Cerebrovascular Accident (Stroke)

Clinical syndrome, of presumed vascular origin, with acute signs of focal or global cerebral dysfunction lasting >24 hours or leading to death. May be ischaemic cerebral infarction (~85%) or intracerebral haemorrhage (10% ICH & 5% SAH).

Causes

- Thrombosis in-situ.
- Athero-thromboembolism (e.g. from carotid or vertebral arteries).
- Heart emboli (atrial fibrillation, infective endocarditis, myocardial infarction).
- Central nervous system bleed (hypertension, head injury, aneurysm rupture).
- Sudden blood pressure drop by more than 40mmHg.
- Subclavian steal.
- Vasculitis, e.g. giant cell arteritis.
- Venous-sinus thrombosis.
- Hyperviscosity syndromes.
- In a young patient, consider: vasculitis, thrombophilia, SAH, venous-sinus thrombosis or carotid artery dissection (e.g. via near-strangling or fibromuscular dysplasia).

Epidemiology

- In UK annual incidence is 1.5/1000, rising rapidly with age to 10/1000 at age 75 years.

Risk Factors

- Male
- Family history
- Past TIA in ~15% of ischaemic strokes
- Hypertension
- Smoking
- Diabetes Mellitus
- Heart dis.(e.g. valve, ischaemic, AF, PFO, IE)
- Hyperlipidaemia
- COCP
- Peripheral vascular disease
- Polycythaemia vera
- Coagulopathy
- Carotid artery occlusion
- Excess alcohol

Presentation

- Onset may be sudden or a step-wise progression of symptoms and signs over hours/days.
- Clinical course may help to differentiate stroke subtypes:
    - ICH doesn't improve in the early period; it progresses gradually during mins/hrs
    - Embolic strokes most often occur suddenly. Rapid recovery also favours embolism.
    - Thrombosis-related symptoms often fluctuate, varying between normal and abnormal or progressing in a stepwise fashion with some periods of improvement.
    - Lacunar (penetrating artery) infarcts usually develop over hours or at most a few days, compared with large artery-related brain ischemia, which can take longer.
    - Aneurysmal SAH develops in an instant. Focal brain dysfunction is less common.
- The two types of stroke are not reliably distinguishable clinically but pointers include:
    - Haemorrhagic: onset seizure, meningism, N&V, sev headache and coma within hours
    - Ischaemic: carotid bruit, atrial fibrillation, past TIA
- Focal signs relate to distribution of the affected artery, but collateral supplies may cause variation in the presentation. (See also table below)
    - Cerebral hemisphere infarcts (50%) – usually embolic
    - Brainstem infarction (25%)
    - Lacunar infarcts (25%) - usually thrombotic

Cerebral Infarction Syndromes	Symptoms and Signs
Anterior cerebral artery (uncommon)	Contralateral hemiparesis (maximal in the leg), urinary incontinence, apathy, confusion, poor judgment, mutism, grasp reflex, gait apraxia
Middle cerebral artery (common)	Contralateral hemiparesis (worse in the arm and face than in the leg), dysarthria, hemianesthesia, contralateral homonymous hemianopia with ipsilat gaze preference, aphasia (if the dominant hemisphere is affected) or apraxia and sensory neglect (if nondominant hemisphere)
Posterior cerebral artery	Contralateral homonymous hemianopia, unilateral cortical blindness, memory loss, ipsilateral 3rd cranial nerve palsy, hemiballismus
Ophthalmic artery (branch of MCA)	Monocular loss of vision (amaurosis)
Vertebrobasilar system (Cerebellar and brainstem lesions) Subtype: Lateral medullary syndrome: (Wallenberg syndrome - PICA)	Unilateral or bilateral cranial nerve deficits (e.g. nystagmus, vertigo, dysphagia, dysarthria, diplopia, blindness), internuclear ophthalmoplegia, truncal or limb ataxia, spastic paresis, crossed sensory and motor deficits*, impaired consciousness, coma, death (if basilar artery occlusion is complete), tachycardia, labile BP, locked-in syndrome. Ipsilateral motor VIIn, IXn, Xn, ipsilateral Horner's, hiccups, contralateral pain & temperature (spinothalamic) loss to body (ipsilateral to face), conjugate gaze palsy. Occasionally also from PICA as well as vertebral artery.
Lacunar infarcts (Small infarcts in distribution of short penetrating arterioles of basal ganglia, thalamus, pons, cerebellum, internal capsule, deep white matter. Account for 15-20% cerebral infarcts. Assoc with poorly controlled DM & HT. Aspirin less effective, but good prognosis.)	Absence of cortical deficits (aphasia, visual loss) plus one of the following: o Isolated unilateral ataxia, o Isolated unilateral dystonia o Isolated unilateral Parkinsonian signs o Isolated hemiparesis o Isolated unilateral sensory deficits o Isolated dysarthria o Unilateral ataxia plus hemiparesis o Dysarthria plus hemiparesis, esp of the face, tongue, and hand

