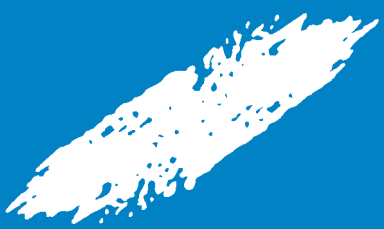
A Consumer's Guide

Prevention of Stroke

December 1996



National Health and Medical Research Council
NHMRC

PREVENTING STROKE

A Consumer's Reference Guide

National Health and Medical Research Council
NHMRC

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The strategic intent of the NHMRC is to work with others for the health of all Australians, by promoting informed debate on ethics and policy, providing knowledge based advice, fostering a high quality and internationally recognised research base, and applying research rigour to health issues.

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INTRODUCTION

This book is written for people who are at risk of stroke, for those who may be concerned about their stroke risk, for their families and others close to them, and for anyone concerned with the issue of stroke prevention and education.

Its purpose is to help people in understanding and reducing their stroke risk, and to help them to be involved in making decisions about treatment that reduces stroke risk.

While the book discusses briefly a wide range of stroke risk factors, it is particularly concerned with people at very high risk of stroke either because of disease of the arteries (atherosclerosis) or because of the heart condition known as atrial fibrillation. It looks at what these conditions are, what causes them, and what treatments will help to prevent stroke.

Both primary and secondary prevention are important. Primary prevention is treatment to prevent stroke before the person has any symptoms of stroke. Secondary prevention is treatment to lessen the risk of stroke in a person who has already had stroke symptoms. Someone in this situation is at very high risk of having another, and possibly more serious, stroke.

Stroke Prevention - A Consumer's Guide is produced by the National Health and Medical Research Council (NHMRC), through its Standing Committee on Quality of Care and Health Outcomes (QCHOC).

NHMRC is an independent body that advises the Australian public and federal and state governments on standards of individual and public health, and supports research and projects to improve those standards.

Stroke Prevention - A Consumer's Guide is part of a national program to improve the quality of health care and outcomes for people treated within the health system, through the development of guidelines, based on research and clinical evidence, for doctors, other health professionals and consumers.

The NHMRC chose stroke prevention for a number of reasons. Stroke is the third most common cause of death in Australia, and a major cause of disability. There are many very effective treatments to reduce the risk of stroke, and promising new methods continue to be investigated. Knowledge of how best to prevent stroke, and who should be treated, however, needs to be very much more widespread, both among doctors and the general public.

QCHOC established a working party comprising representatives from neurology, vascular surgery, general practice, consumers, nursing, and health economics. Appendix A provides a full list of representatives and the terms of reference of the working party.

The working party has produced a fuller book, *Clinical Practice Guidelines: Prevention of Stroke - the Role of Anticoagulants, Antiplatelet Agents and Carotid Endarterectomy*, which has been distributed to those involved in the management of people potentially at risk of stroke. *Stroke Prevention - A Consumer's Guide* is a modified version of that book.

Both books are based on evidence available in 1996 for the best management for stroke prevention. They are not intended to be "rules" for treatment, but to help in making decisions on the best treatment for each individual.

If you would like more information than is contained in this book, you can get a copy of the full guidelines by contacting:

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1. STROKE AND ITS SYMPTOMS

What is stroke?

A stroke is a brain attack - sudden and unexpected damage to brain cells that causes symptoms in the parts of the body controlled by those cells. It can affect thinking, movement, speech and/or the senses. It happens when the blood supply to part of the brain is suddenly disrupted. There are two main ways this can occur.

- An artery in the brain may become blocked by a blood clot or other debris carried in the bloodstream. This cuts off the blood supply to the surrounding brain cells and causes them to die. About 80-85% of strokes happen this way.

  Loss of blood supply to cells, and the oxygen carried by blood, is called *ischaemia*, and the death of cells that follows is called *infarction*. A loose clot or other debris in the bloodstream is called an *embolus*. Thus this type of stroke is called *ischaemic stroke* or *embolic stroke*.

- An artery may burst and bleed. When this happens inside the brain, it is called an *intracerebral haemorrhage* - the cause of about 10% of strokes. A bleed over the surface of the brain is a *subarachnoid haemorrhage*, and this is the cause of about 5% of strokes.

Strokes have in the past been called *cerebrovascular accidents* (*CVAs*). "Cerebro" refers to the brain, and "vascular" refers to blood vessels. The term, however, is imprecise and is best avoided.

What is a TIA?

A *transient ischaemic attack*, commonly known as a TIA, is simply a mini-stroke. The causes and symptoms are identical to those of ischaemic stroke, but the symptoms fade very quickly - within minutes or hours. If symptoms last longer than 24 hours, it is a stroke, not a TIA.

TIAs do not cause any permanent damage, but they are very important warning signs that a more serious stroke may follow. A significant number of people who have an ischaemic stroke have previously had a warning TIA, often only hours, days or weeks beforehand.

Extra information on

THE BRAIN

The symptoms of stroke, and their severity, depend on the part of the brain affected and the amount of damage. To understand stroke symptoms, it helps to know a little about the brain.

The brain is the body's control centre. The largest part is made up of the two cerebral hemispheres. Below them is the cerebellum, then the brain stem:

- The cerebral hemispheres control thinking, understanding, memory, learning, the emotions, and our ability to use words and language. They bring together our sense perceptions of the world - sight, taste, touch etc, and they control our body movements. Each hemisphere is responsible for movement and sensation on the opposite side of the body - the right cerebral hemisphere is responsible for the left side of the body, and the left hemisphere controls the right side.
- The cerebellum is also involved in controlling and coordinating movement.
- The brain stem is responsible for some vital functions that we are largely unaware of, including breathing, blood pressure and blood circulation. It is also the main thoroughfare for nerve fibres between the cerebral hemispheres and the spinal cord.

The brain is made up of nerve cells, or neurones. The nerve cells communicate with each other and with all parts of the body by sending messages (or nerve impulses, which are actually very small electric currents) through a complex system of nerve pathways.

The brain must have a constant supply of blood. Without enough blood, brain cells die within minutes. Unlike other cells in the body, nerve cells are not replaced if they die. The blood vessels that supply the brain branch off the aorta (the large blood vessel leaving the heart).

- Blood to the front part of the brain (including most of the two cerebral hemispheres) is carried in the two common carotid arteries. These pass up each side of the front of the neck - you can feel a pulse here. Just below the corner of the jaw, each artery divides to form the internal and external carotid arteries. This branching point is known as the carotid bifurcation. The internal carotid artery goes to the brain.
- Blood to the cerebellum and brain stem, and to the back part of the cerebral hemispheres, travels through the vertebral arteries, two smaller arteries that lie very close to the spine. These arteries form part of the *vertebro-basilar circulation*.

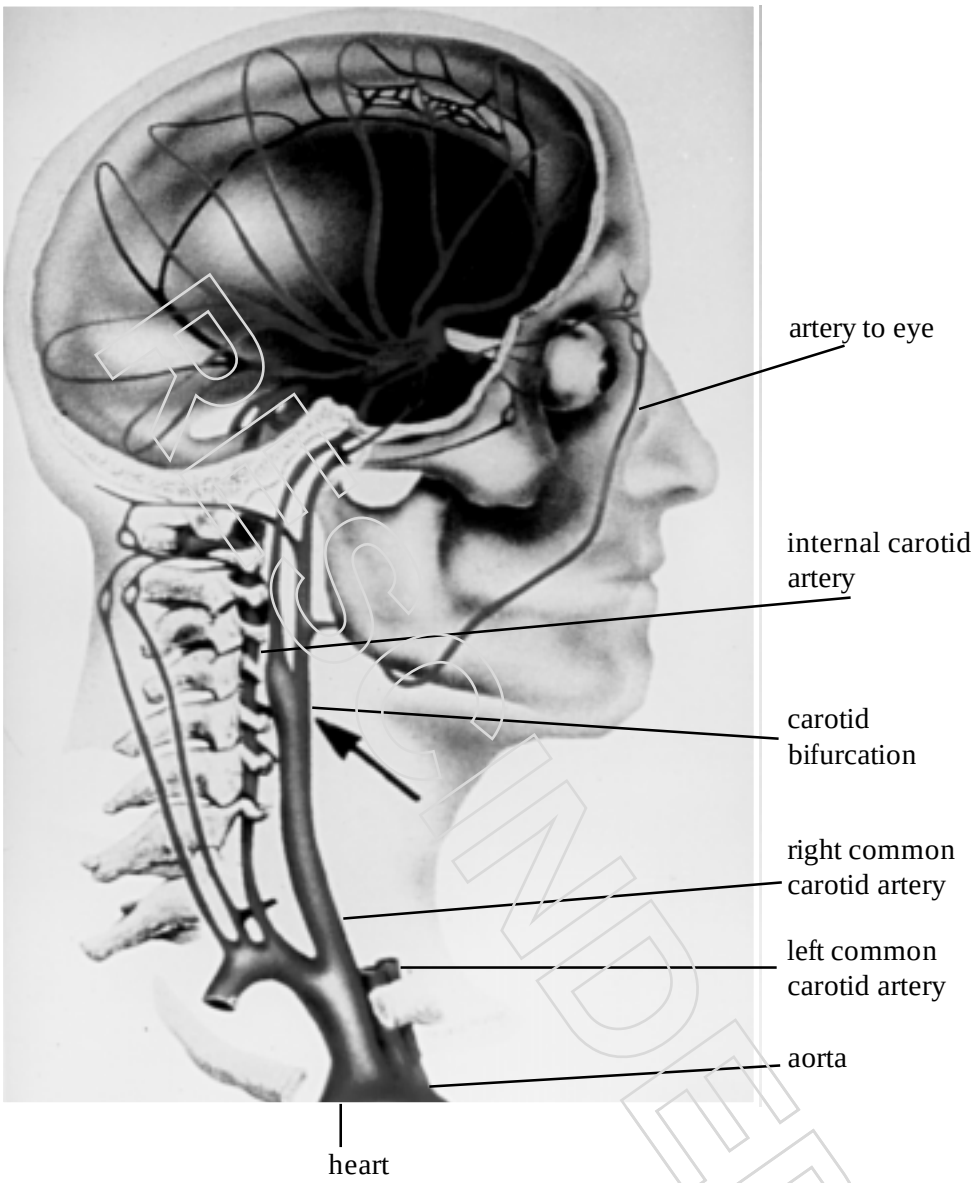

Figure 1 - The Brain

What are the symptoms of stroke?

The symptoms of stroke vary widely. In one person, there may be only a passing weakness or tingling in a limb, while another person may be completely paralysed on one side and have no speech. Some strokes cause unconsciousness or death. A person with a stroke or TIA may have many of the symptoms listed below, or only one or two.

Key point

STROKE WARNING SIGN

Sudden loss or blurring of vision in one eye is one important warning sign of stroke. It may be caused by a clot that has gone to the eye. When this happens, another clot could lodge in the brain.

