Chapter 1

Introduction

Judi Edmans, Fiona Coupar and Adam Gordon

This chapter includes:

- Definition, impact, symptoms, causes, classification of stroke
- International Classification of Functioning, Disability and Health (ICF)
- Medical investigations
- Secondary prevention
- Neuroanatomy
- Damage to different areas of brain
- Policy documents: strategies and guidelines
- Self-evaluation questions

Stroke is a complex condition where the knowledge base is continuously increasing. There are constant advances in the understanding of the condition, assessment and intervention techniques. Occupational therapists are a vital component in the rehabilitation of patients with this condition. It is vital that they understand the condition itself and the theoretical basis for intervention.

Definition of stroke

The World Health Organization (WHO) defines *stroke* as 'a clinical syndrome, of presumed vascular origin, typified by rapidly developing signs of focal or global disturbance of cerebral functions lasting more than 24 hours or leading to death' (WHO, 1978).

Impact of stroke

Stroke is a major public health care concern and has a significant impact on individuals, their families and wider society. Within the UK, an estimated 150,000 people have a stroke each year (Office of National Statistics, 2001). Stroke is the third most common cause of death, after heart disease and cancer, with over 67,000 deaths each year (British Heart Foundation, 2005). However, the most significant and lasting impact of stroke is long-term disability. Stroke is the single, greatest cause of complex and severe adult disability in

the UK (Wolfe, 2000; Adamson *et al*., 2004). A third of people who have a stroke will have some long-term disability (National Audit Office (NAO), 2005). Common problems following stroke include aphasia, physical disability, loss of cognitive and communication skills, depression and other mental health problems.

In addition to the individual impact, stroke places a significant burden on health and social services. In England alone, stroke costs the National Health Service (NHS) and the economy about £7 billion a year: £2.8 billion in direct costs to the NHS, £2.4 billion of informal care costs (e.g. the costs of home nursing borne by patients' families) and £1.8 billion in income lost to productivity and disability (NAO, 2005). Unfortunately, outcomes in the UK compare poorly internationally, despite our services being among the most expensive, with unnecessarily long lengths of stay and high levels of avoidable disability and mortality (Leal *et al.*, 2006).

Symptoms of stroke

The initial symptoms of stroke are (Warlow *et al.*, 2008):

- Sudden weakness or numbness of the face, arm or leg on one side of the body.
- Sudden loss or blurring of vision in one or both eyes.
- Sudden difficulty speaking or understanding spoken language.
- Sudden confusion.
- Sudden or severe headache with no apparent cause.
- Dizziness, unsteadiness or a sudden fall, especially with any of the other signs.

However, there are more specific symptoms that will become apparent to the patient, family, medical and rehabilitation staff over the following weeks, months and years. These may include a variety of abnormalities, which will be described further in later chapters.

Face–Arm–Speech Test

The National Stroke Strategy for England (Department of Health (DH), 2007) highlighted the need to improve public awareness of stroke and the recognition of signs of a stroke, resulting in the 'FAST' acronym being developed by the Stroke Association in partnership with other stroke organisations and experts.

The awareness campaign highlights that stroke is a medical emergency and time is essential to protect the brain from excess damage. Therefore, it is essential for people to recognise the symptoms of stroke and act 'FAST' when these are present. The 'FAST' acronym represents:

Facial weakness – Can the person smile? Has his or her mouth or eyes drooped?
Arm weakness – Can the person raise both arms?
Speech problems – Can the person speak clearly and understand what you say?
Time to call **999**.

Anyone exhibiting any of these signs should be treated as an emergency with 999 being called to get the patient to hospital as quickly as possible, to receive the treatment they need.

FAST was around before the stroke strategy, although 'T' stood for 'Test all three' rather than 'Time to call 999' (Mohd Nor *et al.*, 2004).

Causes of stroke

The main causes of stroke are as follows.

Ischaemia leading to infarction

This describes impairment of blood supply to part of the brain, resulting initially in dysfunction and then tissue death (infarction). The causes of cerebral infarct are classified according to the TOAST (Trial of Org 10172 in Acute Stroke Treatment) (Adams *et al.*, 1993) classification as:

- Large artery occlusion (usually carotid or middle cerebral artery occluded by thrombus or embolism).
- Cardioembolism (clot from the heart, most commonly the atrial appendages, migrating to the cerebral arteries, causing blockage and stroke).
- Small vessel occlusion (thrombus or embolism in the smaller cerebral arteries, causing a lacunar infarct).
- Other aetiologies (e.g. generalised brain underperfusion, causing infarcts in the watershed territories).

Haemorrhage

This is usually intracerebral haemorrhage (i.e. within the body of the brain) but can be subarachnoid haemorrhage (i.e. between the arachnoid mater and the brain).

Intracerebral haemorrhages are commonly caused by hypertension-related changes in the small intracerebral arteries but can, less commonly, be caused by aneurysms (outpouchings of the arterial wall) or arteriovenous malformations (abnormal communications between arteries and veins).

Transient ischaemic attack

Transient ischaemic attack (TIA) is a term used to describe symptoms of stroke, resolving within 24 hours. This does not represent a completed stroke but is, instead, caused by transient impairment of tissue blood supply (ischaemia) with subsequent resolution. These patients are at high risk of proceeding to completed stroke and should be seen by a physician as an emergency, ideally within 24 hours of presentation (Intercollegiate Stroke Working Party (ISWP), 2008).

Classification of stroke

Bamford *et al.* (1991) described a classification of cerebral infarction to help clinicians identify the part of the brain affected. This classification is based on the signs and symptoms that patients experience and is now widely used. It is useful because it correlates to prognosis. Thus, based on a bedside examination, a clinician can make predictions about survival and long-term dependency in order to inform management decisions and discussions with patients/relatives.

The Bamford (or Oxford) classification is as follows:

Total anterior circulation stroke (TACS)

All of the following:

– Motor/sensory deficit affecting greater than two-thirds of face/arm/leg.
– Homonymous hemianopia.
– New disturbance of higher cortical function.

Partial anterior circulation stroke (PACS)

– Any two of the components of a TACS.
– *Or* isolated disturbance of higher cortical function.
– *Or* limited motor/sensory dysfunction (affecting a single limb or the face alone).