*Ipsilateral facial sensory loss or motor weakness with contralateral body hemianesthesia or hemiparesis indicates a lesion at the pons or medulla.

Intracerebral Haemorrhages	Features
Lobar haemorrhages	Rapid onset, focal headache over bleeding area
Putamenal haemorrhages	Most common, contralateral eye deviation, contralateral hemiplegia
Thalamic haemorrhages	Contralateral hemiplegia, eyes down & in, unequal pupils, absent light reflex, ipsilat Horner's, lateral gaze defects, sensory deficit, aphasia
Pontine haemorrhages	Deep coma + quadriplegia, pin-point pupils, decerebrate, hyperpnoea, HT, hyperhydrosis
Cerebellar haemorrhages	Develops over hours, repeated vomiting & vertigo, contralateral eye deviation, no paralysis

Examination

Includes full neurological exam, CVS exam (?AF, BP, pulses), fundoscopy for hypertensive retinopathy. Look for risk factor signs e.g. arcus senilis, plethora of polycythaemia.

Differential Diagnosis

- CNS tumour
- Subdural bleed
- Todd's palsy
- Consider drug overdose if comatose.

Initial Rapid Assessment - NICS Emergency Dept Stroke & TIA Care Bundle

1. Rapid initial stroke screen:
   e.g. ROSIER (93% sens, 83% spec):

LOC or syncope	-1
Seizure	-1
New acute onset of:	
Asymmetric facial weakness	+1
Asymmetric arm weakness	+1
Asymmetric leg weakness	+1
Speech disturbance	+1
Visual field defect	+1
Score ≤ 0 stroke unlikely	

Also includes recording the:

- GCS
- BP
- BSL

Or NIH Stroke Scale (used in trials, simplified for ED as Cincinatti Prehospital Stroke Scale)

CATEGORY	DESCRIPTION	SCORE
1a. Level of consciousness (LOC)	Alert	0
	Drowsy	1
	Stuporous	2
	Coma	3
1b. LOC questions (Month, age)	Answers both correctly	0
	Answers one correctly	1
	Incorrect	2
1c. LOC commands (Open/close eyes, make fist, let go)	Obeys both correctly	0
	Obeys one correctly	1
	Incorrect	2
2. Best gaze (Eyes open — patient follows examiner's finger or face.)	Normal	0
	Partial gaze palsy	1
	Forced deviation	2
3. Visual (Introduce visual stimulus/threat to patient's visual field quadrants.)	No visual loss	0
	Partial hemianopia	1
	Complete hemianopia	2
	Bilateral hemianopia	3
4. Facial palsy (Show teeth, raise eyebrows, and squeeze eyes shut.)	Normal	0
	Minor	1
	Partial	2
	Complete	3
5a. Motor arm — left (Elevate extremity to 90 degrees and score drift/movement.)	No drift	0
	Drift	1
	Can't resist gravity	2
	No effort against gravity	3
	No movement	4
	Amputation, joint fusion (explain)	9
5b. Motor arm — right (Elevate extremity to 90 degrees and score drift/movement.)	No drift	0
	Drift	1
	Can't resist gravity	2
	No effort against gravity	3
	No movement	4
	Amputation, joint fusion (explain)	9
6a. Motor leg — left (Elevate extremity to 30 degrees and score drift/movement.)	No drift	0
	Drift	1
	Can't resist gravity	2
	No effort against gravity	3
	No movement	4
	Amputation, joint fusion (explain)	9
6b. Motor leg — right (Elevate extremity to 30 degrees and score drift/movement.)	No drift	0
	Drift	1
	Can't resist gravity	2
	No effort against gravity	3
	No movement	4
	Amputation, joint fusion (explain)	9
7. Limb ataxia (Finger-nose, heel down shin)	Absent	0
	Present in one limb	1
	Present in two limbs	2
8. Sensory (Pinprick to face, arm, trunk, and leg — compare side to side.)	Normal	0
	Partial loss	1
	Severe loss	2
9. Best language (Name items; describe a picture and read sentences.)	No aphasia	0
	Mild to moderate aphasia	1
	Severe aphasia	2
	Mute	3
10. Dysarthria (Evaluate speech clarity by patient repeating listed words.)	Normal articulation	0
	Mild to moderate dysarthria	1
	Near to unintelligible or worse	2
	Intubated or other physical barrier	9
11. Extinction and inattention (Use information from prior testing to identify neglect or double simultaneous stimuli testing.)	No neglect	0
	Partial neglect	1
	Complete neglect	2