A stroke or TIA in the *left cerebral hemisphere* may cause any of the following:

- weakness or clumsiness in the right side of the body - face, arm and/or leg (known as *hemiparesis* or *hemiplegia*);
- numbness or tingling in the right side - face, arm or leg (*hemisensory loss*);
- difficulty seeing in the right visual field (this affects both eyes, and is called *hemianopia*);
- difficulty thinking of words and/or understanding speech, reading and writing (*dysphasia*).

Symptoms of a stroke or TIA in the *right cerebral hemisphere* may include:

- the same weakness, clumsiness and/or numbness and tingling, but this time in the left side of the body;
- the same type of visual difficulty, but this time in the left visual field;
- spatial and perceptual problems such as difficulty getting dressed, neglecting the left side, and getting lost easily;
- slurred speech (*dysarthria*).

Symptoms of stroke or TIA in the brainstem include:

- loss of consciousness
- weakness and/or loss of feeling on one or both sides of the body
- poor coordination, unsteadiness and loss of balance (*ataxia*)
- slurred speech (*dysarthria*)
- swallowing difficulty (*dysphagia*)
- double vision (*diplopia*)
- a spinning sensation (*vertigo*).

What should I do?

Key point

STROKE IS AN EMERGENCY

If you or someone you are with has symptoms that might be a stroke, act quickly - call a doctor or call 000 for an ambulance and go straight to hospital.

If treatment for stroke starts as soon as possible (within hours), it can sometimes dissolve the clot causing the damage, and it can mean fewer complications. This means a better outcome, and less disability.

Often, strokes have a "stuttering" onset, over hours. Prompt treatment may be able to interrupt this.

Someone who has just had a TIA or stroke is also at very high risk of having another, possibly more serious, stroke over the next few days. Treatment can help to prevent this.

What are the chances of recovery?

Of those who have a stroke:

- about one third will recover completely over a few days, weeks or months;
- about one third will be left with some degree of permanent disability, usually paralysis and/or speech problems;
- about one third will die within 12 months as a direct result of the stroke. Most of these die within one month.

Recovery depends on:

- which part of the brain is affected;
- how big an area of the brain is affected; and
- whether there are complications such as a chest infection, a urinary infection, or a clot in the legs.

At the start, the stroke causes a good deal of swelling in the surrounding brain. This settles down after the first week or so, leaving a central area of dead cells, and the surrounding cells still recovering.

What happens over the weeks and months that follow is uncertain. Some of these "stunned" cells may gradually recover, or other parts of the brain may take over some of the lost functions. Either way, there will be some gradual improvement. Rehabilitation helps to make the most of this recovery.

What is the difference between stroke and heart attack?

Many people confuse stroke and heart attack, although the two are quite different.

- A stroke is a brain attack. It damages an area of the brain and stops it from working. It does not affect the heart.
- A heart attack is caused by damage to the blood supply to the heart muscle (*myocardial infarction*). Unless the problem rights itself very quickly, some heart muscle dies, and this leaves the heart weaker than before.

Unlike heart attack, stroke often leaves people with some disability affecting movement, speech, balance, or other areas.

Both stroke and heart attack may be caused by narrowing and blockage of blood vessels. In most cases, a person at risk of stroke is also at risk of heart attack because arteries in both heart muscle and brain are affected.

Extra information on
STROKE IN THE COMMUNITY

How common is stroke?

Each year about 40,000 Australians have a stroke. About half of these are over 75 years of age, but strokes also occur in the young - at least 5% are in people under 45 years, including a few children.

Stroke causes 10% of all deaths in Australia. This makes it the third most common cause of death (after heart disease and cancer). It also causes nearly 25% of long-term disability.

What does it cost?

Stroke costs the Australian community nearly $1.7 billion per year, or about $40,000 per stroke. These costs include:

- $742 million in direct costs: hospital, rehabilitation, other health costs (e.g. physiotherapy at home), outpatient appointments, visits to the doctor, ambulance and hospital transport, home modifications, district nursing, home help, meals on wheels, community health care, respite care, and nursing home care; and
- $927 million in indirect costs: loss of earnings of both the person with stroke and the carer.

These are broad estimates. There is no research published that looks at the cost of stroke from the individual's point of view, and at the different impact of stroke for people of different ages, income groups and social circumstances. A study in Melbourne is currently tackling this.

2. WHO IS AT RISK OF STROKE?

What causes stroke?

Stroke is caused by conditions that affect the arteries, the heart and the blood.

- *Atherosclerosis*, or "hardening of the arteries", is the most common cause of stroke. A clot may form on the roughened artery wall and block the artery. Or debris from the clot or the artery wall may break off, float in the blood to the brain, and block a blood vessel. Or a sudden drop in blood pressure, combined with the clogged up arteries, can prevent enough blood from getting to the brain cells - this is called *cerebral hypoperfusion*.

  The greatest concern is atherosclerosis in the carotid arteries (the two arteries in the neck that supply the brain). This gradually makes them narrower - a condition called *carotid artery stenosis*. (See chapter 3.)

- Two heart conditions - *atrial fibrillation* and *valvular heart disease* - may cause clots of blood to form in the heart. Bits of these can break off, travel to the brain, and cause a stroke. (See chapter 4.)

- Subarachnoid haemorrhages are usually caused by the bursting of blisters (*aneurysms*) on brain arteries. Sometimes these blisters are caused by atherosclerosis, but some are there from birth. A few people are born with a small, malformed tangle of blood vessels within the brain (an *arterio-venous malformation*), and these can also bleed and cause a stroke. These congenital problems most often cause strokes in younger people.

- Small arteries within the brain can also break down and bleed. Nobody is certain as to what causes this, but high blood pressure is the most likely explanation - over many years, it probably causes small areas of weakness in the artery walls.

  (Brain haemorrhage can also be caused by a head injury, but this is not called a stroke.)

- Up to 5% of ischaemic strokes are caused by a blood disorder that makes the blood thicker and more likely to clot.

Who is at risk?

Stroke largely affects older people. Every ten years, as you get older, your risk of having a stroke roughly doubles.

There are a number of other factors that place some people at higher-than-average risk of stroke, because these factors all contribute to atherosclerosis:

- the way each person's body functions - your risk is increased by:
  - high blood pressure
  - high blood cholesterol
  - diabetes (high blood sugar)
  - obesity

- things people do - your risk is increased by:
  - smoking
  - alcohol
  - lack of exercise
  - high fat diet.

If you have more than one risk factor - for instance, high blood pressure plus smoking - your risk increases substantially.

The most important of these risk factors are discussed below. The two conditions that put people at very high risk of stroke - disease of the arteries and the heart condition *atrial fibrillation* - are discussed in detail in later chapters.

Key points

High blood pressure and smoking are the most important stroke risk factors. Lowering high blood pressure and quitting smoking are vital steps in reducing your stroke risk.

People who have had a TIA or stroke are at high risk of having another stroke. Prompt preventive treatment can reduce this risk.

Can I avoid having a stroke?

There are many things you can do to lessen your chances of having a stroke. None of them can guarantee that you won't have a stroke - but you can improve the odds in your favour.

For instance, the risk gets higher as you get older - you can't do anything about this. But if you smoke, your chances of having a stroke over the next year are at least double the chances of a non-smoker of the same age.

Stroke prevention treatments and lifestyle changes *do help*.

High blood pressure

High blood pressure (*hypertension*) is the single most important risk factor for stroke. "Hypertension" does not mean that you are tense, stressed or agitated. It simply means that your blood pressure is higher than it should be for good health.

What is blood pressure?

Blood pressure is the pressure of blood against the walls of the main arteries. There is a wave of higher pressure each time the heart beats to pump blood around the body - this is what you feel as your pulse. Measurement of blood pressure thus gives two figures: the maximum (*systolic*) pressure as the heart contracts (the heart beat), and the minimum (*diastolic*) pressure as it relaxes. The figures are written as, for example, 120/80 - that is, a systolic pressure of 120 and diastolic pressure of 80.

Arteries carry the blood away from the heart, and they have to withstand these waves of pressure. When blood pressure is too high, arteries are damaged. By the time the blood gets to the veins, which carry it back to the heart, the pressure has evened out.

Why is high blood pressure a problem?

If blood pressure remains high over time, the blood vessels may be damaged in two different ways:

- Firstly, high blood pressure aggravates atherosclerosis, which may cause clots to form and cause a stroke (see chapter 3).
- Secondly, it may weaken the walls of blood vessels, and so lead to haemorrhage, particularly when atherosclerosis has already damaged the artery walls.

What are the symptoms?

High blood pressure usually has no symptoms at all - you can have high blood pressure but feel fine.

Key point

Everyone should have their blood pressure checked regularly, especially as they get older. High blood pressure usually has no symptoms.

How does high blood pressure affect stroke risk?

Blood pressure varies from person to person. It varies with age, and depending on what you are doing. It will be higher, for instance when you are exercising, or if you are afraid or excited. It will be lower when you are asleep. Blood pressure measurements are usually taken when you are relaxed and sitting down.

Recent research has questioned the idea of a "safe" blood pressure. Doctors used to say that a blood pressure of less than 140/90, and perhaps in older people, 160/90, was "safe" or "healthy". Research, however, has shown that, even if you have fairly low blood pressure, any rise in your blood pressure increases your risk of stroke.

Extra information on

BLOOD PRESSURE AND STROKE RISK

- The risk of stroke doubles with every rise of 7.5 in your usual diastolic blood pressure, over a pressure of 70. In other words, the lower your diastolic blood pressure (at least as far down as 70), the lower your stroke risk.
- Some people, particularly older people, have high systolic pressure but a fairly low diastolic pressure. These people roughly double their stroke risk with every rise of 7.5 in their usual systolic pressure. In other words, the lower the systolic pressure for these people, the lower their stroke risk.

Treatment trials have shown that lowering blood pressure will lower your stroke risk. It is important for everyone, particularly as they get older, to keep blood pressure low.

We do not yet know what is a safe minimum blood pressure.

How well do blood pressure tablets work?

High blood pressure can be lowered by medications known as antihypertensives. For these to work properly, it is important that you take them regularly.

There are basically four common types:

- diuretics
- beta-blockers, alpha blockers
- angiotensin converting enzyme (ACE) inhibitors
- calcium channel blockers.

Within each of these groups, there are a number of different drugs. Some people may have unpleasant side-effects - these vary with the type of drug, although they tend to be similar for all drugs of the one type. **Ask your doctor what side-effects to expect with your particular drug, and report back if you have side-effects.** The doctor may be able to give you a drug from one of the other groups instead.

Many people need to take these drugs for the rest of their life. Making changes to your lifestyle also helps in controlling your blood pressure. If you can do this, sometimes you may not need the drugs - but always talk to your doctor first, before giving up any blood pressure drugs.

What lifestyle changes help lower blood pressure?

There is evidence to show that blood pressure can be lowered to some extent through lifestyle changes alone. Even if you are on antihypertensive drugs, these measures will help to control your blood pressure.