Posterior circulation infarction (POCI)

Any of:

– Cranial nerve palsy and contralateral motor/sensory deficit.
– Bilateral motor/sensory deficit.
– Conjugate eye movement problems.
– Cerebellar dysfunction.
– Isolated homonymous hemianopia.

Lacunar infarction (LACI)

Greater than two-thirds of arm/face/leg affected by:

– Pure motor stroke.
– *Or* pure sensory stroke.
– *Or* pure sensorimotor stroke.
– *Or* ataxic hemiparesis.

Disorders of higher cortical dysfunction commonly include aphasia, decreased level of consciousness, neglect syndromes, apraxia and agnosia syndromes.

International Classification of Functioning, Disability and Health

The International Classification of Functioning, Disability and Health (ICF) (WHO, 2002) was produced by the WHO to replace the International Classification of Impairments, Disabilities and Handicaps. The ICF is not used exclusively in stroke; however, stroke patients often present with complex impairments which are a challenge for rehabilitation teams. The ICF provides a means of understanding and describing health status. It takes

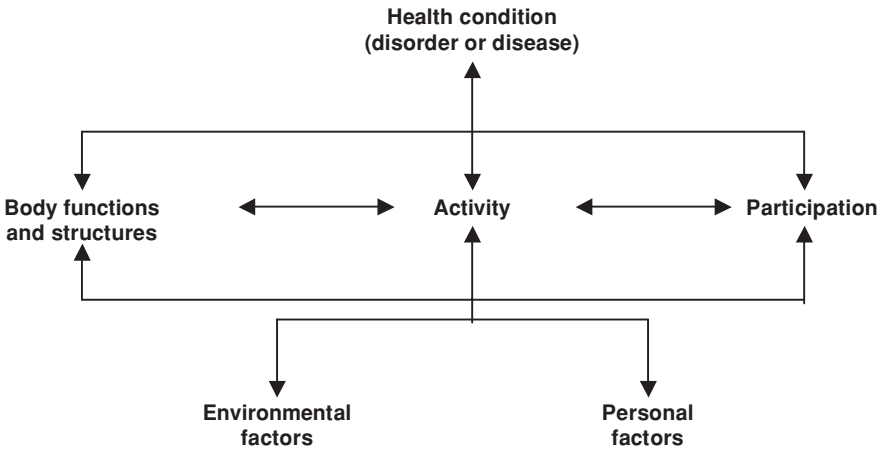

Figure 1.1 Model of disability that is the basis for ICF. (Reproduced by permission from WHO, 2001, with permission of World Health Organisation, p. 9.)

account of impairments of body structure and function and how these interact with personal and environmental factors to affect patient's activities and participation in the wider world. Figure 1.1 illustrates the interactions between different aspects of the ICF.

The domains of the ICF are as follows:

Body functions: physiological functions of body systems (including psychological functions), for example, mental, neuromusculoskeletal and movement-related functions

Body structures: anatomical parts of the body such as organs, limbs and their components, for example, nervous system structures and structures related to movements

Impairments (of body function and structure): abnormal body functions and structures such as a significant deviation or loss, for example, hemiparesis following stroke

Activity: execution of a task or action by an individual, for example, dressing

Activity limitations: difficulties an individual may have in executing activities, for example being unable to dress due to hemiplegia

Participation: involvement in a life situation, for example, attending a social gathering

Participation restrictions: problems an individual may experience in involvement in life situations due to the activity limitation, for example, being unable to visit family and friends due to difficulty dressing

Environmental factors: physical, social and attitudinal environment in which people live and conduct their lives, for example, legal and social structures, architectural characteristics, coping styles, social background and experiences

Personal factors: factors unique to the patient, which impact upon their health status, for example, personality and attitudes.

In ICF the term *functioning* refers to all body functions, activities and participation, while *disability* is similarly an umbrella term for impairments, activity limitation and participation restrictions.

Medical investigations following stroke and TIA

Medical investigations following stroke and TIA are performed to:

- Confirm the diagnosis of stroke.
- Determine the site and type of stroke.
- Establish the cause(s) of the stroke.
- Guide treatment to prevent further strokes.

Computerised tomography or magnetic resonance imaging

Imaging (either computerised tomography (CT) or magnetic resonance imaging (MRI)) helps to establish the pathological diagnosis by detecting either cerebral infarction or haemorrhage. The distinction between haemorrhage and infarction is important as treatment with aspirin or anticoagulants is likely to be indicated for cerebral infarction but would be contraindicated in cerebral haemorrhage. A CT scan should therefore be performed on all patients within 24 hours of a stroke (ISWP, 2008).

It is also useful for excluding other intracranial pathologies that mimic stroke, for example, tumours or subdural haematomas. Practice varies with regard to routine scanning of TIAs; it is, however, increasingly common for physicians to perform a CT scan on these patients, particularly if there is some concern that the history is long, or atypical.

Modern CT scanners can detect abnormalities within a few hours of a large artery stroke; however, smaller infarcts can be difficult to detect if scanned early. Another difficulty can arise when identifying a new acute lesion in a patient with multiple pre-existing strokes. MRI scanning is more sensitive and specific for diagnosis of stroke than routine CT and can be used in this context. Diffusion-weighted MRI, in particular, can be used to separate acute ischaemic strokes – which show up as 'hot spots' on this type of image – from previous cerebral infarcts. MRI is also more useful at imaging the brainstem and cerebellum because these parts of the brain are surrounded by dense bony structures, which generate artefacts on CT scanning.

Blood tests

On presentation, a number of blood tests may be completed for a variety of reasons, including detection of a number of different conditions. Commonly completed blood tests include the following:

Full blood count: To look for rare conditions which predispose to stroke such as polycythaemia (increased red cells) and thrombocytosis (increased platelets) and conditions that predispose to haemorrhage, such as thrombocytopaenia (decreased platelets).

To exclude leucocytosis (raised white cell count) which might indicate systemic infection (e.g. aspiration pneumonia) or intracerebral infection mimicking stroke (e.g. encephalitis, cerebral abscess).

Erythrocyte sedimentation rate (ESR): If this is elevated, it suggests infection, vasculitis or carcinoma and may prompt further investigation.

