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What is stroke?

→ Key points

- ◆ Stroke is the third most common cause of death (after heart disease and cancer) in developed countries.
- ◆ It is a disease of the brain (*not* the heart) and is caused by a blockage or rupture of the essential blood supply.
- ◆ A transient ischaemic attack (TIA), or ‘mini-stroke’ is a major warning sign of impending major stroke and needs to be taken seriously.
- ◆ ‘Brain attack’ has been suggested as a useful new name for the first 24 hours of a stroke or TIA.

Stroke has been recognized for thousands of years and is the third most common cause of death in developed countries (after heart attacks and all cancers combined). Although it can affect people of all ages, it is most common in old age. Perhaps because of the association between stroke and old age, or terminal disease, it has not had the profile of other perhaps less serious or rarer disorders and thus is less well known to the general public. However, stroke is so common that most people will know someone who has had a stroke or have a close family member who has had a stroke.

Stroke has had a major effect on world politics as many political leaders have had a stroke or died of a stroke. Ariel Sharon, when Prime Minister of Israel, had a minor stroke in December 2005, followed by a devastating stroke a few weeks later which left him severely disabled and unfit for office. Winston Churchill had a series of strokes during his lifetime, including one (kept secret from the public in 1949) before his third and final term of office as British Prime Minister. The former American President Richard Nixon died



Figure 1.1 Prime Minister Ariel Sharon had two strokes which ended his political life and affected the political history of the Middle East.

of a stroke. President Dwight Eisenhower suffered a mild stroke in the Oval Office in the White House in November 1957. It is also reported that Margaret Thatcher has had a series of small strokes.

Many other famous people have also had strokes. The American actor Kirk Douglas made a remarkable recovery from a severe stroke and wrote a book about his experiences. The Australian tennis star John Newcombe also wrote about his stroke. Samuel Johnson, one of England's best known literary figures, had a stroke on the 17 June 1783. His thoughts at the time were:

I was alarmed, and prayed God, that however he might afflict my body, he would spare my understanding. This prayer, that I might



Figure 1.2 Samuel Johnson hoped that his stroke would spare his intellect.

try the integrity of my faculties, I made in Latin verse. The lines were not very good, but I knew them not to be very good.

A stroke occurs when the blood supply to the brain is disrupted, and part of the brain stops working. This produces sudden characteristic symptoms ranging from a rapidly fatal illness to a barely perceived loss of sensation on one side of the body. This variability causes many problems! It is hard for the layman to understand what a stroke is (or is not) as there are so many variants. It is also often hard for doctors and nurses to make the correct diagnosis, as many illnesses mimic stroke. Surveys of public knowledge of stroke have shown that this common disorder is not well understood. Many people are not aware that the problem lies within the brain. It is certainly not the same thing as a heart attack, which has quite different symptoms (usually severe chest pain). Stroke is not usually accompanied by severe pain. If pain is present, it is



usually a headache and may be a sign that the stroke has been due to a brain haemorrhage.

The underlying cause of stroke

There are actually two main causes of stroke which, confusingly, can present in exactly the same manner. About 80 per cent of all strokes are due to blockage or **occlusion** of the blood supply to the brain, usually from a blood clot. Blood clots can develop along a blood vessel or may have travelled along the blood vessel from a source further away. The latter sort of blood clot is called an **embolus**. Strokes caused by occlusion of blood vessels are due to death of brain tissue, which is known as **cerebral infarction**. This type of stroke is commonly called **ischaemic stroke**.

The other main pathological cause of stroke is **brain haemorrhage**, which is caused when a blood vessel in the brain (the **cerebral artery**) leaks or bursts. This type of stroke is called **primary intracerebral haemorrhage**. About 15 per cent of strokes are of this type.

The final 5 per cent of strokes are caused by a condition called **subarachnoid haemorrhage** which has a very different presentation, assessment, and treatment from ischaemic stroke and primary intracerebral haemorrhage. It is not discussed further in this book.

A closer inspection of these causes of stroke reveal a major difficulty in the assessment and treatment of the condition. Treatments which can help prevent cerebral infarction, such as blood thinners like anticoagulants or antiplatelet medication, can sometimes cause primary intracerebral infarction. Likewise, treatments for primary intracerebral haemorrhage, such as blood clotting factors, can sometimes cause **cerebral thrombosis** (clots in the blood vessels in the brain). Therein lies the problem: there are two very different types of stroke which require very different approaches to treatment. Indeed, until the invention of the computed tomography scanner (CT scanner) in the 1970s, it was impossible to reliably distinguish cerebral infarction from primary intracerebral haemorrhage and therefore it is not surprising that successful emergency treatments for stroke have only been developed in the last 30 years.

