Stroke

Definition / Supporting Information

Stroke can occur in children and young people, and it is vital to identify a child who is having a stroke as quickly as possible in order to activate the acute paediatric stroke pathway.

There are two main types of stroke, arterial ischaemic stroke (AIS) and haemorrhagic stroke (HS); both are acute focal neurological disorders with imaging evidence of cerebral infarction in a corresponding arterial territory or acute haemorrhage, respectively.

It is impossible to distinguish between AIS and HS, and to differentiate symptoms of real stroke from 'stroke mimics' on clinical grounds and therefore imaging is key to diagnosis. Predisposing risk factors should be considered and, if present, should increase suspicion of the diagnosis of stroke. This guideline specifically excludes venous stroke and this is therefore explicitly excluded from the discussion below as venous stroke presents and is managed in very different ways from AIS or HS.

Essential History

In both stroke sub-types, the most common symptoms at onset are:

- Acute focal neurological deficit
- Seizure
- Headache

Ask about:

- FAST*
- New or sudden onset of:
  - Focal seizures
  - Severe headache
  - Ataxia
  - Vertigo
  - Dizziness
  - Neck pain / stiffness
- Altered mental status
  - Transient loss of consciousness
  - Behavioural changes
- Witnessed acute focal neurological deficit which has since resolved
- History of Sickle Cell Disease (SCD)

- Congenital heart disease
- Nausea, vomiting or fever
  - Such non-specific symptoms can occur in a child presenting with stroke
  - The index of suspicion should be raised by any associated change in behaviour
- Past medical history of vascular disorders
  - Arteriovenous malformation (AVM)
  - Cavernous malformations
  - Cerebral artery aneurysms
  - Moyamoya
- Clotting disorders
  - Platelet
  - Clotting factors
  - Vitamin K deficiencies
- Gender, ethnicity and age (eg, age 15–19 years, black ethnicity, male gender predisposed for HS)
- Illicit drug use
  - Amphetamines
  - Cocaine

Professionals in health and education services should be aware of the possibility of stroke in children and young people who are at higher risk (eg, SCD, congenital heart disease).

*Use the FAST criteria to determine focal neurological deficit /stroke in children and young people, but do not rule out stroke in the absence of FAST signs

- Face: the face, mouth or eye may have drooped on one side of the face and the person may not be able to smile
- Arms: the person with suspected stroke may not be able to lift their arms due to arm weakness or numbness
- Speech: speech may be slurred, or the person may not be able to talk at all despite appearing to be awake
- Time: it is time to dial 999 immediately if any of these signs / symptoms are present

‘Red Flag’ Symptoms and Signs

Ask about:

- Acute focal neurological deficit (eg, hemiparesis)
- Seizure
- Headache
- Speech disturbance
- Focal seizure in child not known to have epilepsy

- Unexplained, persistent reduction in level of consciousness at presentation:
  - Age-appropriate Glasgow Coma Scale (GCS) < 12
  - Or AVPU ('Alert, Voice, Pain, Unresponsive') < V

Differential Diagnosis / Conditions

Stroke mimics:

- Non-vascular conditions with a stroke-like presentation:
  - Complicated focal or hemiplegic migraine
  - Epilepsy / seizures (post ictal deficit)
  - Bell's palsy (ie, a lower motor neurone deficit where the whole of one side of the face is affected, whereas with a stroke the forehead is spared)
  - Functional weakness
  - Syncope
- Cerebellitis (also known as post-viral cerebellar ataxia)
  - Characterised by the sudden onset of ataxia following a viral infection
- Mononeuritis
- Drug intoxication / overdose
- Hypoglycaemia
- Stroke-like episodes without vascular basis (eg, mitochondrial encephalopathy, lactic acidosis, and stroke-like episodes (MELAS) syndrome)
- Meningitis / intracranial abscess / encephalitis / acute disseminated encephalomyelitis (ADEM)
- Acute metabolic crises
- Tumours

Investigations

To be undertaken by non-specialist practitioners (eg, General Practitioner (GP) / Community Medical / Ambulance Service(s)):