Key point

LIFESTYLE CHANGES TO HELP LOWER BLOOD PRESSURE

- Eat less salt, by not adding salt to food and buying food with a low salt content.
- Eat less fats and sugars.
- Have regular exercise.
- Don't smoke.
- Keep your body weight in the healthy range - not overweight.
- Limit the amount of alcohol you drink (an absolute maximum of 2 standard drinks a day for women, 4 for men).

How do I know the treatments and life-style changes are working?
When your doctor takes your blood pressure, the reading will be lower. You won't necessarily feel any different - but if your blood pressure is down, then your risk of stroke is also lower. It is important to keep up your healthy lifestyle to keep your blood pressure and stroke risk down.

Smoking

There is a direct relationship between the amount a person smokes and their risk of stroke.

Key point

SMOKING AND STROKE RISK

Smoking at least doubles your stroke risk, and may increase it up to four times.

People who stop smoking reduce their risk of stroke to around the levels of non-smokers after three to five years.

For instance, people aged between 75 and 84 have about a 2% stroke risk - that is, 2 in every 100 will have a stroke each year. But among smokers of this age, at least four and possibly eight will have a stroke each year.

In people under the age of 65 years, 44% of strokes in men and 39% in women are caused by smoking. The proportions are lower in older people not because smoking becomes less dangerous - it doesn't - but because other risk factors are also causing more strokes, and smoking is less common in the elderly.

Women who smoke are at increased risk of subarachnoid haemorrhage. This risk is greater in women smokers who also use the contraceptive pill.

Giving up smoking is one of the most important things you can do to reduce your stroke risk.

How does smoking cause stroke?
Smoking speeds up the hardening of the arteries (atherosclerosis) (see chapter 3), probably through the action of the nicotine and carbon monoxide in cigarette smoke. It thickens the blood and stimulates the platelets, and probably helps clots to form (see chapter 5 for a discussion of how blood clots). It also makes blood vessels constrict, making it more difficult for the thickened blood to flow through them.

High blood cholesterol

Cholesterol is a fat that occurs naturally in the human body. A sample of blood is needed to test the amount of cholesterol in your blood.

We know that cholesterol in the blood stream can become part of the yellow, fatty substance called *atheroma* that forms on artery walls, and atheroma is a risk factor for stroke (see chapter 3). We also know that high blood cholesterol is a risk factor for

coronary heart disease until at least 80 years of age. It is probably also a risk factor for ischaemic stroke, although there has been little research. One study found that reducing blood cholesterol led to a reduction in the incidence of stroke. People with stroke are also at high risk of heart attack.

There is no doubt that lowering your blood cholesterol level is a sensible thing to do for good health. The main way of doing this is by eating less saturated fats. There are also drugs available for people with extremely high blood cholesterol.

It would seem that, like blood pressure, the lower the level, the lower the risk.

Other lifestyle risk factors

A number of studies have shown that obesity, lack of exercise and heavy alcohol intake increase the risk of stroke. We do not know whether this is simply because they all contribute to hardening of the arteries, or whether they also act in some other way to increase the risk of stroke.

Nevertheless, reducing these risk factors will reduce the risk of stroke, although we do not know by how much. This uncertainty is because:

- there has been little research looking at how common these risk factors are, and how easily they can be changed; and
- they often go with other, better understood risk factors such as high blood pressure and smoking.

Heavy drinkers, particularly binge drinkers, increase their risk of all types of stroke. Even at a modest level, alcohol may increase the risk of stroke. The risk is not related to the type of drink - beer, wine, spirits all lead to increased risk.

Diabetes

Diabetes is a major risk factor for stroke because it speeds up hardening of the arteries. It is a particular problem if the diabetes is not well controlled.

A person with diabetes is about twice as likely to have a stroke as someone of the same age who does not have diabetes.

How important is family history?

Stroke in elderly members of your family does not increase your risk of stroke much, if at all. However family history of stroke may be more important if people in your family had a stroke in middle age.

- A haemorrhagic stroke in a younger person might be caused by an aneurysm or an arterio-venous malformation. Some of these may be inherited.
- An ischaemic stroke in a younger person might suggest, for instance, a family history of high blood cholesterol, which contributes to atherosclerosis.

Your increase in risk varies depending, in part, on how many family members are involved and how old they were when they had their strokes. If you are concerned, talk with your doctor about your particular situation.

What about stress?

People who have had a stroke or TIA often believe that other factors have been involved in causing it - for instance, stress, worry, heavy exercise, or sudden shock.

There is no clear evidence to show that any of these cause stroke, although a connection between stress, smoking and high blood pressure seems likely.

COMMON QUESTIONS ANSWERED

- Family history is not usually an important risk factor for stroke.
- There is no research evidence to show that stress causes stroke, although it may be linked with high blood pressure.
- The low-dose contraceptive pill is not an important risk factor for stroke, although it may increase the risk in smokers. The old high-oestrogen pill *was* a risk factor, but this type of pill is no longer used.

Assessing your stroke risk -
THE DOCTOR'S EXAMINATION

If you are concerned about your stroke risk, your general practitioner can easily assess your level of risk. The doctor will probably ask you about:

- any symptoms that suggest TIA or stroke;
- your history of risk factors, particularly high blood pressure and smoking, as well as things such as diet and exercise;
- whether other members of your family have had strokes.

In examining you, the doctor will:

- take your blood pressure. It is best, at least on one occasion, to compare the blood pressure in both arms - in some people, a blockage to a blood vessel in one armpit can affect the blood pressure reading;
- take your pulse. An irregular pulse suggests atrial fibrillation, and should be investigated;
- listen to your neck with a stethoscope to hear if there is a "neck bruit" - that is, the sound made by uneven blood flow. This suggests that the carotid artery *may* be narrowed by atherosclerosis (though often it is not);
- listen to your heart, to see if you have a heart murmur. This may suggest disease of the heart valves.

Some tests may then be necessary:

- If your pulse is irregular, an electrocardiograph (ECG) records the electrical activity in your heart muscle, and can often diagnose atrial fibrillation (see chapter 4). The doctor may also do a "thyroid function test", because too much thyroid hormone can cause atrial fibrillation.
- The doctor might also take a blood sample to test for blood sugar and blood lipids (fats), if there is reason for concern.
- If you have a neck bruit, or you have had symptoms of TIA or stroke, the doctor might order an ultrasound examination of your carotid artery. (This examination is discussed in chapter 3.)

The doctor should also discuss lifestyle changes, such as stopping smoking, regular exercise, and eating a healthy, low-fat, low-salt diet.

A small number of people have a stroke during or after major surgery. The risk of this happening is small. If you are having a major operation, your own doctor or your surgeon will usually assess your risk of stroke or other complications. If you are concerned, ask your doctor about it. (This is also discussed at the end of chapter 5.)

3. STROKE CAUSED BY DISEASE OF THE ARTERIES

What is atherosclerosis?

The most common cause of stroke is "hardening of the arteries", or *atherosclerosis.*

In atherosclerosis, a yellow, fatty substance (*atheroma*) collects on the inner walls of arteries. These deposits slowly grow and thicken with fibrous tissue, and become part of the artery wall. They are called *atheromatous plaques* or simply *plaques.* Atheroma is found even in teenagers and children in our society, and it gradually builds up through life.

Atherosclerosis means hardening - *sclerosis* - caused by atheroma. It is sometimes called *arteriosclerosis,* though this term is also used to describe a few other conditions.

Key point

The three most important things that contribute to atherosclerosis are smoking, high blood pressure, and high blood fats.

What is the relationship between high blood pressure and atherosclerosis?

The two very often go together, though no-one is sure which comes first. High blood pressure tends to drive the atheromatous plaques into the artery wall. A healthy artery wall is resilient and elastic, and "gives" a little with each heart beat. Atheroma makes it more rigid and brittle. This in turn tends to raise the blood pressure, because the artery can't "give" with the heart beat.

Can atherosclerosis be reduced?

Yes. There is evidence to show that atherosclerosis may be reduced by:

- changing to a low fat diet, and/or
- treatment with drugs to lower blood fats (e.g. cholesterol).

We do not know whether lowering blood pressure can achieve the same effect, but it will certainly reduce further damage.

How does atherosclerosis cause stroke?

People with atherosclerosis in the arteries of the neck and/or the brain are at high risk of stroke. Atheroma can cause stroke in a number of ways.

- Fragments from a plaque may break off and lodge (as an *embolus*) in a smaller artery in the brain.
- A clot (a *thrombus*) may form on the rough surface of plaque and block the artery.

- Pieces of the clot can break off to form an embolus (*thromboembolism*), and be carried to the brain.

  (A thrombus is a clot attached to the artery wall where it has formed; an embolus is any debris or piece of clot floating free in the blood stream.)

- Plaque can gradually narrow or even completely block an artery. This reduces or cuts off the blood supply.

Blood clots travelling to the brain come most commonly from the carotid arteries, but they can also come from other arteries nearby - the aorta, or the vertebral or basilar arteries that supply the back part of the brain.

Atherosclerosis in the brain

Atherosclerosis can affect small arteries within the brain and cause them to block. This is an important cause of stroke. It can produce many small areas of infarction - that is, dead brain cells - known as *lacunes* because they look like lakes (lacuna is Latin for lake).

What about arteries in other parts of the body?

If there is atherosclerosis in one part of the body, it is likely to be present in other parts. The three areas most likely to be affected, other than the neck and brain, are:

- the arteries supplying the muscle of the heart - this is called *coronary artery disease*, and blocking of these arteries causes *myocardial infarction* - a heart attack;
- the arteries in the legs - this is called *peripheral vascular disease*, and it can cause *lower limb ischaemia*;
- the aorta - this can lead to an *aortic aneurysm*, which may bleed.

People with these conditions are also at very high risk of having a stroke because they probably have similar changes in the blood vessels to the brain.

Atherosclerosis in the neck - carotid artery stenosis

When atheroma builds up in the carotid arteries (the two large arteries in the front of the neck that supply the brain), the narrowing it causes is called *carotid artery stenosis* - often simply called carotid stenosis. (*Stenosis* means narrowing.)

Atherosclerosis usually affects the area known as the *carotid bifurcation* - the point where the common carotid artery branches to form the internal carotid artery, which goes to the brain, and the external carotid artery. (See figure 1, page 5)

Atheroma disturbs the smooth flow of blood at this junction. Blood flow becomes turbulent, like a stream flowing around rocks. Areas of slow flow can allow clots to form on the plaque, and these can then break off and travel in the blood stream until they block a blood vessel in the brain.

The risk of stroke depends on how much your carotid artery is narrowed, and whether or not you have already had a TIA or stroke.

Carotid stenosis is measured as *percentage diameter stenosis* - that is, the percentage by which the original inside diameter of the artery is now narrowed:

- less than 30% diameter stenosis is described as *mild stenosis* - at least two thirds of the artery remains open;
- 30-69% stenosis is *moderate* stenosis;
- 70-99% is *severe* stenosis - less than one third of the artery remains open;
- *occluded* means the artery is completely blocked.