Blood sugar: Hypoglycaemia at presentation is a recognised stroke mimic, whilst diabetes mellitus is a risk factor for stroke. Therefore, all patients should receive a bedside finger-prick glucose test and formal laboratory glucose level.

Fasting lipids: Hyperlipidaemia is a recognised risk factor for stroke and lipids should be checked in all patients.

Clotting screen: Coagulation tests are necessary in patients with haemorrhagic stroke. An international normalised ratio (INR) should be checked urgently in any patient who has a stroke whilst on warfarin.

Thrombophilia screen: Patients presenting with venous sinus thrombosis should be checked for an inherited tendency towards clot formation (factor V Leiden, protein C deficiency, protein S deficiency, lupus anticoagulant). This should only be considered in arterial thrombosis for younger patients where no alternative risk factor for stroke is identified (Hankey *et al.*, 2001).

Cardiac investigations

There is a cardiac source of embolism in 20% of cases of cerebral infarction (Sandercock *et al.*, 1989). Electrocardiogram should therefore be performed in all patients to investigate atrial fibrillation or evidence of structural heart disease.

Echocardiogram is performed in patients where intracardiac thrombus or structural heart disease, particularly valvular disease, is suspected. In many centres, it is routine to do echocardiograms in all patients presenting with atrial fibrillation.

Carotid ultrasound

This is performed to look for internal carotid artery stenosis. The technique involves imaging of the artery with measurement of blood flow velocity, which allows an estimation of the degree of vessel stenosis to be made.

Magnetic resonance angiography

This is now used widely in clinical practice. Images can be obtained at the same time as standard and diffusion-weighted MRI, making the investigation only marginally longer. It is non-invasive and is therefore preferred to catheter digital subtraction angiography in most instances.

This procedure is completed to allow 3D reconstructions of the arterial and venous cerebral circulations, which can allow identification of thrombus, arterial stenosis/occlusion and dissection.

The prevention of recurrence of stroke (secondary prevention)

Following stroke, many strategies are used to help prevent recurrence. General measures are recommended in all patients, such as reducing body mass index, adopting a diet low

in salt and saturated fat, stopping smoking and taking regular exercise. These measures, particularly smoking cessation, can be highly effective in reducing stroke risk, even in the absence of medications.

Antiplatelet agents

Based upon current clinical trial evidence, aspirin prescribed after acute stroke will prevent about 11 strokes for every 1000 patients treated (Chinese Acute Stroke Trial (CAST) Collaborative Group, 1997; International Stroke Trialists (IST), 1997). The optimal dosage appears to be between 50 and 150 mg, with higher doses increasing risk of gastrointestinal bleeding in the longer term without further effect on stroke incidence (Sandercock *et al.*, 2008). Higher doses are used to reduce stroke risk during the first 2 weeks.

Dipyridamole (Persantin), when used in combination with aspirin, reduces relative risk of stroke compared with aspirin alone (Halkes *et al.*, 2008). Current recommended practice in the UK is to prescribe patients 300 mg of aspirin daily for the first 2 weeks following an ischaemic stroke, with aspirin 75 mg used in conjunction with dipyridamole following this (ISWP, 2008).

Clopidogrel is an alternative antiplatelet agent, used in combination with aspirin following acute coronary syndromes. This combination, if used following stroke, increases the risk of cerebral haemorrhage and so tends to be avoided (Diener *et al.*, 2004; Bhatt *et al.*, 2006). Clopidogrel, used as a single agent, probably conveys some advantage over aspirin (CAPRIE Steering Committee, 1996) but debate remains as to its cost-effectiveness. In many areas this treatment is therefore reserved for patients where aspirin cannot be given due to intolerance.

Blood pressure

Hypertension should be aggressively treated following a stroke. The target blood pressure following a stroke is 130/80 (ISWP, 2008). Current evidence favours prescription of thiazide diuretics and angiotensin-converting enzyme (ACE) inhibitors over other types of antihypertensives (PROGRESS Collaborative Group, 2001). Angiotensin receptor blockers (ARBs) are used where ACE inhibitors cannot be tolerated due to cough.

Hyperlipidaemia

There is now good evidence that medications to reduce serum low-density lipoprotein cholesterol reduce the incidence of stroke (Smilde *et al.*, 2001; Kastelein *et al*., 2008). Current data suggest that statin drugs (simvastatin, atorvastatin, rosuvastatin) promote regression of cholesterol plaques in the carotid arteries (Smilde *et al.*, 2001).

Anticoagulants

Clinical trials have demonstrated the benefit of warfarin in the prevention of stroke in patients with atrial fibrillation (Mant *et al.*, 2007).

There is a risk of haemorrhage for patients taking warfarin, and a careful consideration of the balance of risks and benefits must be undertaken in any patient where it is to be commenced. Contraindications include a bleeding tendency (e.g. recent peptic ulceration or haemorrhagic bladder tumour), high falls risk, alcohol dependency (alcohol interacts with warfarin) and an inability to follow instructions to take the medicine safely (which may be the case in cognitive impairment).

Where a patient is not suitable for warfarin, aspirin is used as an alternative. It is, however, very much inferior to warfarin for stroke prevention in this context.

Carotid endarterectomy

Trials have shown that this operation to widen the internal carotid artery is beneficial in preventing stroke in symptomatic patients with recent TIA or stroke (Barnett *et al.*, 1998). It is only recommended for patients with a stenosis of greater than 70% and should be limited to patients with reasonable functional status and salvageable brain tissue in the vascular territory under consideration. Therefore, bed-bound patients with large total anterior circulation strokes are not appropriate for this therapy.

Preventative neurosurgery

Patients who have suffered from haemorrhagic stroke (primary intracerebral haemorrhage, subarachnoid haemorrhage) and who have an underlying arterial abnormality, such as an aneurysm or arteriovenous malformation, may benefit from neurosurgical techniques such as aneurysm clipping or embolisation of arteriovenous malformations.