Total Score:

0 = no stroke
1-4 = mild stroke
5-15 = mod stroke
15-20 = mod-sev stroke
>20 = severe stroke

2. $ABCD^2$ assessment if TIA suspected:
3. Urgent CT or MRI
   - Stroke or High risk TIA: ASAP <24hr, ideally within 30mins
   - Low risk TIA: <72hr +/- a carotid USS (where indicated)
4. Nil by mouth until bedside swallow screen (within 24 hours) for stroke
5. **Aspirin** 150-300mg PO as soon as possible (<48hr) if haemorrhage excluded
6. Physiological monitoring and management:
   - Neurological status – regular monitoring e.g. GCS
   - BSL – cautiously treat marked hyperglycaemia. Avoid hypoglycaemia
   - BP – cautiously lower by 10-20% if ≥220/120mmHg or MAP ≥130. Avoid hypoBP
   - Hydration status – maintain euvolaemia

Investigations

Bloods: FBC, ESR, UEC, BSL, lipids, coags, CK/Trp, ABG. Occ sickle cell disease or syphilis tests.
ECG: Arrhythmias, MI
Imaging:

- CXR – aortic dissection, aspiration, cardiac chamber enlargement, intrathoracic Ca
- CT scan:
    - Immediate scan used:
        - Rule out haemorrhage where thrombolysis or anticoagulation indicated
        - ICH/SAH suspected: known bleeding tendency, on anticoagulants, unexplained progressive or fluctuating symptoms, severe headache at onset
        - DDx: depressed LOC, papilloedema, neck stiffness or fever
    - 50% infarcts detectable <6hrs (init signs: hypodensity (↑density over next 2wks & then ↓again), loss grey/white diff, local mass effect, hyperdense cerebral artery)
    - CT perfusion scans can detect ischaemia in targeted areas in <2hrs. Colour coded – irrev ischaemia red, possibly reversible green.
    - CTA for extracranial carotid dissection/stenoses, Circle of Willis trunk occlusion
- MRI
    - Can detect earlier & smaller infarcts than CT. Good for late Dx of ICH.
    - Diffusion weighted most sensitive & Dx <2hrs, 95% sens & spec after 3hrs.
    - Perfusion MRI maps blood flow, mismatches with diffusion scan identifies potentially salvageable areas.
    - MRA good for carotid dissection/stenoses>50%
- ECHO – thrombus, vegetation
- Carotid duplex ultrasound: in stroke in carotid territory.
- Transcranial Doppler USS: MCA patency & flow – not widely available.

Other: LP after 12hrs if suspected SAH and CT clear.