Extra information on

STROKE RISK AND CAROTID STENOSIS

For people who have already had a stroke or TIA - those with *symptomatic carotid stenosis* - the risk is high. ("Symptoms" here mean symptoms of stroke or TIA.)

- For those with 70-99% narrowing (severe stenosis), up to 18 in every 100 will have a stroke each year. The greater the stenosis, the greater the risk. The risk is also higher if the walls of the narrowed artery are roughened or irregular - they might, for instance, be ulcerated.
- The risk for people with 30-69% narrowing is known to be less, but no exact figure is available - it is still under study.

For people with *asymptomatic carotid stenosis* - that is, people who have not already had symptoms of TIA or stroke - the risk is much lower.

- For those with 60%-99% narrowing (moderate to severe stenosis), about 3 in every 100 will have a stroke each year.
- The stroke risk is low for those with less than 30% narrowing (mild stenosis), about the same as for people of the same age in the general population.

How common is carotid stenosis?

Overseas studies suggest that carotid stenosis of 50-99% (that is, more than half blocked) is present in:

- 10% of people aged 80 years and over
- 6% of people aged 70-79 years
- 3% of people aged 60-69 years
- 0.5% of people aged 50-59 years.

That means, in total, about 150,000 people in Australia. Most of these people will have no symptoms, and will not know they have carotid stenosis.

What can be done to reduce stroke risk from atherosclerosis?

Tablets

Aspirin (or other antiplatelet drugs) lowers the risk of stroke by up to 25% - that is, it prevents about one in four strokes - in people at high risk of stroke because of atherosclerosis. This is the best treatment for the large majority of these people, including those with carotid stenosis (whether or not they also have surgery). For a few people with atherosclerosis in arteries deep in the brain, the anticoagulant drug warfarin may be better than aspirin.

Both aspirin and warfarin help to prevent clots forming on the thickened and roughened artery walls. They are discussed in detail in chapter 5.

Surgery for carotid stenosis

People with severe stenosis (70-99%) may have surgery to remove the plaque that is narrowing the artery - a "rebore" of the artery. The operation is known as *carotid endarterectomy* - it means literally, removal (*-ectomy*) of the thickened inner lining (the *endothelium*) of the artery. It is discussed in detail in chapter 5.

Will lifestyle changes help?

Yes. As discussed above, a low-fat diet can help to reverse the atherosclerosis, and there are a number of lifestyle changes that will help to control blood pressure at the same time. Stopping smoking is the most important of these.

Lifestyle changes are important in the longer term. The changes in risk, however, only happen gradually. People at high risk of stroke also need treatment straight away to reduce their stroke risk.

How do I know if I have carotid stenosis?

Most people don't know they have carotid stenosis until they have symptoms - a TIA or stroke in the part of the brain supplied by the carotid artery. This is called *carotid territory ischaemia*. (It could still, of course, have a different cause, such as a clot from the heart).

Carotid territory ischaemia is not always easy to diagnose. The symptoms might be from a different part of the brain, or be caused by something such as a migraine - but symptoms should always be urgently investigated. You may need to be referred to a neurologist for this. (Stroke symptoms are listed in chapter 1.)

A neck bruit might also suggest that you have carotid stenosis.

What is a neck bruit? What does it mean?

A neck bruit (also called a *carotid bruit*) is the sound made by uneven blood flow in the carotid artery. The doctor can hear it through a stethoscope placed on your neck. It suggests you probably have some carotid stenosis, but the stenosis is often only mild. Or the bruit may be caused by various other things, often not serious, that have nothing to do with carotid stenosis.

A lot of people - about one person in ten over the age of 50 years - have a neck bruit. Only half of these, however, have severe stenosis. At the same time, about one quarter of those with severe stenosis and nearly half those with moderate stenosis have no bruit.

The only way to be certain is to use what are called *imaging techniques* - ways of looking inside the body. The simplest of these, and the least expensive, uses ultrasound. This should be the first investigation, if your neck bruit is investigated.

Should my neck bruit be investigated?

If you have had stroke symptoms, the answer is definitely "yes".

If you have no symptoms, doctors' opinions vary on what to do.

Many people with a neck bruit and no other symptoms are at low risk of stroke. Preventive treatment is probably not necessary, and investigating and finding mild or moderate carotid stenosis may only lead to unnecessary worry. Some, however, will be at higher risk, with severe stenosis. These people are candidates for carotid endarterectomy to reduce their stroke risk.

The question facing doctors is: Is it better to investigate everyone, and possibly make a lot of people anxious, in order to find these few?

If you have a neck bruit, you should talk over with your doctor whether or not you want to have ultrasound and possibly other tests. The decision may also depend on whether you have other stroke risk factors (such as high blood pressure), and whether you want surgery if you find you have carotid stenosis.

Carotid ultrasound - the first investigation

Ultrasound simply means sound waves of a very high frequency, higher than the human ear can hear. If ultrasound is directed at a part of the body - for instance, the carotid artery - echoes are reflected back differently from different types of tissue. These differences can be measured by computer and used to build up pictures of structures inside the body - very much the way radar works.

Two different types of ultrasound studies are usually done - Doppler flow studies, and B-mode imaging. Doppler studies provide information about the speed of blood flow, and whether it is smooth or turbulent. B-mode imaging provides a good picture of the blood vessel walls.

The two combined are called *duplex carotid ultrasound.*

Duplex ultrasound is done simply and quickly. The person doing the test (an ultrasonographer) moves a small probe, about the size of a microphone, along the outside of your neck. The probe both produces the ultrasound beam and picks up its echoes. The picture of your artery can be seen on a TV monitor. The whole investigation takes about 15 or 20 minutes. It is quite painless and has no after-effects.

The main aim is to find people with severe stenosis (70-99%), who may benefit from surgery to clear the carotid artery. Ultrasound cannot do this accurately. If it shows

stenosis of less than 50%, you can be sure that you don't need surgery. But if ultrasound suggests 50% stenosis, you might actually have 70% stenosis.

What next?

Opinions differ among experts on what to do next. Currently, if further investigation is to be done, the choice is between:

- catheter angiography - an excellent, well researched investigation, but one that carries a small but important risk; and
- magnetic resonance angiography (MRA) - newer, less well investigated, but safer. MRA is only available in a limited number of larger hospitals.

Extra information on

DIFFERENT VIEWS ON INVESTIGATING CAROTID STENOSIS

A few years ago, catheter angiography was the only option (see below). This is the tried and true technique - the "gold standard" on which all the research evidence is based. Some surgeons still prefer catheter angiography for all patients before they will operate on the carotid artery.

Over recent years, however, a number of new and safer imaging techniques have become available, including ultrasound (see above) and magnetic resonance angiography (below). There has not yet been time for large clinical trials to show the reliability of these techniques. Some surgeons will operate on the basis of the new techniques, without catheter angiography.

Where duplex ultrasound shows that a person has 70-99% stenosis, some will operate without further investigations. Duplex ultrasound, however, does not show arteries in the brain, and others want to know whether these arteries are also clogged up with atherosclerosis. If they are, then surgery may be of much less benefit. There is also an outside chance that someone may have an aneurysm on an artery in the brain, and this might burst and bleed during surgery.

Catheter angiography

Catheter angiography is carried out by a doctor specialising in x-ray - a radiologist. You will be lying on a bed with a large x-ray machine nearby. The doctor inserts a catheter - a long, thin, flexible tube - into an artery in your groin, and, watching it on x-ray, guides it up to the aorta and then to the carotid artery. The catheter then releases a dye that shows up on x-ray, and x-rays are taken as the dye flows through the carotid artery and the blood vessels of the brain.

This is usually done as a day procedure in hospital, though people occasionally stay overnight. It takes about half an hour, and you will need to rest at the hospital for a few hours afterwards, as you will probably either be sedated or have an anaesthetic.

Catheter angiography gives a very accurate measure of carotid stenosis, and it also

provides excellent pictures of the arteries in the brain. On the other hand, it is uncomfortable and carries a small but important risk.

- Up to one in 100 people having catheter angiography have a stroke within 24 hours. The risk of death is less than one in 1000. The more severe stenosis, the greater the risk.
- About 6% of people have significant bruising in the groin, or some nerve injury where the catheter goes in. Symptoms of peripheral vascular disease in that leg can also become worse.
- A few people also have an unpleasant and occasionally dangerous allergic reaction to the dye, particularly if large quantities are needed.

Key point

If your doctor recommends that you have catheter angiography, you may want to ask about the complication rate in the place where it is to be done - what percentage of patients have a stroke as a result of angiography at that hospital or clinic?

This information should be available to potential patients.

It is reasonable to expect that no more than 1% of patients should have a stroke that leaves them with permanent disability.

Magnetic resonance angiography (MRA)

MRA uses magnetism to build up a picture of the blood vessels of the neck and brain. A magnetic pulse causes hydrogen nuclei in the brain to "wobble", and this is picked up and turned into a picture on a screen. The picture is good, but not quite as clear as catheter angiography. It will show whether there is narrowing or blockage in blood vessels in the brain, but it may not show an aneurysm in the brain.

MRA is completely painless, and the magnetism is thought to be completely harmless. You will be asked to lie very still on a couch inside a metal cylinder, which is open at both ends. The whole test may take up to an hour to complete. The cylinder makes some people feel claustrophobic, but you can usually take someone into the room with you to keep you company.

People with a pacemaker cannot have MRA, as the MRA will damage the pacemaker. Only a small number of hospitals have MRA available.

What is spiral CT?

This is a new technique still being developed, based on the technique of CT scanning. A CT scan is a special type of X-ray. The scanner encircles the person's head, a bit like a very large doughnut, and takes X-ray pictures from many angles. A dye is injected into the blood stream, usually in your arm, so that the blood vessels will show clearly on x-ray. In spiral CT, a computer then uses the information from the scan to create a three-dimensional image on a screen. The image can be turned around to look at it from various angles.

Spiral CT is not yet available for routine use, but it is likely to be used more in the future.

4. STROKE CAUSED BY BLOOD CLOTS FROM THE HEART

Two heart conditions put people at high risk of ischaemic stroke:

- *atrial fibrillation* (AF) - this is very common in older people; and
- disease of the heart valves (*valvular heart disease*) - this is less common.

The two occasionally occur together.

Both conditions disturb the smooth flow of blood through the heart. Blood flow becomes uneven, it swirls around within the heart, and clots can form in areas where blood is hardly moving (clot formation is called *thrombosis*). Bits of these clots may then break away (forming an *embolus*), travel in the blood stream, and lodge in a smaller artery in the brain.

Strokes caused in this way are known sometimes as *cardioembolic stroke*. The embolism is called a *cardioembolism*, and it is said to be *cardiogenic*, that is, originating in the heart.

