Cerebrovascular Events

A cerebrovascular event (stroke) is a clinical syndrome caused by disruption of blood supply to the brain, characterised by rapidly developing signs of focal or global disturbance of cerebral functions, lasting for more than 24 hours or leading to death. A transient ischaemic attack (TIA) refers to a similar presentation that resolves within 24 hours.

A stroke results either from ischaemic infarction of part of the brain or from intracerebral haemorrhage. Ischaemic infarction may be caused by atheroma or thromboembolism and, more rarely, by trauma, infection or tumours.

- Cerebral infarction accounts for about 70% of strokes.
- Posterior circulation stroke accounts for 20-25% of ischaemic strokes[1].
- Primary haemorrhage accounts for about 15%.
- Subarachnoid haemorrhage accounts for approximately 5%.
- The remainder are of uncertain type.

The two main types of stroke are not reliably distinguishable clinically but pointers include:

- Haemorrhagic stroke: meningism, severe headache and coma within hours.
- Ischaemic stroke: carotid bruit, atrial fibrillation, past TIA.

Aetiology

Young patient

- Vasculitis.
- Thrombophilia.
- Subarachnoid haemorrhage.
- Venous sinus thrombosis.
- Carotid artery dissection - eg, via near-strangling or fibromuscular dysplasia.

Older patient

- Thrombosis in situ.
- Atero-thromboembolism - eg, from carotid arteries.
- Heart emboli (particularly associated with atrial fibrillation, infective endocarditis or myocardial infarction).
- Central nervous system (CNS) bleed (associated with hypertension, head injury, aneurysm rupture).
- Sudden blood pressure drop by more than 40 mm Hg.
- Vasculitis - eg, giant cell arteritis.
- Venous sinus thrombosis.

Epidemiology[2]

Stroke is a major health problem in the UK:

- Stroke is the third most common cause of death in the UK.
- In England, about 110,000 people have a first or recurrent stroke each year.
- A further 20,000 people have a TIA[3].
- More than 900,000 people in England are living with the effects of stroke and about half of these people are dependent on other people for help with everyday activities.
- Strokes can occur at any age but most strokes occur in people older than 65 years.

Risk factors

- Hypertension.
- Smoking.
- Diabetes mellitus.
- Heart disease (valvular, ischaemic, atrial fibrillation).
- Peripheral arterial disease.
- Post-TIA (TIAs are associated with a high early risk of stroke)[4].
- Polycythaemia vera.
- Carotid artery occlusion; carotid bruit.
- Combined oral contraceptive pill.
- Hyperlipidaemia.
- Excess alcohol.
- Clotting disorders.
Presentation

- Either sudden onset or a step-wise progression of symptoms and signs over hours (or even days) is typical.
- In people with sudden onset of neurological symptoms, a validated tool, such as FAST (Face, Arm, Speech, Time to call 999/112/911), should be used outside hospital to screen for a diagnosis of stroke or TIA[3].
- Focal signs relate to distribution of the affected artery but collateral supplies may cause variation in the presentation.
- Cerebral hemisphere infarcts may cause:
  - Contralateral hemiplegia which is initially flaccid (floppy limb, falls like a dead weight when lifted) and then becomes spastic.
  - Contralateral sensory loss.
  - Homonymous hemianopia.
  - Dysphasia.

- Posterior circulation ischaemia[1]:
  - Motor deficits (weakness, clumsiness, or paralysis of any combination of arms and legs, up to quadriplegia, sometimes changing from one side to another in different attacks).
  - 'Crossed' syndromes: ipsilateral cranial nerve dysfunction and contralateral long motor or sensory tract dysfunction.
  - Sensory deficits: numbness, including loss of sensation or paraesthesia in any combination of extremities, sometimes including all four limbs or both sides of the face or mouth.
  - Homonymous hemianopia.
  - Ataxia, imbalance, unsteadiness, or disequilibrium.
  - Vertigo, with or without nausea and vomiting.
  - Diplopia (ophthalmoplegia).
  - Dysphagia or dysarthria.
  - Isolated reduced level of consciousness can result from bilateral thalamic or brain stem ischaemia.
  - Complete infarction affecting the pons causes ‘locked-in syndrome’ with quadriparesis, loss of speech, but preserved awareness and cognition, and sometimes preserved eye movements.