Management

Acute Stroke Management

- Resuscitation:
    - Airway – to intubate or not. Often needed for airway protection/CT yet outcome likely to be poor. Oral/nasopaharyngeal airway. NGT if gag reflex affected.
    - Breathing – O_2. Assisted ventilation
    - Circulation – Maintain adequate BP. In infarction **labetalol** if >220/120 reduce by 10-15%. In ICH: reduce BP>180/105, MAP 130 to 160/90 if CPP maintained.

General

- Should be admitted ideally a stroke unit for initial care and treatment, unless palliative
- General: supportive – hydration, nutrition, BSL, thermal protection, pressure care, IDC
- Screening <24hrs for swallowing deficits before given oral fluid/food/drugs.

Cerebral Infarction

- Thrombolysis – Controversial still.
    - Indications:
        - <80yo & can give consent
        - Presents<3-4.5hrs (~5% cases) – ideally <90min
        - NIHSS<25, good prospect of recovery
        - CT: <1/3 MCA territory infact & no haemorrhage
        - No other CI

    - CI: ?SAH, seizure, rapidly improving signs or very major deficits, previous brain tumour/haemorrhage/AVM, recent stroke/HI/major surgery/LP, GI haemorrhage, acute pericarditits, pregnancy, INR>1.5, BP>185/110, 22<BSL<2.7, plts<100.
    - 0.9mg/kg **tPA** (10% as bolus, rest over 1hr). No antiplatelet/anticoag for 24hr.
    - See trials summary below.
        - Pros: NNT ~8 for benefits, benefits at 3mo sustained to 12mo+
        - Small no. of positive trials. Benefits occur after 24hrs, 75% of early presenters improve anyway (placebo). Cx: ↑ICH, ↑mortality by ~1% if given >90mins, ~3% death from ICH. 3hr limit prone to violation, consent difficult.
- Antithrombotic: **aspirin** 150-300mg within 48hrs.
- Anticoagulation – Controversial - LMWH ?improves long term outcome in infarcts >48hrs.
- DVT/PE prophylaxis (usually just an antiplatelet unless high risk) & early mobilisation.

ICH/Subarachnoid haemorrhage

- Reverse coagulopathy: **prothrombinex** & **FFP**. Factor VII doesn't alter clinical outcome.
- Consider platelet transfusion if on antiplatelet Rx and NeuroSx considered.
- Discuss with a neurosurgeon immediately ?endovascular or surgical obliteration.
- Oral **nimodipine** 60 mg four-hourly is given for SAH, unless specific contraindications.
- Anti-fibrinolytic agents and steroids should not be given acutely.

Surgical

- General indications for considering possible neurosurgical intervention:
    - Supratentorial haemorrhage + mass effect or posterior fossa/cerebellar bleed.
    - Secondary hydrocephalus.
    - SAH
    - Cerebellar bleeds >3cm diam (30ml)
- Carotid endarterectomy: non-severe carotid artery territory CVA if stenosis>70%, carotid angioplasty or stenting is an alternative.

Secondary Prevention

- Antiplatelet therapy
    - **Aspirin** (75-300mg OD) reduces ischaemic stroke risk by 20% (CAST, IST trials)
    - Alternatives are **clopidogrel** 75mg daily and/or **dipyridamole** MR 200mg BD
    - Addition of dipyridamole to aspirin provides extra protection.
- Anticoagulation (**warfarin**) beneficial in preventing ischaemic stroke in persistent or paroxysmal AF (valvular or non-valvular) unless CI. Aim INR 2.0-3.0.
- Blood pressure. Treat cautiously if persistently>140/85 (non-DM) or 130/80 (DM) with a thiazide diuretic (e.g. **indapamide**) or an ACE inhibitor (e.g. **perindopril** or **ramipril**) or preferably a combination of both (PROGRESS trial).
- Anti-lipid agents:
    - Treatment with a statin should be given to patients with ischaemic stroke, and total cholesterol of >3.5mmol/L unless contraindicated.
- Appropriate advice on lifestyle factors, including: stopping smoking, regular exercise, diet and achieving a satisfactory weight, reducing salt intake, and avoiding excess alcohol.