Blood clots from the heart cause about 25% of all ischaemic strokes in Australia - about 8,000 strokes every year. Most of these are due to atrial fibrillation.

Disease of the heart valves

The valves in the heart stop any back-flow of blood - they ensure that blood flows in the right direction when the heart pumps. The left side of the heart is important for stroke, because blood leaving this side of the heart travels directly to the aorta, the carotid arteries and the brain.

When your heart beats, the *atrium* - essentially the receiving chamber of the heart - contracts and pushes blood into the *ventricle*, the chamber below. Then the ventricle contracts and pushes the blood out into the circulation via the aorta. The mitral valve separates the left atrium from the left ventricle. The aortic valve stops back-flow from the aorta into the heart after each heart beat.

If one of these valves leaks, there is back-flow. Blood swirls about in the heart, and stagnant areas can allow clots to form.

A faulty valve can be replaced with an artificial (or *prosthetic*) valve. Many people with artificial heart valves are at high risk of stroke, because clots tend to form on things that are not body tissue. This tendency is greatly reduced by taking aspirin or warfarin.

Rheumatic heart disease is a common form of valvular heart disease.

What is atrial fibrillation?

Fibrillation is rapid and chaotic beating of many individual muscle fibres in the heart - a bunch of twitching muscle fibres. In *atrial fibrillation*, this happens in the *atria* (sing. *atrium*), the chambers of the heart that receive blood from the veins. As a result, the heart beats fast and unevenly - its rhythm is disturbed. You can feel this unevenness in the pulse.

Atrial fibrillation occurs in

- about one in 10 people over the age of 80 years
- about one in 200 people aged 50-59.

What causes it?

Often atrial fibrillation is caused by heart disease of some type. In a few people, it is caused by too much thyroid hormone in the blood - *thyrotoxicosis*. The hormone is released by the thyroid gland in the neck, and the condition is caused by over-activity of this gland.

If you have atrial fibrillation, the doctor will normally do a thyroid function test - thyrotoxicosis is easily treated.

What are the symptoms?

Atrial fibrillation is hard to pick. Some people may have breathlessness, dizziness, palpitations or fainting. One of the most common symptoms is inability to do much physical activity - "exercise intolerance". But often there are no symptoms.

What are the different types of atrial fibrillation?

In some people, the heart rhythm is disturbed all the time. This is call *sustained atrial fibrillation*. In others, the problem only occurs every now and then. These people have *paroxysmal atrial fibrillation*. Paroxysmal AF often turns into sustained AF after a while, but the stroke risk is the same for both.

Atrial fibrillation (either paroxysmal or sustained) without any disease of the heart valves is known as *non-valvular atrial fibrillation* or *NVAF*. This is the most common form. A smaller number of people will have both atrial fibrillation and disease of the heart valves.

Some people have atrial fibrillation with no other sign of heart disease of any sort. This is called *lone atrial fibrillation*. People with lone AF tend to be younger men, and the stroke risk is low.

What is the risk of stroke?

Stroke is about five times more common among people with non-valvular atrial fibrillation than in the general population - but the actual risk depends on how long the person has had NVAF and how old they are.

- For people in their 50s and 60s, the risk is less than 3% per year - that is, for every 100 people with atrial fibrillation, no more than 3 will have a stroke each year.
- For those in their 70s, the risk is nearly 5% - 5 strokes in every 100 people each year.
- For those over 80 years, it is over 7% per year - that is, 7 strokes per 100 people per year.

The one exception to this is lone AF - the risk is much lower, close to the risk for the overall population. Several studies have shown less than 1 in 200 strokes per year, although one study reported a risk of 2.6% per year (5 in 200).

People with atrial fibrillation often have other risk factors for stroke, including ischaemic heart disease (that is, blockage to part of the blood supply to the heart muscle - heart attack) and high blood pressure. This increases their overall risk

Because people with atrial fibrillation also often have other risk factors for stroke, it is possible that up to a third of strokes in these people are not due to the atrial fibrillation, but to other factors.

How is atrial fibrillation diagnosed?

People with atrial fibrillation have an uneven pulse, though many people with an uneven pulse do not have atrial fibrillation. It is easy for your doctor to check your pulse routinely while checking your blood pressure.

If the doctor finds an uneven pulse, the next step is an ECG - an *electrocardiogram*. This is quick and painless, and done in your doctor's surgery. A number of leads are taped onto your chest. They pick up the electrical activity in your heart muscle, and this is displayed as a graph on the ECG machine.

An ECG will find sustained AF, but it will not detect paroxysmal AF unless the ECG is taken while the atrial fibrillation is happening. In the same way, your pulse will only be uneven when the atrial fibrillation is happening.

In a few people with normal pulse and ECG, the doctor may still be concerned about paroxysmal AF - maybe you have symptoms or you are at high stroke risk. The next step, for these people, is an ECG that records your heart's activity over 24 hours or more. The leads will be taped to your chest, and you will carry a small recorder. This is called *Holter monitoring*. Some people can feel when their heart rhythm changes. For these people, *event monitoring* works well - instead of recording your heart all the time, you switch the recorder on when you notice symptoms and off when they stop.

Should I be checked?

Everyone should have their blood pressure taken regularly, and it should be checked more often as you get older. And when the doctor measures blood pressure, it is very easy to check your pulse, to see whether or not it is regular.

If you have an irregular pulse, it is also very easy and inexpensive for your doctor to take your ECG.

If your ECG is normal, further tests for atrial fibrillation may or may not be worthwhile. It depends on whether or not you have other high risk factors, and whether or not preventive treatment with warfarin would help. You should talk over the risks and benefits with your doctor.

Key point

It is easy for your doctor to check your pulse when checking your blood pressure. If you have an irregular pulse, it is easy and inexpensive to have an ECG, to check for atrial fibrillation.

What about echocardiography?

Echocardiography is a technique for "looking" inside the heart using ultrasound. Sound waves too high to hear are directed at the heart from a small, hand-held instrument moved over the chest. The echoes bouncing off the heart tissue are fed into a computer, which constructs moving pictures of the heart, on a screen.

In people with atrial fibrillation, the doctor will sometimes order "an echo" to be sure whether or not you have any other heart disease. This may help in deciding what treatment is best to prevent stroke - aspirin or anticoagulants (warfarin). Some doctors, however, regard echocardiography as unnecessary, and rely on good clinical judgement.

What can be done to reduce stroke risk?

In most people with atrial fibrillation, the anticoagulant drug *warfarin* is very effective in helping to prevent strokes. It can reduce the risk of stroke by up to 70%. For instance, among people over 80 years of age with atrial fibrillation, there will be about 7 strokes per year. Warfarin can prevent 4 or 5 of these.

Warfarin is discussed in detail in the next chapter.

Key point

If you have atrial fibrillation, and especially if you have had a TIA or small stroke, treatment with warfarin should be considered. If appropriate, it should be started immediately to prevent another, possibly more serious, stroke.

5. TREATMENT TO PREVENT STROKE

Can treatment stop me from having a stroke?

There are no guarantees, but treatment does improve your chances considerably.

All the treatments discussed in this book are important. They greatly improve your chance of avoiding a stroke altogether, or of putting it off for many years. These treatments prevent many strokes - but they cannot prevent all strokes.

If you do have a stroke even though you are on warfarin or aspirin, these treatments lessen the chance that it will be serious. And they greatly improve your chances of avoiding another stroke.

Managing stroke risk with your doctor

Who will manage my treatment?

Treatment to reduce your stroke risk will normally be managed by the general practitioner, who is very important in your ongoing care. General practitioners usually manage anticoagulant and antiplatelet therapy.

You always have the right to a second opinion if you want one.

If you are in one of the groups at particularly high risk of stroke, your general practitioner may also ask you to see one or more specialists - for instance:

- a general physician
- a neurologist (a brain specialist)
- a vascular surgeon (specialising in blood vessels)
- a cardiologist (a heart specialist)
- a geriatrician (specialising in conditions affecting older people)
- a neurosurgeon (a brain surgeon)

or another doctor with a particular interest in stroke.

What if the doctors give different advice?

Different specialists may have different approaches to the same problem, and this can be confusing. You have the right to ask for all the information you want, to help you decide on the best course of action for you. It may help to take notes while you are seeing the doctor and/or make an extra appointment to discuss things further. Your general practitioner may also be able to help you to sort through different opinions.

You have the right to a second (or a third) opinion at any time. You may, for instance, want to talk with both a surgeon and a neurologist before deciding about carotid endarterectomy. You could ask either your general practitioner or specialist to organise this. It is wise to go through the doctors who already know you, as they can pass on any test results and this can save unnecessary extra tests. You will need a

referral to a specialist to be able to claim the cost of the consultation on Medicare or medical insurance.

Clinical trials

Often more than one type of drug or treatment is available for a particular condition, and new treatments are being discovered. To compare these different treatments, and find out which are the best and most effective, hospitals and clinics take part in clinical trials. The improvements in stroke prevention and treatment over recent years have come about as the result of such trials. As soon as researchers find that one treatment is any better than another, then all patients benefit.

If your doctor asks you to take part in a clinical trial, make sure that you fully understand the reasons for the trial and what it may mean for you in terms of treatment and outlook. You do not have to agree to be part of a clinical trial - the decision is yours.

CHECKLIST FOR A PARTNERSHIP OF CARE

- If you don't have enough information, or you don't understand, ask your doctor. You are entitled to have the doctor answer as many questions as you need. You may need another consultation with your doctor to talk things over.
- You are always entitled to a second opinion from another doctor.
- Is there a local stroke support group in your area? Ask your general practitioner to find out about it.
- Ask if there are any useful pamphlets that your doctor can give you.
- If necessary, ask for an appointment with an interpreter present, either in person or via the telephone interpreter service.
- If you don't understand the jargon, say so, or ask a family member to ask for you.
- If you are having angiography or surgery, ask your general practitioner to find out the surgeon's complication rate, and to explain it to you.
- If you are having other major surgery, discuss your stroke risk with your doctor.

Treatments to prevent unwanted blood clots

The most common cause of stroke is a blood clot travelling to the brain in the blood stream, either from the heart or the carotid artery. Treatment aims to stop these blood clots from forming in the first place.

There are two types of medications to do this:

- antiplatelet agents (aspirin and other drugs) and
- anticoagulants (warfarin).

Anticoagulants are stronger-acting than antiplatelet agents. They are better at stopping clot formation, but the risk of bleeding is greater.

To understand how these drugs work, it helps to understand a little about how blood clots form.

Extra information on

BLOOD CLOTTING AND PREVENTING UNWANTED CLOTS

How does blood clot?

Blood is made up of clear fluid (*plasma*) with large numbers of cells floating in it, including platelets, and red and white blood cells.

Blood clots form to stop you bleeding to death when a blood vessel is damaged. But unwanted clots may also form in areas where blood flow slows down, or where there is a rough patch on an artery wall.