- Appropriate training of community medical and ambulance services about the pre-hospital stroke pathway, so that they recognise symptoms suggesting an acute stroke as an emergency requiring urgent transfer to hospital must include training to perform
  - A screen for hypoglycaemia, with a capillary blood glucose
  - The use of the FAST tool to screen for stroke
- If the FAST screening tool is positive (or negative but stroke still suspected), the pre-hospital stroke pathway should be activated

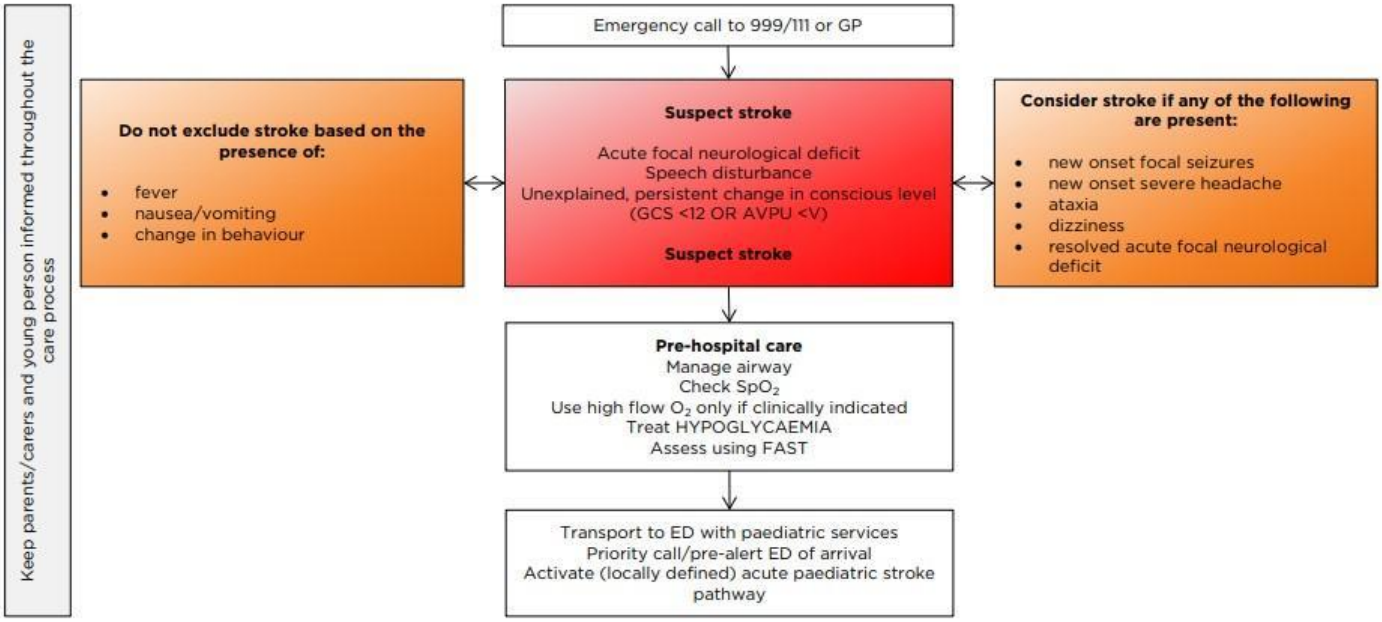

Figure 1: Pre-hospital pathway for the management of suspected childhood stroke

To be undertaken by specialist practitioners (eg, Paediatrician / Emergency Medicine / Haematology / Intensive Care and Anaesthesia Team(s)):

- Trigger acute paediatric stroke pathway upon arrival at the emergency department including urgent brain imaging within 1 hour of arrival
- Paediatric haematologists should be involved in acute management if the child has SCD
- Assess child's neurological status using the Pediatric National Institutes of Health Stroke Scale (PedNIHSS)
- Assess child's condition using age-appropriate GCS or AVPU ('Alert, Voice, Pain, Unresponsive') to assess the child's neurological status and conscious level, respectively
- Local protocols should be developed to coordinate liaison between specialties at secondary and regional centres including:
  - Urgent acquisition of appropriate brain imaging within < 1 hour of arrival
  - Transfer to the regional neurosciences centre
  - Facilitation of appropriate and time-sensitive transfers between centres