The changing names for stroke

The Greek physician Hippocrates (about 460–370 BC) recognized stroke and called it ‘apoplexy’, derived from the Greek word ‘apoplexia’ (being struck with violence). It is likely that Hippocrates and his followers used this name for the most catastrophic of strokes, such as large primary intracerebral



haemorrhages or subarachnoid haemorrhages which commonly cause loss of consciousness and can rapidly lead to death. We still describe such a rapid and severe onset of illness as ‘apoplectic’. Hippocrates also recognized other types of stroke. He used the term ‘partial apoplexy’ to describe someone with a ‘hemiparesis’ – a weakness of the face, arm, and leg on one side of the body. A well-known saying of the time reflected the expected outcome from such disorders: ‘It is impossible to cure a severe attack of apoplexy, and difficult to cure a mild one’. This sentiment is still held, rather inaccurately, by many doctors today.

Since the time of Hippocrates a large variety of terms have been used to describe stroke. Perhaps the most commonly used, and the least helpful, is ‘cerebrovascular accident’ (CVA). The term ‘stroke’, which has been used by the layman for several hundred years, conveys the suddenness and randomness with which it occurs, and has now become the preferred medical term.

As ‘stroke’ and ‘transient ischaemic attack’ have become the widely accepted standard medical terms, it is useful to look at their definitions.

Definition of stroke and transient ischaemic attack

Medical definition of stroke

A stroke is a clinical syndrome characterized by rapidly developing clinical symptoms and/or signs of focal, and at times global (applied to patients in deep coma and those with subarachnoid haemorrhage), loss of cerebral function, with symptoms lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin (Hatano 1976).

The use of this definition of stroke over the past 30 years has had many advantages. The description of ‘rapid onset’ of neurological symptoms nicely captures the key features of stroke for healthcare professionals. In fact, this is a defining feature of vascular disease (disease of the blood vessels). A heart attack (occlusion of a coronary artery by a ruptured atherosclerotic plaque) is characterized by sudden chest pain. Arterial thrombosis of the leg is characterized by a sudden onset of a painful, pulseless, and pale leg.

Focal neurological signs, such as weakness down one side (unilateral hemiparesis) or loss of vision (unilateral loss of visual field called hemianopia), describe the common patterns of stroke symptoms that are due to the way the blood is supplied to the brain, which follows a similar pattern from person to person. The proviso in the definition ‘with no apparent cause other than that

of vascular disease' excludes other common causes of damage to the brain such as trauma. The definition does not depend on fancy technology and can be made at the bedside by the doctor. The strict use of this definition has been essential in epidemiological studies assessing stroke incidence and prevalence around the world, and studies of stroke treatment and outcome. However, as time has gone by there have been increasing problems with this formal definition. The most powerful medical treatment for stroke, namely clot-busting medication (thrombolysis) for cerebral infarction, has to be given within a few hours of stroke onset. You cannot wait for 24 hours to be sure this was a stroke! Subarachnoid haemorrhage is officially a subtype of stroke, but the milder forms of this disease present with headache and no focal or global neurological deficit, and thus this definition is not quite right for all subarachnoid haemorrhages.

Transient ischaemic attack

Medical definition of transient ischaemic attack

A transient ischaemic attack (TIA) is a clinical syndrome characterized by an acute loss of focal cerebral or monocular function with symptoms lasting less than 24 hours and which is thought to be due to inadequate cerebral or ocular blood supply as a result of arterial thrombosis or embolism associated with arterial, cardiac or haematological disease (Hankey and Warlow 1994).

TIA's are not just 'mini-strokes'

In simple terms a TIA is merely a 'mini-stroke', one from which you make a full recovery within 24 hours, but closer attention to the wording reveals three important differences.

- ◆ TIAs are all ischaemic events. Although short-lived attacks can, very rarely, be due to intracerebral haemorrhage, it is reasonable to assume that all TIAs are ischaemic because of the causes mentioned in the definition, such as arterial thrombosis (blood clot), an embolus (thrombosis from upstream in the blood supply), cardiac disease (of which there are a large number of causes), or haematological disease ('sticky' blood).
- ◆ A TIA differs from a stroke in that the definition includes a list of the possible causes of the ischaemic attack. This implies a need for medical investigation to identify the cause for a specific patient.