Neuroanatomy

The brain is divided into four main areas:

- *Forebrain*
  - Cerebrum divides into two hemispheres with four lobes (frontal, parietal, temporal and occipital lobes) (Figure 1.2).
  - Internal capsule (Figure 1.3).
  - Basal ganglia (caudate nucleus, globus pallidus and putamen) (Figure 1.4).
  - Diencephalon (thalamus and hypothalamus) (Figure 1.3).
- *Midbrain (brainstem)* (Figure 1.3)
  - Mesencephalon (midbrain).
  - Pons.
  - Medulla oblongata.
- *Hindbrain*
  - Cerebellum (Figure 1.2).
- *Spinal medulla (spinal cord)* (Figure 1.3)

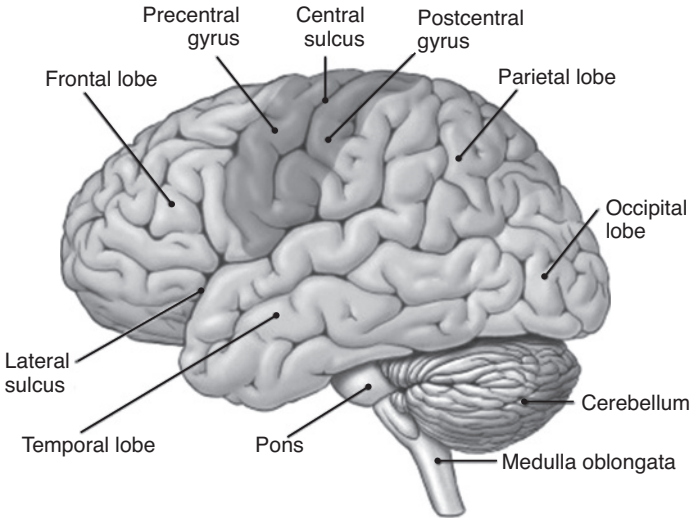

Figure 1.2 Lateral view of the brain. (Reproduced by permission of Pearson Education Inc from Martini, 2006, Figure 14-12b, p. 471.)

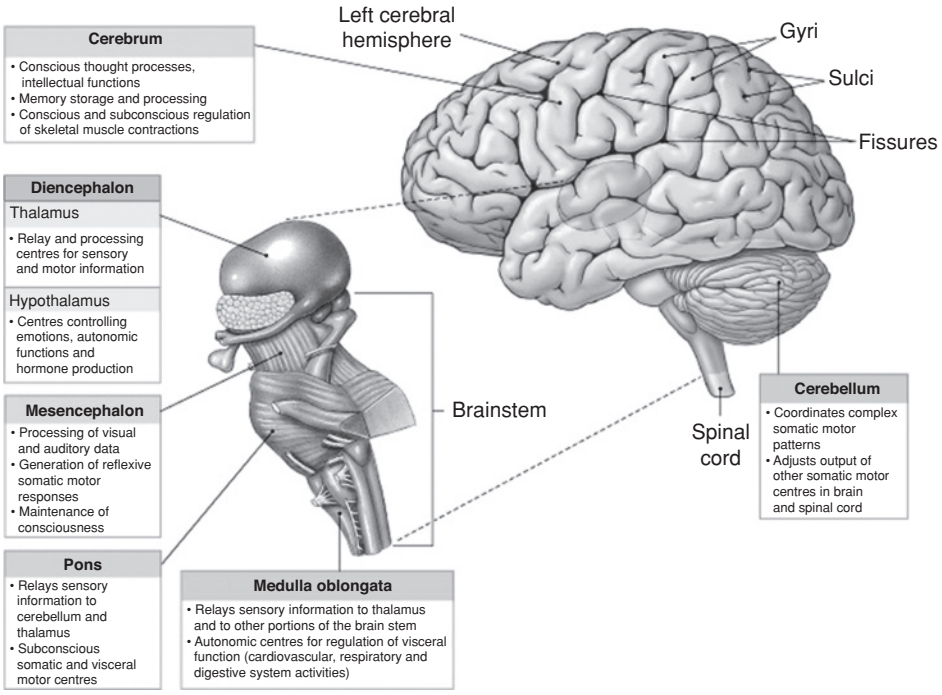

Figure 1.3 The diencephalon and brainstem structures of the brain. (Reproduced by permission of Pearson Education Inc from Martini, 2006, Figure 14-1, p. 453.)

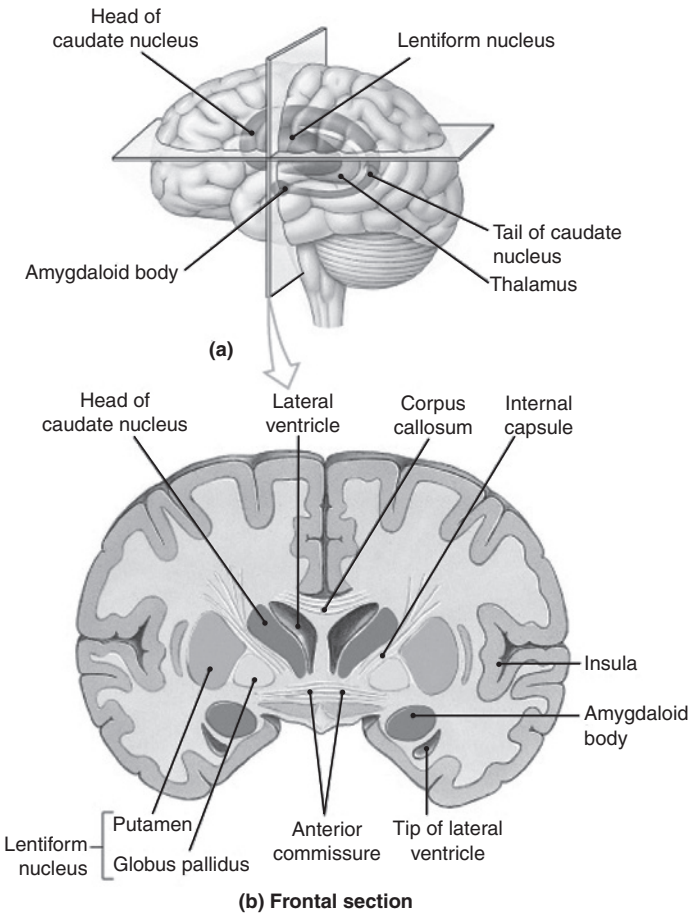

Figure 1.4 Frontal section of the brain showing the basal nuclei, internal capsule and thalamus. (Reproduced by permission of Pearson Education Inc from Martini, 2006, Figure 14-14a,b, p. 473.)