First, platelets clump together to form a plug. This happens quickly, over a few minutes, and it can be started by a tiny tear in the artery wall or by a roughened patch of atheroma. A complex chain of chemical reactions follows, involving chemicals called enzymes and *clotting factors*. The end product is a mesh of sticky threads - *fibrin* threads - that trap blood cells. This is the clot.

What do antiplatelet agents and anticoagulants do?

Aspirin and the other antiplatelet drugs disrupt the first stage of clotting - the clumping of the platelets - by affecting an enzyme called cyclo-oxygenase.

The anticoagulant drug warfarin slows down the action of vitamin K in the liver. The blood clotting factors are produced in the liver, and this process needs vitamin K. People on warfarin have less of the active clotting factors in their blood, so the blood does not clot as easily.

There are risks as well as benefits. Both aspirin and warfarin reduce the risk of stroke from a blood clot, but both also increase the risk of bleeding. This bleeding can occur anywhere in the body, including the brain, and bleeding in the brain, of course, is a haemorrhagic stroke.

Are anticoagulants and antiplatelet agents ever given together?

For most people, the combined risk of bleeding is too high. But the two drugs together have been shown to be of benefit for those with a mechanical heart valve.

How much do they cost?

All are available on the National Health Scheme and will cost only a few dollars per month.

Antiplatelet agents

Who should be taking aspirin?

Aspirin is an effective, cheap and easy method of reducing the risk of ischaemic stroke in people at high risk because of artery disease. (At the same time, it helps to prevent myocardial infarction - heart attack due to a blood clot blocking arteries supplying the heart muscle.)

It is of most benefit for people who have already had a stroke or TIA, a myocardial infarction, or various other conditions including heart surgery, diabetes, renal dialysis, or peripheral vascular disease (atherosclerosis affecting arteries in the legs). It may reduce the risk of stroke by about one quarter in these people. For instance, for someone who has about a 7 in 100 chance of having a stroke over the next year, aspirin will reduce that chance to a bit over 5 in 100.

It is also given to people who have a blood disorder that makes their blood clot too easily.

What about people at lower risk of stroke? We do not know - there is no clear research evidence. Research has not shown that aspirin can prevent strokes in people at low or average risk of stroke. But doctors often prescribe it for people with a few stroke risk factors, or simply for older people, provided there is no good reason not to (such as a stomach ulcer). It seems likely that the benefits will outweigh the risks for these people, but we don't know. You should talk over the risks and benefits in your own particular case with your doctor.

Are there any side effects?

A few people are allergic to aspirin, and cannot take them. For a few others, aspirin can irritate the stomach. For most, however, it is unlikely to have worrying side effects when it is taken at the low dose needed for stroke prevention.

What is the dose?

The dose is low - doctors usually suggests about 100-150 mg per day. Different trials have shown doses between 50 and 325 mg to work, but the higher doses are more likely to cause side-effects.

What about people who are allergic to aspirin?

These people can take another antiplatelet drug - dipyrimadole (packaged as persantin) or ticlopidine are the two currently recommended. Another drug, clopidogrel, is also being trialled.

These newer drugs have not yet been as well studied as aspirin, but so far, they appear to be as good as, but no better than, aspirin in preventing stroke.

Do the other antiplatelet drugs have side-effects?

Ticlopidine often has side-effects, some of them serious, and a few people are allergic to it. You should tell your doctor about any cold or flu-like symptoms, or about any sign of easy bruising or unusual bleeding.

Dipyrimadole usually has no side-effects. Sometimes it may cause mild problems such as headaches, dizziness, or indigestion, but these often disappear with time. Very occasionally, it has serious side effects which need urgent attention: chest pain, irregular heart beat, abnormal bleeding, migraine headaches. People taking dipyrimadole should not smoke, as smoking almost completely blocks the benefits of the drug.

How should the tablets be taken and stored?

Aspirin should be taken with food or milk to avoid stomach irritation.

Ticlopidine should be taken with meals to avoid irritation of the gut. If you miss a dose, don't take two doses together - continue with your normal schedule.

Dipyrimadole should be taken one hour before or two hours after meals.

All three should be stored in a cool, dry place away from light and heat.

How long will I be taking antiplatelet agents?

In general, people on antiplatelet drugs should probably continue to take them in the long term, unless there is any good reason to stop. Studies have not yet looked at benefits in the long term, but the short-term benefits are well established.

Are antiplatelet agents more effective for some people than others?

An early trial suggested that antiplatelet agents are better at preventing strokes in men than women. An overview of all the trials available (involving 96,316 patients), however, found no overall difference for men or women, older or younger people, or people with or without high blood pressure or diabetes.

Key point

It is important to remember that no stroke prevention treatment can prevent *all* strokes - but they do make a stroke less likely.

Anticoagulants

Who should be taking warfarin?

In general (with one or two exceptions), the only people who should be on anticoagulants (warfarin) are people at risk of stroke caused by blood clots from the heart - that is, people with atrial fibrillation or valvular heart disease.

- **Atrial fibrillation**: There is strong evidence that warfarin is very good for preventing stroke in people with non-valvular atrial fibrillation. It can reduce the risk of stroke for these people by up to two-thirds. The one exception is people with lone atrial fibrillation (see chapter 4). The risk of stroke for these people is low and warfarin is not necessary - its risks outweigh its benefits.

  Warfarin also helps to prevent a second stroke in people with atrial fibrillation.

- **Valvular heart disease:** Warfarin is also given to people with most types of disease affecting the heart valves, including rheumatic heart disease.
- **Artery disease in the brain:** In general, people with atherosclerosis in the arteries within the brain are given aspirin. Sometimes, however, a stroke or TIA will still occur. In this situation, warfarin may help. The risks and benefits vary with each person - you should talk this over with your doctor.

Key point

Warfarin can prevent up to two thirds of strokes in most people with atrial fibrillation (except those who have no other stroke risk factors).

Who should not be taking warfarin?

Anticoagulants are not suitable for everyone. People who should not be taking anticoagulants because of their increased risk of bleeding include those who:

- have dementia
- are likely to fall
- drink large amounts of alcohol
- have previously had a cerebral haemorrhage or other bleeding problems
- have a peptic ulcer
- have liver or kidney damage.

Anyone who has a stroke should have a CT scan straight away to check for a brain haemorrhage. Warfarin should never be given until the doctors know the stroke was not a haemorrhage.

How do you balance risks and benefits?

The risk of bleeding is considerably higher in elderly people - those over about 75 years - but the risk of ischaemic stroke and the benefits of warfarin are also higher in these people.

Another factor to consider is the type of stroke. Warfarin prevents many ischaemic strokes, but causes a small number of haemorrhagic strokes. A haemorrhagic stroke tends to be more severe - they are more likely than an ischaemic stroke to be fatal, while an ischaemic stroke is more likely to leave you alive but possibly disabled.

Key point

The risks and benefits of warfarin need to be weighed up for each person - they will vary depending on the individual risk of stroke and risk of bleeding. You need to talk this over with your doctor.

What is heparin?

Heparin is one of a number of anticoagulants that occur naturally in the blood. It is given as an important first step in getting people onto warfarin.

When the doctors decide a person needs anticoagulants, it is usually important to get them started as quickly as possible. Heparin takes effect immediately. It must be given straight into the blood stream, through a drip, and this is done in hospital.

Warfarin is started at the same time, but it takes five or six days to swing into action. The heparin drip is then removed, and the person will stay on warfarin probably for the rest of their life.

Why do I need regular blood tests for warfarin?

It is very important to have exactly the right dose - a delicate balance between preventing dangerous blood clots from forming and avoiding a high risk of bleeding. This means that people taking warfarin must have regular blood tests (once every week or less often) to check the level in their blood, and alter the dose if necessary.

The blood can usually be taken in your home, and tests can easily be arranged anywhere in Australia if you are going away. If you are going overseas, you will be able to arrange testing in some countries.

Warfarin delays clotting of the blood, and the tests measure the length of this delay. The result is expressed as the INR - the "international normalised ratio". The aim is usually an INR of 2-3. Doses are started high, but when the warfarin takes effect, most people need between about 3 and 10 mg per day.

It is important that you take the warfarin tablets exactly as prescribed, and keep track of changes in the number of tablets after each blood test.

Are there any side-effects?

Some people have mild side-effects, which often disappear over time. These include poor appetite, nausea and vomiting, diarrhoea, patchy hair loss, or allergic reactions such as skin rash or itching. Talk to your doctor about these.

Are there any danger signs or precautions?

You should contact your doctor immediately if you have any sign of unusual bleeding or bruising. It is wise to carry a card or wear a medical bracelet stating you are taking an anticoagulant drug.

Can I eat normally?

Foods rich in vitamin K may partly reduce the effects of warfarin. You should eat only moderate amounts of leafy green vegetables, liver, cabbage, cauliflower, asparagus and bacon.

A glass or two of wine a day is fine. People drinking more alcohol than this may need their warfarin dosage adjusted. Smokers also need higher doses.

What about other medications?

Always ask your doctor before starting, stopping or changing the dose of any other drug, including any you get from the health food shop or anywhere else.

Key point

If you take warfarin, check with your doctor before using any other tablets or mixtures, including aspirin, pain killers, vitamin tablets, herbal remedies etc.

How long will I be taking warfarin?

Probably for the rest of your life. You should not stop taking warfarin suddenly (unless you have abnormal bleeding). If you need to stop, the doctor will reduce the dose gradually.

How should the tablets be taken and stored?

Warfarin should be taken on an empty stomach at the same time each day, and the tablets should be stored away from heat and light.

Carotid endarterectomy

What does carotid endarterectomy involve?

The operation is done in hospital, and is normally done by a surgeon who specialises in operating on blood vessels - a vascular surgeon.

It may be done under a general or a local anaesthetic. You should discuss this with your surgeon. The surgeon makes a cut down the side of your neck, about 8 or 10 centimetres long, cuts open the artery, and removes the plaque. Sometimes the surgeon may use a shunt - that is, a temporary plastic tube that carries the blood around the area of stenosis. The surgeon may also use a piece of vein from your leg to patch the artery wall. The operation takes about two hours, and you will probably be in hospital about five days and off work about two weeks.

Afterwards, you can go back to leading a normal life.

Are there any risks?

Yes. In a few people, the operation itself causes a stroke or a heart attack. This usually occurs either during the operation or in following week. It probably happens because a clot forms at the site of the operation. The risk varies, depending particularly on who is doing the surgery, and where. This is discussed further in the section on "Making decisions about surgery",

Who can benefit from the operation?

Symptomatic carotid stenosis

People with symptomatic carotid stenosis are those who have had a TIA or stroke affecting the same side of the brain (this produces symptoms on the other side of the body).

- You need to be reasonably well to be considered for surgery. This excludes most people who have had a stroke that left them disabled.

- For those with 70-99% stenosis, evidence from clinical trials shows quite clearly that the benefits of surgery outweigh the risks. Two large studies have looked at stroke risk for two or three years after surgery. For this group of people, they have shown that surgery roughly halves the risk, even taking into account strokes caused by the operation. (Even with surgery, the stroke risk for these people remains high.)
- With moderate stenosis, the situation is not clear. The benefits may outweigh the risks for people with 50-69% stenosis, but the evidence is not strong. With milder stenosis, surgery is definitely not recommended.