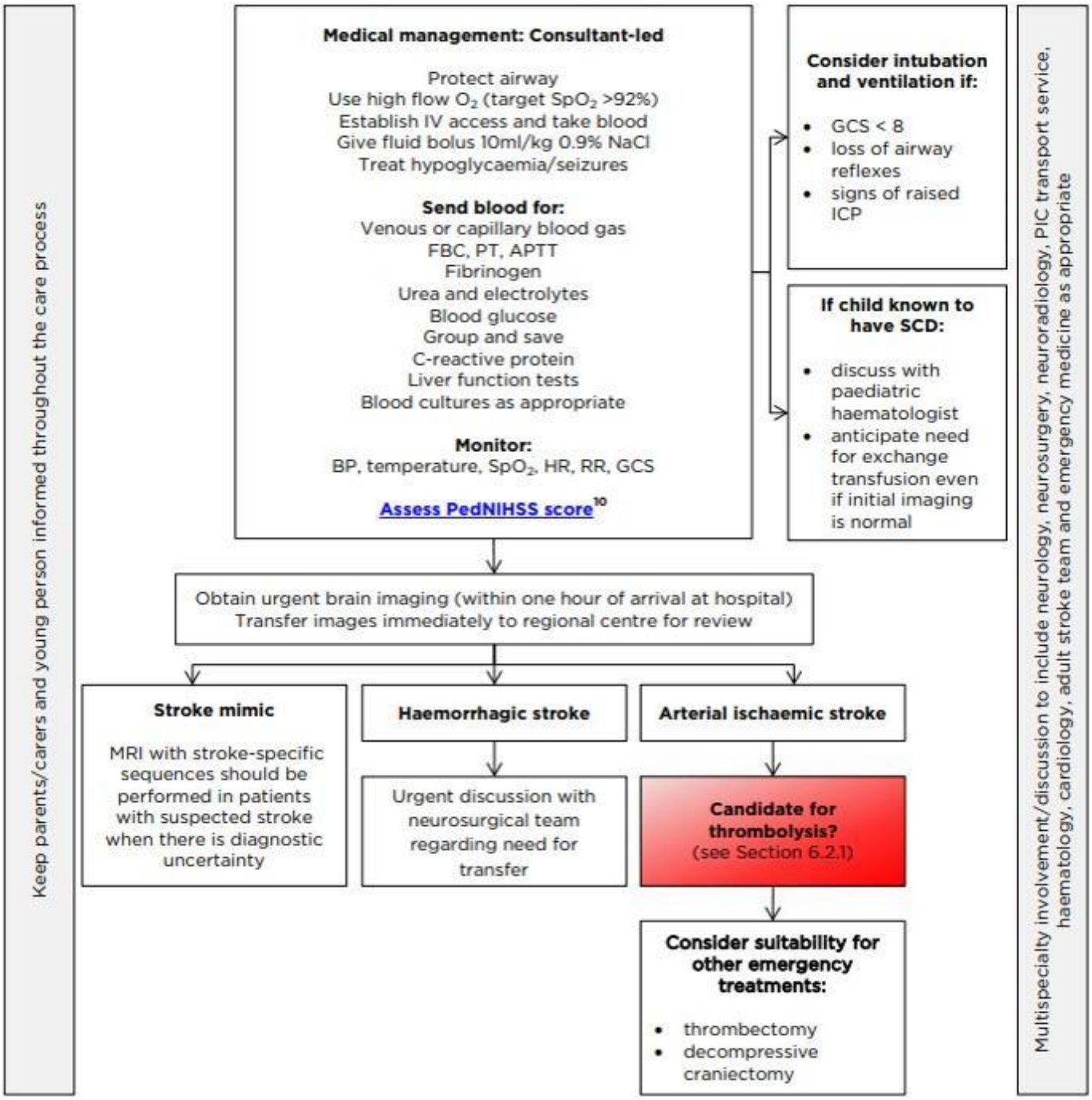

Figure 2: Hospital pathway for the management of suspected childhood stroke (see section 6.2.1 of RCPCH Stroke in Childhood clinical guideline for further information on thrombolysis)

Treatment Approach

The treatment options for stroke in childhood involve:

- Acute assessment
- Acute medical interventions for AIS
- Acute medical interventions and indications / consideration for surgical interventions for HS
- Early functional assessment