The arterial supply to the brain (Figures 1.5 and 1.6) is from:

- The anterior circulation comprising two *internal carotid arteries* which divide into two major arteries:
  - Anterior cerebral artery.
  - Middle cerebral artery.
- The posterior circulation comprising two *vertebral arteries* which lead to:
  - Posterior inferior cerebellar artery.
  - Basilar artery.
  - Posterior cerebral artery.

The anterior circulation can also be divided into right and left circulations, as there is a carotid artery on each side. Because the vertebral arteries join quite low down the brainstem, most of the posterior circulation is supplied by a single basilar artery.

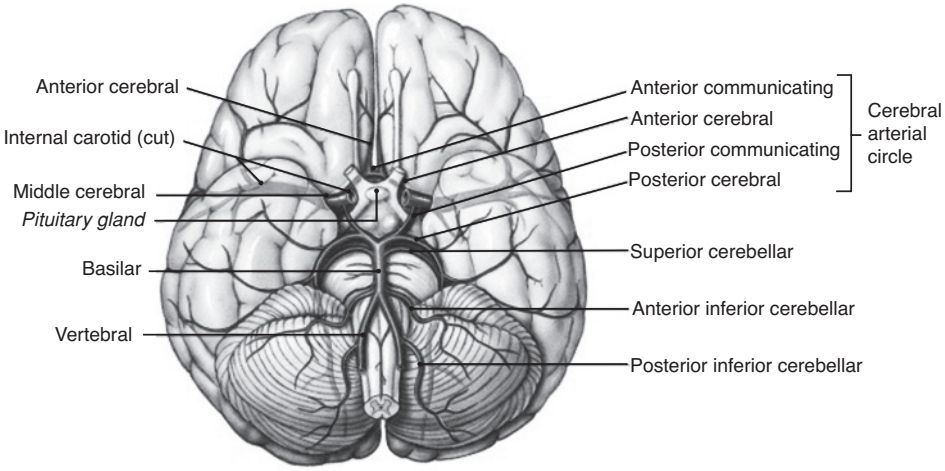

Figure 1.5 Arteries of the brain. (Reproduced by permission of Pearson Education Inc from Martini, 2006, Figure 21.23, p. 741.)

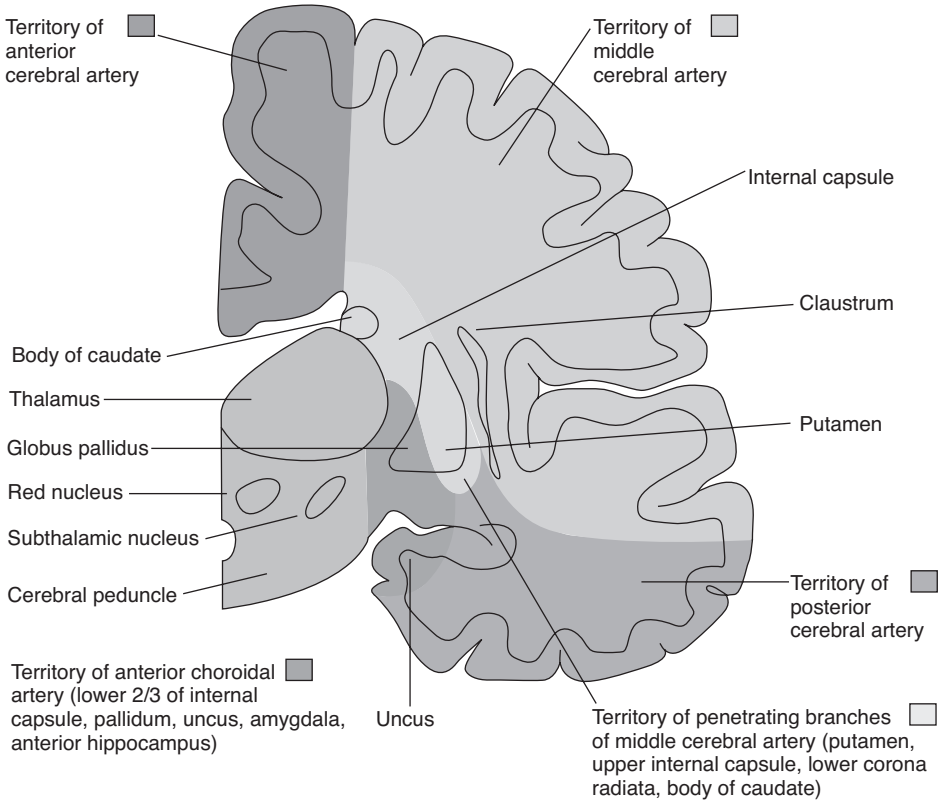

Figure 1.6 Frontal section of the left hemisphere showing the arterial supply. (Reproduced by permission of McGraw-Hill from Kandel *et al.*, 2000, Figure C-2, p. 1304.)

If each of these circulations existed in isolation, then blockage of either carotid or the basilar artery would result in extensive, life-threatening infarction. This does not occur, however, because of anterior and posterior communicating arteries which connect the brain arteries into an anatomical circle, known as the circle of Willis. Thus when one vessel is blocked, an alternative (or collateral) blood supply is available.

There is considerable variation between individuals with regard to how effective their communicating arteries are, and thus collateral circulation, is. Thus carotid, or basilar, occlusion can result in life-threatening stroke for some individuals and will pass unnoticed by others. In reality, most patients exist on a spectrum somewhere between these extremes. This explains why a given vascular abnormality, for example, carotid occlusion, will result in different severities of stroke in different patients.

Damage that can occur in different areas of the brain

Each hemisphere has specialised functions known as hemispheric lateralisation. For example, the left hemisphere senses and controls movement on the right side of the body and specialises in language-based skills such as reading, writing and speaking, and performs analytical tasks such as mathematics and logical reasoning. Oppositely, the right hemisphere senses and controls movements on the left side of the body and is specialised in more creative, spatial and interpretive skills (Figure 1.7).