- Lacunar infarcts (25%):
  - Small infarcts around the basal ganglia, internal capsule, thalamus and pons.
  - May cause pure motor, pure sensory, or mixed motor and sensory signs, or ataxia.
  - Intact cognition/consciousness.

Dysphagia affects a large proportion of stroke patients[5].
Differential diagnosis

- Always exclude hypoglycaemia as a cause of sudden-onset neurological symptoms.[3]
- TIA in the first 24 hours of the stroke.
- CNS tumour.
- Subdural bleed.
- Todd’s palsy.
- Consider a drug overdose if the patient is comatose.

Investigations

- FBC - thrombocytopenia, polycythaemia.
- Test for sickle cell disease.
- Erythrocyte sedimentation rate (ESR) - giant cell arteritis (consider temporal lobe artery biopsy, start steroids).
- Hypoglycaemia, hyperglycaemia and hyperlipidaemia.
- Syphilis - active, untreated.
- Hypertension:
  - Hypertensive retinopathy.
  - Large heart on CXR.
  - Ventricular hypertrophy on ECG.

- Emboli from the left atrium may have caused the stroke. Look for a large left atrium on CXR and consider echocardiography.
- Post-myocardial infarction - mural thrombus is best shown by echocardiography.
- Brain imaging should be undertaken as soon as possible in all patients. Brain imaging should be undertaken immediately if the patient[3]:
  - Has indications for thrombolysis or early anticoagulant treatment.
  - Is currently taking anticoagulant treatment.
  - Has a known bleeding tendency.
  - Has a depressed level of consciousness (Glasgow Coma Score below 13).
  - Has unexplained progressive or fluctuating symptoms.
  - Has papilloedema, neck stiffness or fever.
  - Has severe headache at onset of stroke symptoms.

- Brain imaging[6]:
  - CT scanning is recommended for most patients in the acute phase of stroke. CT is widely available, practical, quick and easy to use in ill patients.
  - CT is very sensitive in diagnosing haemorrhage in patients in the acute stage.
  - In patients with ischaemic stroke, especially those with mild neurological deficits, CT imaging is often normal in the first few hours but the accuracy for ischaemic stroke delineation improves after six hours. However, CT remains less accurate than MRI for determining the site and extent of ischaemic damage, particularly for small lesions and posterior fossa lesions. The accuracy of CT is reduced after one week following the stroke event, especially distinguishing between haemorrhagic and ischaemic stroke origin.
  - MRI may be contra-indicated in up to a fifth of patients because they are too ill, confused, dysphasic, have an intraocular or intracerebral metallic foreign body or have a pacemaker.

- Infective endocarditis: 20% of those with endocarditis present with CNS signs due to septic emboli from valves.
- Carotid duplex ultrasound: in stroke or TIA in carotid territory.
Management