Asymptomatic carotid stenosis

The situation for people with asymptomatic carotid stenosis - those who have not had symptoms of stroke or TIA - is less clear. One study suggested that surgery is worthwhile for people with 60-99% stenosis, but the evidence is not strong. The trial was done in a centre where the surgical complication rate was low. In other centres, a higher complication rate could cancel the benefits of surgery.

The answer also depends on what is meant by "asymptomatic". It could mean:

- no symptoms of stroke or TIA in the same side of the brain as the narrowed artery, but symptoms on the other side (*asymptomatic other side*); or
- no symptoms of stroke or TIA on either side (*truly asymptomatic*).

You should discuss your own risk, and the risks and benefits of surgery, with your doctor.

Extra information on
CAROTID STENOSIS AND STROKE RISK

What is symptomatic carotid artery stenosis?

- You have had stroke symptoms that the doctor has diagnosed as a TIA or stroke

AND

- The doctor has referred you for ultrasound and/or angiography, which has shown mild, moderate or severe carotid stenosis.

  Your risk of stroke: Between 7 and 10 people in every 100 will have another (possibly more serious) stroke each year - the greater the stenosis, the greater the risk.

What is asymptomatic carotid artery stenosis?

- You have not had a TIA or a stroke, but
- The doctor has listened to your neck and found a bruit, and possibly
- The doctor has referred you for ultrasound, which has shown
  - mild to moderate stenosis (up to about 60%) - **Your risk of stroke**: is about the same as for anyone of your age
  - moderate to severe stenosis (60-99%) -

    Your risk of stroke: is increased, and for people with over 75% stenosis, about 3 in 100 will have a stroke each year.

Some people may have carotid stenosis with no symptoms in one carotid artery, but also have had a stroke or TIA affecting the other side of their brain. This is known as *asymptomatic other side.*

Those who have carotid stenosis but have had no stroke or TIA on either side are known as *truly asymptomatic*.

What if the carotid artery is completely blocked?

Surgery is not possible. The blockage probably extends some distance along the artery, and it cannot be repaired. These people should take aspirin.

Once a carotid artery has blocked, things settle down (although atherosclerosis, of course, can still cause problems in other arteries). The blocked artery can no longer cause a stroke, and other arteries take over supplying blood to the brain. However, the person may have had a mild or severe stroke before the artery closed off completely.

Making decisions about surgery

Deciding whether or not to have a carotid endarterectomy can be difficult and frightening. Either course involves risk of stroke. Some people may want to make a

decision quickly, but others will want time to talk it over and consider the alternatives.

You may want to talk it over, probably more than once, with your specialist (surgeon and/or neurologist). You may also want to get a second opinion from another surgeon, and/or a neurologist. This is your right, and it is a perfectly acceptable thing to do. Often a surgeon and a neurologist will consider the problem from different points of view.

It may help to write down your questions beforehand, and to write down the doctor's answers. You may find it useful to take along another family member or friend, to help understand and remember all the details.

It may also help to talk the issue over with your family and with your general practitioner. You might want to find out about the experiences of other people who have had the operation.

The safety of the operation depends very much on the skill of the surgeon and the back-up team. The risk can vary widely from one hospital to another, and from one surgeon to another - it may be as high as 10% or more, or as low as 1%. It is reasonable to look for a risk of no more than 5% (5 people in 100), and preferably less. For people with asymptomatic stenosis, where the risk of stroke is not as high, the NHMRC *Clinical Practice Guidelines* suggest that surgery should be considered only in a centre where the surgical complication rate is no higher than 3% - that is, 3 people in every 100.

Key point

If you are considering a carotid endarterectomy, you have the right to know:

- how many carotid endarterectomies your surgeon has done in the past year - around 20 is a reasonable number to ensure the surgeon's expertise;
- what the complication rate has been - how many strokes have occurred within a month of these operations?

Your general practitioner may be able to help you get this information, or you could ask your neurologist or your surgeon.

You also need to consider what your risk of stroke is without surgery - is it greater or less than the risk of surgery?.

The risks of the operation itself remain much the same, regardless of the degree of stenosis. Without surgery, however, the risks of stroke increase as the degree of stenosis increases. Your stroke risk, with or without surgery, will also be influenced by other things, for instance:

- whether or not you are having catheter angiography to investigate the carotid stenosis - this carries its own risk (see chapter 3);
- whether you have already had a TIA or stroke;

- whether you have any circulatory problems in your legs;

The situation seems to be different for men and women. Women have less strokes than men without surgery. They may also be at slightly higher risk from surgery than men. This is probably because their smaller arteries are harder to work on. These factors both influence the balance of risks and benefits.

The time available to make a decision varies. If, for instance, the doctor sees you when you have just had a TIA, and you have severe stenosis, then it is important to operate as soon as possible - you are at very high risk of stroke in the next hours and days. If the TIA was a month ago, the risk of stroke has dropped and so a decision about surgery is less urgent.

Key point

If you have just had a stroke or TIA, and you have severe carotid stenosis, your risk of another stroke in the next few days is very high. If surgery will help, it should be done urgently.

Will the blockage build up again?

It can, in a few people. If necessary, you can have another operation.

Can both arteries be done?

Yes. Both arteries can be done if necessary.

Carotid endarterectomy before elective surgery

If you are about to have a major operation that might involve loss of blood, and you have carotid stenosis, you may be at risk of stroke during the operation.

Operations of concern include those involving large blood vessels, coronary artery bypass graft (open-heart surgery), and total hip replacement.

The risk is that blood loss and the trauma of surgery might produce very low blood pressure, and there may not be enough blood getting to the brain if atherosclerosis has clogged up your carotid arteries.

Should you have carotid endarterectomy first? Should you be examined for carotid stenosis even if you have no symptoms? The guidelines on endarterectomy discussed above all apply here. But if you are a borderline case, there is very little evidence to guide your decision. Different specialists may give you different advice. You should talk your situation over with your doctors, and take into consideration:

- your pattern of stroke risk factors
- your own preference
- the complication rates, both for surgery and angiography, of the centres and specialists you will be using.

What is carotid angioplasty?

Angioplasty is a technique that has been used for some time to open up narrowed blood vessels in the heart muscle. Angioplasty is currently being investigated as a technique for treating carotid stenosis.

It is done at the same time as catheter angiography. When the catheter reaches the narrowed area, a tiny balloon at the tip of the catheter is inflated to stretch the walls of the artery and open it up.

From the patient's point of view, angioplasty is simpler, with less discomfort than carotid endarterectomy. It may, however, have some risks, and we do not yet know how well it works in preventing strokes. It will not be generally available until more is known about it.

APPENDIX A: NHMRC WORKING PARTY TERMS OF REFERENCE AND MEMBERSHIP

Working Party

Professor Geoffrey Donnan, Chairman	Neurologist
Dr Craig Anderson	Neurologist and geriatrician
Ms Jeanne Barr	Nurse
Dr Maxwell Clayton	General practitioner
Associate Professor Stephen Davis	Neurologist
Dr Thelma Hunter	Consumer representative
Professor Reginald Lord	Vascular surgeon
Professor Chris Silagy	Director of the Australasian Cochrane Centre
Dr Robert Wilson	Health economist
Associate Professor Peter Woodruff	Vascular surgeon

Contractors

Dr Brian Chambers	Neurologist
Dr Paul Glasziou	Epidemiologist
Dr Graeme J Hankey	Neurologist
Ms Sophie Hill	Freelance researcher
Dr Angela Kirsner	Consultant writer/editor

Secretariat

Ms Fiona Clapin	Commonwealth Department of Health and Family Services

Terms of Reference and Scope

Undertake the development and implementation of clinical practice guidelines for:

I the role of antiplatelet agents and anticoagulants in the primary and secondary prevention of stroke;

II the role of carotid artery endarterectomy in symptomatic and asymptomatic patients; and

III screening.

For each of these issues, a series of important questions will be addressed:

I Antiplatelet agents and anticoagulants:

(a) What is the prevalence of at-risk patients in Australia suitable for stroke prophylaxis using antiplatelet agents and anticoagulants in both primary and secondary settings?

(b) What is the effectiveness of antiplatelet agents (both primary and secondary prevention)?

(c) What is the effectiveness of anticoagulants (both primary and secondary prevention)?

(d) What is the cost-effectiveness of antiplatelet and anticoagulant therapy?

(e) What are recommendations for best practice?

II Carotid endarterectomy

(a) What is the prevalence of varying degrees of carotid artery stenosis (symptomatic and asymptomatic) within the Australian community?

(b) What are the risk-benefit ratios of endarterectomy and best medical therapy versus best medical therapy for symptomatic and asymptomatic carotid artery stenosis of varying degrees?

(c) What is the current frequency of endarterectomy in Australia for symptomatic and asymptomatic carotid stenosis?

(d) What is the cost-effectiveness ratio for endarterectomy in symptomatic and asymptomatic settings?

III Screening

(a) How, when, who, and how often to screen those at risk (including cost implications).

The above issues will be addressed by assessing the extent and strength of scientific evidence relating to them.

Following the procedures recommended by the Quality of Care and Health Outcomes Committee's draft first edition of *Guidelines for the development and implementation of clinical practice guidelines*, the Working party will undertake to:

- identify:
  - target groups for the guidelines
  - short- and long-term health outcomes and measures; and
  - the recommendations for best practice;
- assess existing guidelines;
- write evidence-based guideline documents for the identified target groups. As a minimum it is expected that two documents will be written: one aimed at clinicians and one aimed at consumers;
- undertake wider consultation;
- report on the guideline development process, including:
  - a strategy for dissemination and implementation; and
  - a short- and long-term plan for evaluation and updating the guideline documents;
- provide advice and present clinical practice guidelines to the Quality of Care and Health Outcomes Committee.