Long-term Management

- Multidisciplinary rehabilitation and psychosocial support.
- All patients should receive an annual flu vaccination.
- Driving ceased for at least 1-4wks
- The needs of the carers should be considered from the outset.

Complications

- Patients with TIA and stroke also have an ↑risk of MI and other vascular events.
- Other complications for the patient include: thromboembolism, pneumonia, depression, contractures, bladder and bowel problems (e.g. incontinence, constipation) and bed-sores.
- Morbidity from stress within the carers is high and only partly relieved by respite care.

Prognosis

- Use of a stroke scale may help quantification of deficit & progress.
    - Commonest: National Institutes of Health stroke scale (NIHSS) (Canadian). 42pt score covers LOC, date orientation, comprehension, gaze, visual fields, facial paresis, motor function, limb ataxia, sensation, language, dysarthria and inattention. >22 = severe stroke.
- Mortality:
    - Overall 20% at 1mo (infarct 10%, haemorrhage 30%) and then 5-10% per year
    - If Hemiparesis/hemianopia/aphasia – 90% dead or dependent at 6mo.
    - If haemorrhage on warfarin – 80% mortality.
    - Lacunar infarcts have low mortality.
- Drowsiness suggests a poorer prognosis.
- By 6mo >50% stroke survivors need help with ADLs. 15% have communication impairments and 53% motor weakness and many will have problems with mood or cognition.
- Full recovery 40%.

Summary of Thrombolytic Therapy Trials for Iscaemic Stroke.

Trials Within Three Hours

NINDS (National Institute of Neurological Disorders and Stroke) [1995] placebo vs alteplase [tPA] (0.9 mg/kg max90 mg; 10% as bolus+1hr infusion). NIHSS sig. better with alteplase @3mo & 1yr. No sig. difference in mortality, but ↑symptomatic ICH. **Recent reanalysis refutes findings.**

Safe Implementation of Thrombolysis in Stroke-Monitoring Study (SITS-MOST) [2007] Observational study only. 18-80yrs given rtPA within 3hrs showed no increase in ICH risk but reduced mortality at 3 mo.

Trials That Extended Beyond Three Hours

MAST-I (Multicenter Acute Stroke Trial - Italy) [1995] SK/Aspirin vs placebo within 6 hours. Terminated early for ↑mortality.

ECASS (European Cooperative Acute Stroke Study), [1995] Alteplase (1.1 mg/kg up to 100 mg; 10% as a bolus, then 1hr infusion) vs placebo within 6 hours. At 3mo, no difference (until reanalyzed & exclusion criteria reapplied), but higher mortality with tPA, risk ICH.

MAST-E (Multicenter Acute Stroke Trial - Europe) [1996] SK vs placebo within 6 hrs. Terminated early for ↑mortality.

ASK (Australian Streptokinase) [1996] SK vs placebo within 4 hrs. Terminated early for ↑mortality.

ECASS-II (European Cooperative Acute Stroke Study - II) [1998] Alteplase [tPA] (0.9 mg/kg up to 90 mg; 10% as a bolus, then 1hr infusion) vs placebo. No significant differences at 3mo.

ATLANTIS trial [1999] Alteplase (0.9 mg/kg over 1hr) vs placebo between 3-5hrs of onset. ↑Risk of early ICH. Also a trend to ↑mortality at 3mo. Small number of patients were treated<3hrs and these had a significantly better (NIHSS score ≤1).

DIAS (Desmoteplase in Acute Ischemic Stroke Trial) [2005] *Desmoteplase at various doses within 3-9hrs. Results suggest benefit with 125 and 90mcg/kg. Benefit also >3hrs and no diff in ICH rates but~2% had ICH in higher dose group.*

ECASS-III (European Cooperative Acute Stroke Study - III) [2008] *Alteplase [tPA] vs placebo within 3-4.5hrs. Reported just significant OR for improvement at 90d in some scores. No diff in mortality but increased ICH with tPA.*

EPITHET (Echoplanar Imaging Thrombolytic Evaluation Trial) [2008] *Alteplase [tPA] vs placebo within 3-6hrs. Reported better reperfusion with tPA but no difference in scorteing outcomes or infarct growth.*