Testani-Dufour and Morrison (1997) summarised the arterial supply of the brain and the results of occlusion to those arteries. They also summarised the functions of the different areas of the brain and the impairments that can occur as a result of damage (occlusion) to those areas. This information is collated in Tables 1.1–1.3, but should not be considered as a definitive list.

Policy documents relating to stroke

Over the past 10 years, stroke has become an increasing priority for UK health system (Scottish Government, 2002; DH, 2007). This has led to a number of policy documents being published, all of which aim to reduce stroke incidence, improve services and increase awareness.

The first notable policy document related specifically to stroke was published by the DH in 2001.

National Services Framework for older people

The National Services Framework (NSF) for older people (DH, 2001) is a comprehensive strategy to ensure fair, high-quality, integrated health and social care services for older people. It is a 10-year programme of action linking services to support independence and promote good health, specialised services for key conditions and a culture change so that all older people and their carers are treated with respect, dignity and fairness. This NSF sets eight standards for the care of older people across health and social services.

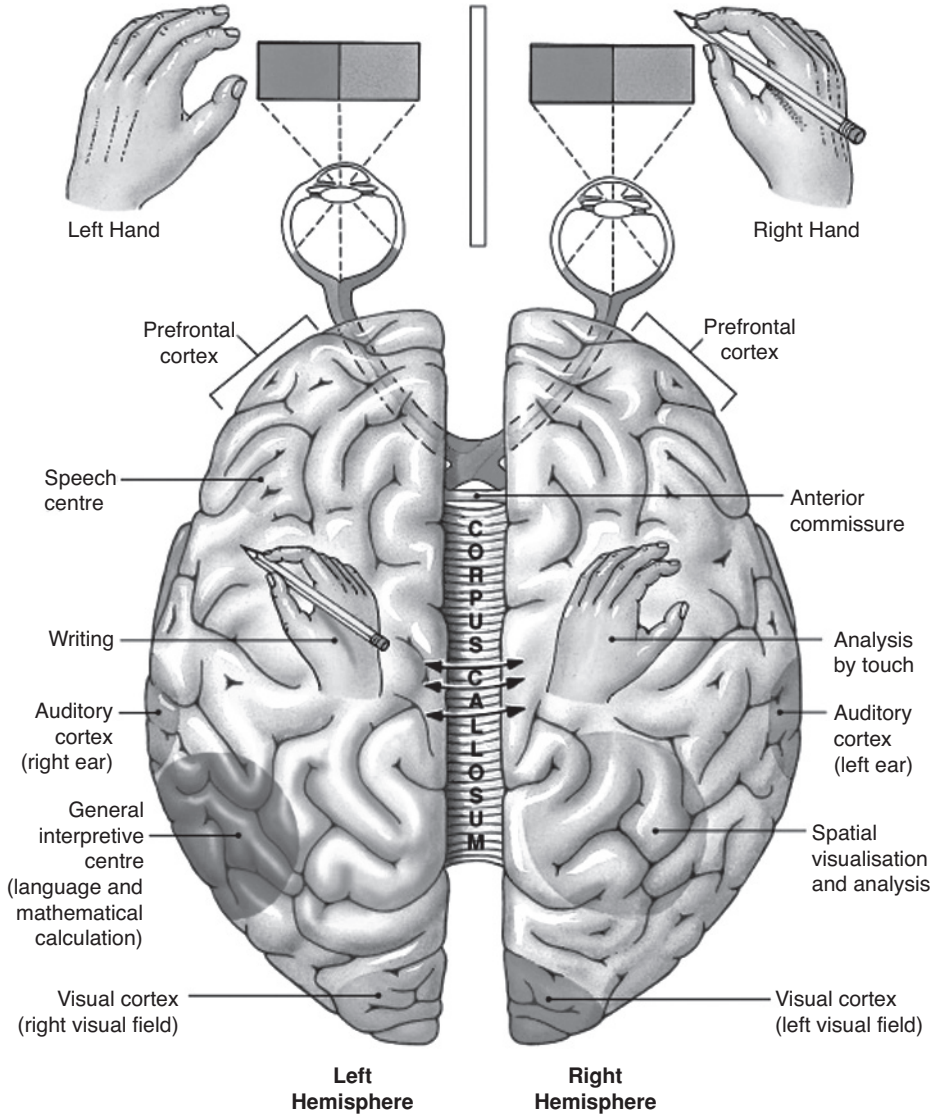

Figure 1.7 Hemispheric lateralisation of the brain. (Reproduced by permission of Pearson Education Inc from Martini, 2006, Figure 14-6, p. 477.)

Standard five of the NSF is specific to stroke and aims to reduce the incidence of stroke in the population and ensure that those who have had stroke have prompt access to integrated stroke care services. This standard sets out four components for the development of integrated stroke services:

- Prevention, including the identification, treatment and follow-up of those at risk of stroke.
- Immediate care, including care from a specialist stroke team.

Table 1.1 Areas of the brain and the results of occlusion to arteries in those areas.

Functions	Impairments
Frontal lobe	
• Concentration • Abstract thought • Memory • Judgement • Ethics • Insight • Emotion • Tact • Inhibition • Sequencing thoughts • Evaluates consequences of actions • Solves intellectual problems • Morality • Motor function	*Impairments Anterior Cerebral Artery and Middle Cerebral Artery* • Memory • Abstract thinking • Judgement • Ethical behaviour • Emotions • Insight • Tact • Inhibition
Broca's area	
• Expression of speech • Word formation • Articulation • Pronunciation • Voice and speech production	• Movement problems, trunk, limbs, eyes • Non-fluent aphasia • Oral apraxia
Parietal lobe	
• Interpretation of sensory input • Contralateral sensation – Two-point discrimination – Pressure – Weight – Texture – Body interpretation – Orientation – Pain – Proprioception • Recognises nature of complex objects by touch and form	• Sensory impairments • Unilateral neglect
Temporal lobe	
• Auditory area • Wernicke's area: – Receive and discriminate sounds – Interpretation of sounds • Olfactory area • Detailed memories, especially those involving more than one sensory modalities (dominant side)	*Impairments Middle Cerebral Artery and Posterior Cerebral Artery* • Wernicke's aphasia • Comprehension • Repetition of speech • Jargon • Reading comprehension
Occipital lobe	
• Visual reception • Visual association • Detects spatial organisation of vision, shapes, colours, contrasts • Secondary complex visual interpretation	• Visual and interpretative disorders • Contralateral field disorders, e.g. quadrantanopia/hemianopia • Partial visual field loss • Altered perception