- ◆ TIAs also include symptoms due to disturbed blood supply to the eye (vascular insufficiency). If the blood flow to the eye becomes sluggish or blood clots (emboli) block the blood supply to the retina of the eye, the retina becomes short of blood (ischaemic) and this causes transient blindness in the one eye. Characteristically, patients describe a shutter coming down at the beginning of the attack. These are often short lived (seconds or minutes) and have been given a variety of different names: transient monocular blindness or, more traditionally, amaurosis fugax.

The importance of these TIAs is that they can be a warning of a more serious stroke to come. Curiously, a permanent occlusion of the retinal arterial supply is called a retinal infarct not a stroke! For reasons which are not quite clear, a TIA due to a 'brain attack' carries a higher risk of future stroke than a TIA due to an 'eye attack'.

There has been a great deal of discussion as to whether the current definitions of stroke and TIA are appropriate for the twenty-first century. Modern brain imaging, such as CT scanning and magnetic resonance scanning (see Chapter 5, Figures 5.2 and 5.3), has clearly shown that cerebral TIAs and ischaemic stroke are the same disease, and it is our artificial time limit of 24 hours that separates the two. However, in an ever-changing world the problem of basing a definition just on the results of brain imaging would mean that what was a TIA today may be called a stroke tomorrow! Such changes to the definition would cause major problems in the science of medicine as doctors would not be able to compare like with like over time. This emphasizes the value of the current clinical definitions: the study of stroke and TIA over time will be comparing like with like, no matter what progress is made in identifying the underlying infarcts or ischaemic brain with advanced brain imaging.

There are further advantages of the current definitions. Different conditions tend to mimic short-duration attacks (TIA) rather than longer attacks (stroke), and this can be helpful information for the doctor.

'Brain attack', a new term for TIA and stroke

As we become more successful in reversing the consequences of stroke, time is of the essence. Treatments need to be started within minutes or hours of the TIA/stroke onset for maximal effect. We simply mustn't wait until the 24 hours is up before deciding what to do as 'time is brain'. There is increasing consensus that a new term, **brain attack**, should be used to describe the typical features of TIA and stroke within the first 24 hours. There are many advantages

to this approach. First, there will be the inevitable comparison with ‘heart attack’, and hopefully a similar public response of urgency. The term also clearly identifies the organ at risk, thus improving public understanding. The use of ‘brain attack’ will also help to motivate an often sluggish medical response in the emergency room and provide a useful hint that the main conditions mimicking stroke are also brain conditions (such as epilepsy, brain tumours, or multiple sclerosis). The key aim of emergency treatments for ‘brain attacks’ is to reverse all the neurological symptoms as soon as possible, thus resulting in more TIAs and fewer strokes. At 24 hours, reassessment of patients will identify whether the brain attack has led to a permanent stroke or not.

Other definitions and names

A variety of other names and definitions have been proposed over the years.

- ◆ **Apoplexy** The ancient term for devastating stroke.
- ◆ **Cerebrovascular accident** The term for stroke used in the mid-twentieth century and still enshrined in some medical search engines and registers. It is not a useful medical term nowadays. Stroke is not an accident, and many people use the term CVA in a confusing manner. For example, ‘the patient had a right CVA’ is alternatively interpreted as a right hemiparesis or a right brain stroke (which would usually cause a left hemiparesis). This term is best abandoned.
- ◆ **CITS (cerebral infarction with transient signs)** This was proposed when CT scanning revealed that about a fifth of patients with TIA had definite evidence of new cerebral infarction on brain imaging.
- ◆ **RIND (reversible ischaemic neurological deficit)** This has been proposed to describe a stroke that leads to full recovery.

Haemorrhagic stroke

Stroke due to haemorrhage continues to have a variety of different names. The official medical term for haemorrhagic stroke is **primary intracerebral haemorrhage (PICH)**, and the volume of blood in a PICH is often referred to as a **haematoma**, or confusingly as a **blood clot**. Any abnormal blood within the skull is called **intracranial haemorrhage**. Bleeding around the brain may be due to a **subdural haematoma** (but this is not usually called a stroke). **Subarachnoid haemorrhage** may be pure subarachnoid bleeding

but may also arise from a **PICH**. Finally, some cerebral infarcts bleed and this is called **haemorrhagic transformation of infarction**.

Further reading

Hankey GJ, Warlow CP (1994) *Transient Ischaemic Attacks of the Brain and Eye*.
WB Saunders–Baillière Tindall, London.

Hatano S (1976) Experience from a multicentre stroke register: a preliminary report.
Bulletin of the World Health Organization, **54**, 541–53.

