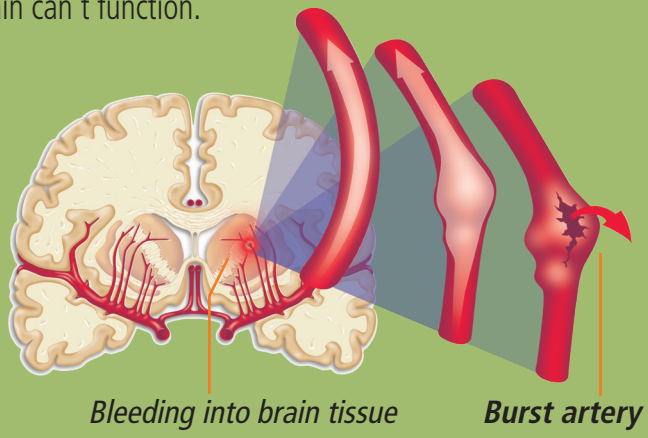
This means sufficient blood is not getting to the brain cells in that area. Cells cannot live without oxygen, so a few minutes after the blood supply is cut off, nerve cells die and that part of the brain stops working.

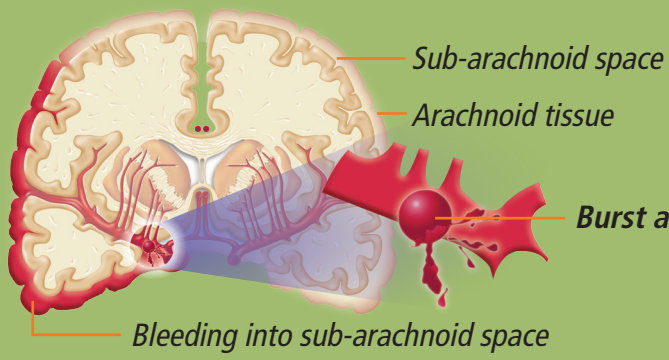


Haemorrhagic stroke (bleeding into the brain)

In the second type of stroke, blood bursts through the walls of an artery and leaks into the brain itself (**intracerebral haemorrhage**) or onto the surface of the brain (**subarachnoid haemorrhage**). This can happen because the person was born with a faulty artery, or because disease has caused the artery walls to become too thin and brittle.

The blood is forced into brain tissue, and, because there isn't much space around the brain in the skull cavity, the build-up of blood presses on the part of the brain where the bleeding occurs, damaging the nerve cells so that area of the brain can't function.





When nerve cells are damaged

The different types of stroke described above cause similar damage to nerve cells in the brain.

Some nerve cells (neurones) are too severely damaged to recover and these die. However other cells can sometimes repair themselves. This process, together with the 're-wiring' of connections to other cells can be helped with lots of practice of the relevant movement or task.

Brain neurones die every day of our lives, but because there are so many billions of cells, the loss of a few here and there is not noticeable. However, in stroke a whole group of neurones die together, which means that the message pathways they have established over a lifetime are 'cut off'.

Example: The person with stroke is sitting with a foot too near a heater. The message "Too hot!" cannot get through because the pathway reaches a dead end in the damaged part of the brain (the electrical signal cannot jump to the next link). Therefore the brain does not instruct the leg muscles to pull the foot out of danger, and the skin on the foot may get burnt. (The person will not 'feel' pain because the brain hasn't been told.)

Making new pathways

Some neurones may be only partially damaged, usually by the brain swelling that takes place after a stroke. When the swelling goes down, these nerve cells recover and start working again, even though sluggishly, which is why a noticeable improvement can occur a couple of weeks after a stroke.

It is not possible to 'cure' a stroke – that is, to re-establish the original message pathways. Instead nature, assisted by rehabilitation therapy, concentrates on teaching other neurones to make new pathways. Parts of the brain that were not affected by the stroke may begin to take over the functions of the dead parts, and therapy is aimed at encouraging these cells to learn and practise their new tasks. This ability to re-learn is called 'brain plasticity'. This brain plasticity is helped by lots of practice.

Warning strokes - Transient Ischaemic Attacks (TIAs)

One or several of the symptoms listed below may occur and last from a few minutes to several hours. If they go away within a short space of time the episode is called a TIA:

T – Transient (short-lasting)
I – Ischaemic (deficient blood supply)
A – Attack (not a full stroke).

This used to be referred to as a 'mini-stroke', but there is nothing 'mini' about it and it should be treated with the utmost urgency.

Warning signs of a stroke or TIA

The most common symptoms of a stroke can be recognised by remembering the FAST acronym:

TIA symptoms are very similar to those of a stroke, and the causes are the same as for ischaemic stroke (**see page 20**).

A TIA is caused by the blood supply to the brain being temporarily disrupted. Although the body returns to normal, a TIA is **an extremely important warning** that something is wrong in the circulatory system, so anybody with these symptoms should see a doctor immediately.

It is important to find and treat the cause of the TIA to help avoid a more serious stroke in the future. People who experience a TIA are at very high risk of having a full stroke in the following days and weeks. People with TIA will usually be prescribed medication to reduce this risk.

Sometimes an operation is recommended to clean out an artery that carries blood to the head – the carotid artery, which runs up the side of the neck. This operation is called 'carotid endarterectomy'.

When is a 'stroke' not a stroke?

There are a number of medical conditions which may have symptoms and signs similar to those of stroke. When a person with stroke-like symptoms comes to hospital one of the first things doctors do is find out exactly what has caused the symptoms (**see page 41**).

Conditions which can cause symptoms similar to stroke include:

- a brain tumour (especially one which has bled into the brain)
- low blood sugar (in diabetics)
- bleeding under the skull
- inflammation of the arteries of the brain
- compression of the spinal cord, eg, by tumours or bone.