(Continued)

Table 1.1 (*Continued*)

Functions	Impairments
• Perception of form and meaning • Eye fixation	
Thalamus	
• Sensory and motor pathways contact thalamus except olfactory pathways	• Contralateral hemiplegia • Contralateral hemisensory impairments • Vertical and lateral gaze • Central post-stroke pain
Basal ganglia	
• Production of dopamine • Coordination of muscle movements and posture	• Movements and posture disorders, such as: – Tremor – Rigidity – Chorea – Athetosis – Dystonia – Hemiballismus
Midbrain	
• Synthesises dopamine • Protects basal ganglia	• Motor visual problems • Parkinsonism • Auditory and visual reflexes interrupted
Pons	
• Transmits information from cerebral cortex to brainstem and between two hemispheres • Sensory pathways pass through pons • Regulates respiratory system	• Sensory and motor problems • Altered mastication and facial sensations • Altered eye movement and eyelid closure • Altered taste, facial expression, salivation, equilibrium and hearing • Respiratory insufficiency
Medulla	
• Blood pressure and respiratory regulation • Maintenance of arousal • Initiation of sleep	• Persistent vegetative state • Contralateral sensory and motor impairments • Altered postural sense, proprioception, vibration • Respiratory insufficiency • Cardiac/vasomotor dysfunction • Swallowing • Head and shoulder movement • Tongue movement • Salivation and pharyngeal function
Cerebellum	
• Receives proprioceptive input • Maintains equilibrium • Coordinates automatic movement • Regulates muscle tone	• Poor coordination and fine dexterity • Gait ataxia • Intention tremor • Diadochokinesia • Dysmetria • Hypotonia • Asthenia

ACA, anterior cerebral artery; MCA, middle cerebral artery; PCA, posterior cerebral artery.

Table 1.2 Anterior arterial supply of the brain and the results of occlusion to those arteries.

Supplies	Occlusion
Ophthalmic artery	
• Orbit • Optic nerve	• Transient mononuclear blindness (amaurosis fugax) • Complete unilateral blindness
Anterior choroidal artery	
• Deep structures of the brain (basal ganglia, thalamus, posterior limb of internal capsule and medial temporal lobe)	• Contralateral hemiplegia, hemihypesthesia, homonymous hemianopia
Anterior cerebral artery	
• Anterior three-quarters of medial surface of cerebral hemisphere • Portions of the basal ganglia • Internal capsule	• Contralateral sensory and motor impairments foot and leg greater than arm • Face and hand not usually involved • Incontinence • Deviation of eyes and head towards lesion • Contralateral grasp reflex • Abulic symptoms (apathy, decreased spontaneity, limited speech) *Left Anterior Cerebral Artery* • Arm apraxia • Expressive aphasia *Distal Anterior Cerebral Artery* • Contralateral upper and lower extremity weakness • Contralateral sensory loss in foot • Motor and/or sensory aphasia
Middle cerebral artery	
• Basal ganglia • Fibres of internal capsule • Cortical surfaces of the parietal, temporal and frontal lobes	*Complete occlusion* • Contralateral gaze palsy • Hemiplegia • Hemisensory loss • Spatial neglect • Homonymous hemianopia • Global aphasia (with left hemisphere lesions) *Occlusion superior trunk of Middle Cerebral Artery* • Contralateral hemiplegia • Hemianaesthesia in face and arm greater than leg • Ipsilateral deviation of eyes and head • Broca's aphasia (with dominant hemisphere lesion) *Occlusion inferior trunk of Middle Cerebral Artery* • Contralateral hemianopia or upper quadrantopia • Wernicke's aphasia (usually with left-sided lesions) • Left visual neglect (usually with right-sided lesions) • Motor or sensory impairment usually absent

Table 1.3 Posterior arterial supply of the brain and the results of occlusion to those arteries.

Supplies	Occlusion
Vertebral artery	
• Anterolateral parts of the medulla	*Lateral medullary syndrome* • Contralateral impairment pain and temperature sensation • Ipsilateral Horner's syndrome • Dysphagia • Decreased gag reflex • Vertigo • Nystagmus • Ataxia
Posterior–inferior cerebellar artery	
• Medulla • Cerebellum	*Occlusion medial branch* • Vertigo • Nystagmus • Ataxia • Persistent dizziness *Occlusion lateral branch* • Unilateral clumsiness • Gait and limb ataxia • Inability to stand or sudden fall often • Vertigo • Dysarthria • Nystagmus • Eye deviation
Basilar artery	
• Pons • Midbrain	• Limb paralysis • Bulbar or pseudobulbar paralysis of the cranial nerve motor nuclei • Nystagmus • Eye movement disturbance • Coma *Complete occlusion* • Locked in syndrome • Consciousness with complete motor paralysis, inability to communicate orally or by gesture
Posterior choroidal artery	
• Third ventricle • Dorsal surface of thalamus	• Not seen
Posterior cerebral artery	
• Occipital lobe • Medial and inferior surface of temporal lobe • Midbrain • Third and lateral ventricles	• Contralateral hemiplegia • Sensory loss • Ipsilateral visual field impairments • Weakness greater in face and upper extremities

Table 1.3 (*Continued*)

Supplies	Occlusion
Anterior inferior cerebellar artery	
• Cerebellum • Pons	• Vertigo • Nausea • Vomiting • Nystagmus • Tinnitis • Ipsilateral cerebellar ataxia • Horner's syndrome • Contralateral loss of pain and temperature sense of arm, trunk and leg
Superior cerebellar artery	
• Cerebellum upper part • Midbrain	• Ipsilateral cerebellar ataxia • Nausea • Vomiting • Slurred speech • Contralateral loss of pain and thermal sensation

- Early and continuing rehabilitation.
- Long-term support for the stroke patient and their carers.

Stroke strategies

Since the publication of the NSF for older people, specific stroke strategies have been developed in Scotland 2002/4, England 2007, Wales 2007 and Northern Ireland 2008.