APPENDIX B: GLOSSARY OF TERMS

aneurysm
A balloon-like swelling on the wall of an artery that is liable to rupture and bleed (haemorrhage). Aneurysms can be present from birth, or caused by atherosclerosis.

angiogram
An image of the blood vessels within the body. This can be done either by x-ray (catheter angiography) or using magnetism (magnetic resonance angiography).

angioplasty
A method of improving blood flow in a narrowed artery. A catheter is threaded through an artery to the narrowed area, and a tiny balloon at its tip is inflated to stretch the artery walls.

anticoagulant
A type of drug that slows down the clotting of blood by interrupting the action of chemicals called blood clotting factors.

antiplatelet
A type of drug that slows down the clotting of blood by affecting the activity of the blood platelets.

aorta
The large artery that carries blood away from the left side of the heart.

arterio-venous malformation
An abnormal tangle of blood vessels in the brain that can bleed and cause stroke.

artery
One of the network of blood vessels that carries blood away from the heart to the various parts of the body.

asymptomatic
Without symptoms. In the context of this document, the term means the absence of symptoms of cerebral ischaemia, that is, the absence of stroke or TIA.

ataxia
A failure by the brain to regulate the body's posture and the strength and direction of limb movements, resulting in shaky movements and unsteady gait.

atheroma
Yellow, fatty deposits on the inner walls of arteries. These deposits slowly grow and thicken with fibrous tissue, and become part of the artery wall.

atherosclerosis
"Hardening of the arteries"; a disease of the arteries in which fatty and scar-like deposits (*plaques*) of atheroma form on the inner walls of arteries. It is the most common cause of *ischaemic stroke*.

atrial fibrillation
Rapid irregular beating of the heart.

blood pressure
The pressure of blood against the walls of the main arteries. Blood pressure varies during the course of each heart beat, and measurement yields two figures: the maximum (*systolic*) pressure, when the heart muscle contracts; and the minimum (*diastolic*) pressure, when the heart muscle relaxes.

bruit
The sound made by turbulent blood flow in an artery or the heart. It can be heard with a stethoscope.

cardiac
To do with the heart.

cardioembolism
An *embolism* that originates in the heart.

cardiologist
A physician who specialises in diseases of the heart.

cardiovascular
To do with the heart (*cardio*) and the blood vessels (*vascular*). *Cerebrovascular* diseases are a subset of cardiovascular diseases, affecting the blood vessels of the brain, and stroke is caused by cerebrovascular disease.

carotid artery
Either of the two major arteries in the neck that supply blood to the head and neck, including the brain.

carotid bifurcation
The point in the neck, just below the side of the jaw, where the common carotid artery branches in two to form the external and the internal carotid arteries. The internal carotid artery goes to the brain.

carotid endarterectomy
A surgical "rebore" of one or both of the *carotid arteries*, done because the arteries have become dangerously narrowed.

carotid stenosis
Narrowing of the carotid artery.

catheter
A long, flexible and very fine tube passed through arteries in order to perform specialised tests and procedures or inject a substance into the blood stream. Catheterisation is the process of doing this.

cerebral
To do with the brain.

cerebral hemisphere
One half of the cerebrum, the largest and most highly developed part of the brain.

cerebrovascular
To do with the blood vessels of the brain (see also *cardiovascular*).

cerebrovascular accident (CVA)
An imprecise term still used sometimes to describe stroke.

clopidogrel
A new *antiplatelet* drug, currently being investigated.

contralateral
On the other side.

catheter angiography
A technique for looking at the blood vessels of the brain by inserting a catheter via the groin and into a carotid artery, releasing a dye into the artery, and taking an x-ray as the dye flows in the blood through the brain. The picture produced is called an angiogram.

diastolic
See *blood pressure.*

dipyrimadole
An *antiplatelet* drug (sold commercially as persantin).

duplex ultrasound
A non-invasive technique of producing images of the blood vessels (in this case the carotid arteries) using ultrasound.

dysarthria
Slurred speech due to muscle weakness or poor coordination.

dysphagia
Difficulty swallowing. It is common in acute stroke, and can result in food and liquid passing into the lungs.

dysphasia
A disorder of language, caused by damage to the speech areas of the brain, which affects the ability to understand and/or use words and sentences, either spoken or written.

echocardiography
An ultrasound imaging technique for looking at the heart. Ultrasound beams are directed at the heart, and the echoes are used to build up video images of the heart as it is beating.

electrocardiograph
A measurement of the electrical activity of the heart. This provides good information on how well the heart muscle is working.

embolism
The condition where an *embolus* becomes lodged in an artery and blocks it.

embolus
A detached clot or other material that is carried in the blood stream from one point and lodges at another.

endarterectomy
A surgical "re-bore" of an artery that has become obstructed as a result of atherosclerosis.

geriatrician
A doctor who specialises in looking after older people.

haemorrhagic stroke
A stroke caused by a bleed either into the brain (intracerebral haemorrhage) or over the surface of the brain (subarachnoid haemorrhage).

hemianopia
Loss of half of the usual field of vision; most commonly, the inability to see anything to either the left or right of centre.

hemiparesis
Paralysis affecting one side of the body. Also called hemiplegia.

hemisensory loss
Loss of sensation (e.g. touch, hot/cold) affecting one side of the body.

heparin
A naturally occurring *anticoagulant* drug which takes effect immediately. It can only be given directly into the blood stream (not in tablet form).

hypercholesterolaemia
High blood cholesterol

hypertension
High blood pressure.

hypoperfusion
Not enough blood and oxygen getting to cells and tissues of the body. If this affects the brain, it can cause stroke.

hypotension
Abnormally low blood pressure. It can cause *hypoperfusion* and stroke.

infarction
Death of cells in an organ (e.g. the brain) due to lack of blood supply.

INR
International normalised ratio; a measure of the time a person's blood takes to clot when they are taking the anticoagulant drug warfarin. Warfarin delays blood clotting, and INR is measured to regulate the dose of warfarin.

intracerebral haemorrhage
A bleed into the brain.

invasive
Describes a test or technique that involves going inside the body, rather than working entirely from outside it.

ipsilateral
On the same side.

ischaemia
An inadequate flow of blood to part of the body due to blockage or constriction of the arteries that supply it.

ischaemic stroke
A stroke caused by blockage of blood vessels.

lacune
A small area of infarction in the brain caused by blockage of a single small blood vessel. The term is drawn from the lake-like appearance of the lesion when seen under a microscope.

lone atrial fibrillation
Non-valvular atrial fibrillation in people usually under 65 years with no other heart or stroke symptoms or high blood pressure.

magnetic resonance angiography (MRA)
Magnetic resonance angiography - a technique that uses magnetism (rather than x-rays) to provide detailed pictures of the blood vessels within the body.

mitral valve
The one-way valve separating the left atrium and ventricle of the heart, preventing backflow of blood when the heart pumps. It is important in stroke because blood leaving this side of the heart travels directly into the aorta, the carotid arteries and the brain.

myocardial infarction (MI)
Death of part of the heart muscle caused by blockage of an artery supplying the muscle; a type of heart attack.

neurologist
A physician who specialises in diseases of the nervous system (including the brain).

non valvular atrial fibrillation (NVAF)
Atrial fibrillation with no accompanying disease of the heart valves.

non-invasive
Describes a test or technique that can be carried out entirely from outside the body (such as standard x-rays).

occlusion
Complete blockage.

peripheral vascular disease
Disease of the blood vessels (*atherosclerosis*) causing narrowing of the arteries in the leg.

persantin
The commercial name for the antiplatelet drug, dipyrimadole.

plaque
Fatty and scar-like deposits that form on the inner walls of arteries in *atherosclerosis.*

platelets
Small disk-like structures present in large numbers in the blood. They play an important part in blood clotting.

primary prevention
Prevention of stroke through modifying risk factors before any TIA or stroke has occurred. c.f. secondary prevention.

risk factor
Anything that increases a person's chance of developing a particular disease or condition. Smoking, high blood pressure, and old age, for example, are all risk factors for stroke.

secondary prevention
Prevention of stroke through modification of risk factors after a TIA or stroke has already occurred.

stenosis
Narrowing.

subarachnoid haemorrhage
Bleeding over the surface of the brain.

symptomatic
With symptoms. In the context of this document, the term means the presence of symptoms of cerebral ischaemia; that is, stroke or TIA.

systolic
See *blood pressure*.

thromboembolism
Formation of a clot (a thrombus), which then dislodges and travels on in the blood stream as an embolus.

thrombolysis
The dissolving of a blood clot through the use of medication (a thrombolytic drug).

thrombosis
The production of a blood clot. The clot itself is called a thrombus.

ticlopidine
An antiplatelet drug.

transient ischaemic attack (TIA)
Identical to an *ischaemic stroke* (i.e. caused by blockage of blood supply to part of the brain), except that the symptoms clear entirely within 24 hours. TIA is a critical warning sign that a more severe stroke may occur.

valvular heart disease
Disease affecting the valves of the heart. This allows some backflow of blood, and the turbulent blood flow can allow clots to form in the heart, which may cause stroke.

vascular
Related to or supplied by blood vessels.

vertigo
A sensation of spinning or continuous movement.

warfarin
An *anticoagulant* drug used widely to prevent stroke in people with atrial fibrillation or valvular heart disease.

APPENDIX C: SOURCES OF HELP

Each state has a stroke association, and each has a state office of the Australian Brain Foundation. The National Stroke Foundation is located in Melbourne, and is happy to accept reverse-charge calls. Contact any of these for information, including up-to-date information on stroke clubs and support groups and other stroke services.

State Stroke Associations

ACT

Stroke Association ACT
12 Clarkson Street
Pearce ACT 2607
Phone: (062) 863 333 (Peter McMahon)

New South Wales

Stroke Recovery Association Inc.
2nd Floor, 1 West Street, Lewisham NSW
PO Box 673, Petersham NSW 2049
Phone: (02) 550 0594
Fax: (02) 560 2306

Queensland

Support, Self-help and Social Activities for Stroke People
PO Box 426
Morningside Qld 4170
Phone: (07) 3999 9461

South Australia

Stroke SA
Neurological Resource Centre
23A King William Road
Unley SA 5061
Phone: (08) 357 8909

Tasmania

Stroke Club of Tasmania
10 Maritana Place
Claremont Tas 7011
Phone: (002) 492 033 (Val Manson)

Victoria

Stroke Association of Victoria
PO Box 226
Geelong Vic 3220
Phone: (052) 787 980 (Clare Gray)

Western Australia

Contact: Manning Stroke Club
138 Planet Street
Carlyle WA 6101
Phone: (09) 361 3839

National Stroke Foundation

394-400 Little Bourke Street
Melbourne Victoria 3000
Phone: (03) 9670 1000
Fax: (03) 9670 9300

Australian Brain Foundation State Offices

New South Wales

PO Box N27, Grosvenor Place
Sydney NSW 2000
Phone: (02) 9259 1219
Fax: (02) 9247 2430

Queensland

"Ladhope", 131 Wickham Terrace
Brisbane Queensland 4000
Phone: (07) 3831 1704
Fax: (07) 3832 6674

South Australia

1st Floor, 28 Greenhill Road, Wayvill SA 5034
Mail to: PO Box 125, Unley Business Centre, SA 5061
Phone: (08) 8357 8911
Fax: (08) 8373 1496

Tasmania

169 Campbell Street
Hobart Tasmania 7000
Phone: (03) 6231 4424
Fax: (03) 6234 3442

Victoria

746 Burke Road
Camberwell Victoria 3124
Phone: (03) 9882 2203
Fax: (03) 9882 5737

Western Australia

320 Rokeby Road
Subiaco WA 6008
Phone: (09) 382 2320
Fax: (09) 382 1149

National Office Brain Foundation

PO Box 20
Hawthorn Victoria 3122
Phone: (03) 9818 7844
Fax: (03) 9818 1566