**Acute stroke management**

- Patients should be admitted to hospital (ideally a stroke unit for initial care and treatment, unless the diagnosis will make no difference to management - eg, where the optimal management is palliative care[7]).
- Maintenance or restoration of homeostasis[3]:
  - Oxygen therapy; give supplemental oxygen only if oxygen saturation drops below 95%.
  - Blood sugar control; maintain blood glucose concentration between 4 and 11 mmol/L. Provide optimal insulin therapy with intravenous insulin and glucose, for people with diabetes.
  - Blood pressure control:
    - There is currently insufficient evidence to reliably evaluate the effect that altering blood pressure has on the outcome after acute stroke[8].
    - Give antihypertensive treatment only if there is a hypertensive emergency with one or more of the following:
      - Hypertensive encephalopathy.
      - Hypertensive nephropathy.
      - Hypertensive cardiac failure/myocardial infarction.
      - Aortic dissection.
      - Pre-eclampsia/eclampsia.
      - Intracerebral haemorrhage with systolic blood pressure >200 mm Hg.
  - Consider blood pressure reduction to 185/110 mm Hg or lower in people who are candidates for thrombolysis.
- People with acute stroke should have their swallowing screened before being given any oral food, fluid or medication. Also screen for malnutrition[9].
- Antiplaettelet therapy:
  - Aspirin (300 mg) should be given as soon as possible after the onset of stroke symptoms once a diagnosis of primary haemorrhage has been excluded[10].
  - For long-term vascular prevention in people with ischaemic stroke or TIA without paroxysmal or permanent atrial fibrillation[9]:
    - Clopidogrel 75 mg daily should be the standard antithrombotic treatment.
    - Aspirin 75 mg daily with modified-release dipyridamole 200 mg twice daily should be used for those who are unable to tolerate clopidogrel:
      - Aspirin 75 mg daily should be used if both clopidogrel and modified-release dipyridamole are contra-indicated or not tolerated.
      - Modified-release dipyridamole 200 mg twice daily should be used if both clopidogrel and aspirin are contra-indicated or not tolerated.
- Thrombolytic treatment: see separate Thrombolytic Treatment of Acute Ischaemic Stroke article. Unless there are contra-indications, thrombolytic treatment appears to be effective in improving prognosis after an acute stroke[11]. Treatment with alteplase should only be given provided that:
  - It is administered within four and a half hours (preferably within three hours) of onset of stroke symptoms[9].
  - Haemorrhage has been definitively excluded.
- Anticoagulants should not be started until brain imaging has excluded haemorrhage. In patients with acute ischaemic stroke, immediate anticoagulant therapy is not associated with any overall short-term or long-term benefit. Treatment with anticoagulants reduces recurrent stroke, deep vein thrombosis and pulmonary embolism but increases bleeding risk. Therefore, anticoagulants should not be used routinely for patients with acute ischaemic stroke[12].
- Drugs depressing the function of the CNS (eg, anxiolytics and tranquillisers) and new prescriptions for sedatives should be avoided.
Do not start statin treatment immediately after an acute stroke but continue statin treatment for people who are already taking statins [3].

Encourage the person to sit up and mobilise as soon as their clinical condition permits [3].

Patients with TIA, or patients with a stroke who have made a good recovery when seen, should be assessed and investigated in a specialist service (eg, a neurovascular clinic) as soon as possible and within seven days of the incident.

### Subarachnoid haemorrhage

Subarachnoid haemorrhage should be considered in any patient presenting with sudden-onset, severe and unusual headache with or without any associated alteration in consciousness. See separate Subarachnoid Haemorrhage article.

### Surgical management

- Surgical intervention should be considered in cases of supratentorial haemorrhage with mass effect or posterior fossa/cerebellar haematomata.
- Neurosurgical opinion should be sought for cases of secondary hydrocephalus.
- Carotid endarterectomy: see separate Carotid Artery Occlusion and Stroke Prevention articles.
- Mechanical clot retrieval aims to remove the arterial obstruction in the brain, restoring blood flow to the brain and minimising brain tissue damage. The National Institute for Health and Care Excellence (NICE) recommends that mechanical clot retrieval may be considered for treating acute ischaemic stroke [13].
- There is currently insufficient evidence to support intracranial stenting, unless part of research protocol [14].
- Consider referring for surgical decompressive hemicraniectomy if middle cerebral artery (MCA) infarction is present and all the following are met (refer within 24 hours of symptom onset and perform surgery within 48 hours of symptom onset):
  - Aged 60 years or under.
  - Clinical deficits suggestive of infarction in the territory of the MCA.
  - Decrease in the level of consciousness.
  - Signs on CT scan of an infarct of at least 50% of MCA territory or infarct volume greater than 145 cm$^3$ as shown on diffusion-weighted MRI.

### Clinical Editor's comments (September 2017)

Dr Hayley Willacy recommends the following paper on mechanical thrombectomy [15]. Until recently, the only licensed treatment for acute ischaemic stroke was intravenous thrombolysis. However, since November 2014, nine positive randomised controlled trials of mechanical thrombectomy have been published. The efficacy of this treatment is unmatched by any previous therapy in stroke medicine, with a number needed to treat of less than 3 for improved functional outcome. With effectiveness shown beyond any reasonable doubt, the key challenge the authors state, is how to implement safe and effective services accessible to the patients who need it.

### Secondary prevention of stroke and TIsAs

See separate Stroke Prevention article.