Scotland

The *Coronary Heart Disease and Stroke: Strategy for Scotland* was published by the Scottish Government in 2002 and subsequently updated in 2004 (Scottish Government, 2004). This strategy covered:

- Prevention.
- Managed clinical networks (MCNs).
- Workforce issues.
- Information technology and the development and use of databases.

In relation to stroke care, the main targets included:

- Establishing MCNs.
- Stroke units.
- More rapid imaging.
- Manpower plan and training.
- National audit.
- Improved IT.

In 2009 a revised action plan was launched for Scotland (Scottish Government, 2009). It continued to promote the targets set out in the first action plan and subsequent revision, and developed new targets around:

- Services for stroke
  - Public awareness of stroke – FAST campaign.
  - Thrombolysis.
  - Younger people and stroke – including vocational rehabilitation.
  - Early supported discharge.
  - Rehabilitation and recovery.
  - Stroke Training and Awareness Resources (STARs).
- Improving the quality of care and support
  - Information and communication.
  - Self-management.

England

The *National Stroke Strategy* for England published in 2007 is a comprehensive strategy which summarised a 10 point plan for action (DH, 2007):

1. Awareness of stroke.
2. Preventing stroke.
3. Involvement of patients.
4. Acting on the warnings.
5. Stroke as a medical emergency.
6. Stroke unit quality.
7. Rehabilitation and community support.
8. Participation.
9. Workforce.
10. Service improvement.

Quality service markers were put in place to monitor the compliance with the strategy regarding:

1. Awareness raising.
2. Managing risk.
3. Information, advice and support.
4. Involving individuals in developing services.
5. Assessment – referral to specialist.
6. Treatment for TIA or minor stroke.
7. Urgent response.
8. Assessment – immediate structured clinical assessment.
9. Treatment on a stroke unit.
10. High-quality specialist rehabilitation.
11. End-of-life care.
12. Seamless transfer of care.
13. Long-term care and support.

14. Assessment and review after discharge.
15. Participation in community life.
16. Return to work.
17. Networks.
18. Leadership and skills.
19. Workforce review and development.
20. Research and audit.

Wales

The Welsh health circular *Improving Stroke Services: A Programme of Work* (Welsh Assembly Government, 2007) summarises the programme of stroke improvements for Wales in the following three areas:

Preventing strokes
- Public information leaflets.
- Public and health professional education programmes.
- Identification of gaps in local and national resources.
- Referrals to lifestyle initiatives.
- Referral of TIA patients to a one-stop assessment and investigation service.

Improving stroke survival rates
- Commissioning specification for stroke services.
- Action plans to implement the older people's NSF stroke standards of care.
- Evidence for stroke as a 999 call.
- Protocols and quality requirements.
- Profession-specific audits.
- Introduction or expansion of specialist and consultant staff.
- Dedicated and colocated acute stroke beds.
- Referral to palliative care and end-of-life care, where appropriate.
- Establishment of research programmes for stroke.

Maximising post-stroke-independent living and quality of life
- Development of protocols and quality requirements for rehabilitation assessments and interventions.

Northern Ireland

In July 2008 revised recommendations for the Northern Ireland stroke strategy were published in *Improving Stroke Services in Northern Ireland* (Department of Health, Social Services and Public Safety, 2008) to make improvements in the key areas of prevention, treatment and rehabilitation of stroke patients in a modern health service setting. This document sets out seven standards:

1. Organisation of stroke services.
2. Acute stroke care and hospital-based rehabilitation.
3. Secondary prevention.
4. Discharge planning.

5. Community-based care.
6. Palliative care.
7. Communication with patients and carers.

Guidelines

The College of Occupational Therapists (2000a) definition is that:

> clinical guidelines outline the nature and level of intervention that is considered best practice, for specific conditions in specific populations. They are systematically developed statements which assist clinicians (including Occupational Therapists) and service users in making decisions about appropriate health and social interventions for a specific condition or population. They are sets of recommendations which are based upon the best available evidence.

That is, guidelines are recommendations based on evidence.
The following evidence-based guidelines have been developed specifically for stroke.

Scotland

Evidence-based guidelines for the care of patients following stroke in Scotland (Scottish Intercollegiate Guidelines Network, 2002) were developed with sections on:

1. Organisation of services.
2. General rehabilitation principles.
3. Specific management and prevention strategies.
4. Discharge planning and transfer of care.
5. Roles of the multidisciplinary team.
6. Patient issues.

These are currently being updated, with the revised edition expected by late 2010.

The Scottish Intercollegiate Guidelines Network (2008) also published guidelines on the *Management of Patients with Stroke or TIA: Assessment, Investigation, Immediate Management and Secondary Prevention*, which include sections on:

- Management of suspected stroke or TIA.
- Assessment, diagnosis and investigation.
- Treatment of ischaemic stroke.
- Treatment of primary intracerebral haemorrhage.
- Other causes of stroke.
- Physiological monitoring and intervention.
- Preventing recurrent stroke in patients.
- Carotid intervention.
- Promoting lifestyle changes.
- Provision of information.

England, Wales and Northern Ireland

The Intercollegiate Stroke Working Party of the Royal College of Physicians, London, published evidence-based guidelines for the care of patients following stroke in England, Wales and Northern Ireland (ISWP, 2008). The guidelines include sections on:

- Commissioning.
- Systems underlying stroke management.
- Acute-phase care.
- Secondary prevention.
- Recovery phase from impairments and limited activities: rehabilitation.
- Long-term management, after recovery.
- Profession-specific concise guidelines.

Each section contains many guidelines using the general structure of introduction, recommendations, evidence and implications of the guideline. Tables of evidence are also included.

Self-evaluation questions

1. What is the impact of stroke in the UK?
2. What are the main symptoms of stroke?
3. What are the main causes of stroke?
4. What are the main stroke classifications?
5. What does the 'FAST' acronym stand for?
6. What medical tests/investigations are common following stroke?
7. What secondary prevention could be used?
8. What are the main arteries in the brain?
9. What specific impairments are associated with injury to the frontal, parietal and temporal lobes?
10. What are the key elements of the national stroke strategies?