### Long-term management

See separate Cerebrovascular Event Rehabilitation article.

### Complications [2]

- Neurological problems: balance, movement, tone and sensation.
- Pain: neuropathic and/or musculoskeletal.
- Depression, anxiety, emotionalism, disturbed social interaction, disinhibition, aggression.
- Cognitive impairments: attention and concentration, memory, disturbances of spatial awareness, disturbance of perception (eg, visualagnosia), apraxia and disturbances of executive functioning (planning, organising, initiating and monitoring behaviour).
- Speech and communication difficulties: dysphasia, dysarthria, and apraxia of speech.
- Visual impairments and hemianopia.
- Bladder and bowel problems: urinary incontinence, faecal incontinence, constipation.
- Swallowing problems, poor oral health, malnutrition, dehydration.
- Sexual dysfunction.
- Difficulties with activities of daily living: personal, social and vocational.
- Other complications include thromboembolism, pneumonia and bedsores.

Dysphagia affects a large proportion of stroke patients. Swallowing difficulties can result in reduced fluid and food intake, and cause aspiration, which can lead to aspiration pneumonia, undernutrition and dehydration [5].

**NB:** morbidity within carers is high - in particular stress, which is only partly relieved by respite admissions.

### Prognosis [2]

- The inpatient death rate for people admitted with a stroke is about 24%. The risk of stroke recurring within 30 days of an ischaemic stroke depends on the cause of the stroke:
  - Stroke caused by large-vessel cervical or intracranial atherosclerosis with stenosis - risk about 20%.
- Cardioembolic stroke - risk about 5%.
- Lacunar stroke - risk about 1%.
- About half of stroke survivors are left with dependency on others for everyday activities.
- A study in Australia found that:
  - Having survived 30 days after a stroke, the risk of dying in the subsequent 10 years of recurrent stroke was about 25%, and of a cardiovascular event (excluding stroke) was about 33%.
  - The median survival time for people after an ischaemic stroke six months previously was longer in those who were independent in activities of daily living.
- Basilar occlusion is associated with high mortality or severe disability, especially if blood flow is not restored in the vessel[1].

Prevention

See separate Stroke Prevention and Primary Prevention of Cardiovascular Disease articles.

ABCD prognostic score for people with a TIA[9]

Total scores range from 0 (low risk) and 7 (high risk):

- Age (1 point where aged 60 years or over).
- Blood pressure (1 point for blood pressure of 140/90 mm Hg, or higher).
- Clinical features (2 points for unilateral weakness; 1 point for speech disturbance without weakness).
- Duration of symptoms (2 points for 60 minutes or longer; 1 point for 10-59 minutes).

1 point is added for the presence of diabetes.

People who have had a suspected TIA who are at high risk of stroke (ie an ABCD score of 4 or above) should have aspirin (300 mg daily) started immediately, specialist assessment and investigation within 24 hours of onset of symptoms and measures for secondary prevention introduced as soon as the diagnosis is confirmed, including discussion of individual risk factors.

Further reading & references

- Stroke and transient ischaemic attack in over 16s - diagnosis and initial management; NICE Guideline (July 2008, updated March 2017)
- Merwick A, Werring D; Posterior circulation ischaemic stroke. BMJ. 2014 May 19;348:g3175. doi: 10.1136/bmj.g3175.
- Stroke and TIA; NICE CKS, December 2013 (UK access only)
- Stroke and transient ischaemic attack in over 16s: diagnosis and initial management; NICE Clinical Guideline (July 2008)
- Management of patients with stroke: Identification and management of dysphagia; Scottish Intercollegiate Guidelines Network - SIGN (June 2010)
- Management of patients with stroke or TIA assessment, investigation, immediate management and secondary prevention; Scottish Intercollegiate Guidelines Network - SIGN (December 2008)
- Stroke Guidelines; Royal College of Physicians, 2016
- Mechanical clot retrieval for treating acute ischaemic stroke; NICE Interventional Procedure Guidance, February 2016
- Endovascular stent insertion for intracranial atherosclerotic disease; NICE Interventional Procedure Guidance, October 2007
- QOF Guidance; British Medical Association (BMA)

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