Arterial ischaemic and haemorrhagic stroke

- Withhold oral feeding (eating and drinking) until swallow safety has been established
- Maintain normal fluid, glucose and electrolyte balance
- Target oxygen saturation above 92%
- Treat hypotension

Arterial ischaemic stroke

Thrombolysis

Off-label use of tissue plasminogen activator (tPA) should be considered in children > 8 years presenting with suspected stroke in whom AIS is confirmed using the following criteria:

  - PedNIHSS > 4 and < 24 AND treatment can be administered within 4.5 hours of known onset of symptoms
- **AND** intracranial haemorrhage has been excluded
  - CT and CTA demonstrates normal brain parenchyma / minimal early ischaemic change
  - CTA demonstrates partial or complete occlusion of the intracranial artery corresponding to clinical or radiological deficit
- **OR** magnetic resonance imaging (MRI) and MRA showing evidence of acute ischaemia on diffusion-weighted imaging plus partial / complete occlusion of the intracranial artery corresponding to clinical or radiological deficit

If no contraindications, begin thrombolysis irrespective of patient location (ie, district general hospital secondary care centres at point of AIS diagnosis after discussion / advice and agreement with the regional neurosciences centres / CTS)

Decompressive Craniectomy

- Consider decompressive hemicraniectomy in patients with middle cerebral artery (MCA) infarction under the following circumstances:
  - Neurological deficit indicates infraction in the MCA territory
  - An increase of ≥ 1 on item 1a of the PedNIHSS
  - PedNIHSS score > 15
- Consider performing a decompressive craniectomy in vascular infarctions in other territories (eg, posterior fossa infarction)

- Children should only receive blood pressure-lowering treatment in the following circumstances:
  - If they are eligible for intravenous (IV) thrombolysis but their systolic blood pressure exceeds the 95th percentile for age by > 15%
  - If they are encephalopathic
  - If they have evidence of end organ damage / dysfunction (eg, cardiac or renal failure)
- Consider decompressive hemicraniectomy in patients with middle cerebral artery (MCA) infarction under the following circumstances:
  - Neurological deficit indicates infarction in the MCA territory
  - An increase of > 1 on item 1a of the PedNIHSS
  - PedNIHSS score > 15
- Anti-thrombotic therapy (unlicensed, but well-documented in published literature)
  - Prescribe and deliver 5 mg/kg of aspirin up to a maximum of 300 mg (loading dose) within 24 hours of diagnosis (in the absence of contraindications)
  - Delay administering aspirin for 24 hours in patients where thrombolysis has been given
  - Reduce dose of aspirin after 14 days to 1 mg/kg to a max of 75 mg/kg
  - Aspirin should not be routinely given to children and young people with SCD presenting with AIS
- For cardiac disease presenting with AIS, the multidisciplinary team should assess the risk-benefit of antithrombotic therapy (antiplatelet versus anticoagulation)
- Treatment of AIS in SCD
  - Treat urgently with a blood transfusion, to reduce the sickle haemoglobin (HbS) to < 30%, and increase the haemoglobin concentration to > 100–110 g/l
  - Provide a top-up transfusion to bring Hb to 100 g/l to improve cerebral oxygenation if the start of the exchange is likely to be delayed by > 6 hours
- Consider surgical revascularisation in patients with moyamoya and ongoing ischaemic symptoms or other risk factors for progressive disease

Haemorrhagic stroke

- Children and young people with HS should be cared for in conjunction with the neurosurgical team
- Do not routinely evacuate intracerebral hemorrhage (ICH) except where there is a rapidly decreasing GCS
- Transfer children and young people with an underlying inherited bleeding disorder (eg, severe haemophilia) who have an intracerebral bleed to a paediatric haemophilia Comprehensive Care Centre (CCC) as soon as possible
- If coagulation abnormalities are present, focus treatment on:
  - Intense initial treatment to maintain normal levels of coagulation factor
  - Then prophylactic treatment to prevent recurrence
- Consider nimodipine (mean starting dose 1 mg/kg every 4 hours) to prevent vasospasm in children and young people with subarachnoid haemorrhage
- Neurological management
  - The management of any structural vascular lesions underlying an ICH (most commonly AVM, aneurysm or cavernous malformation) must be discussed at a neurovascular MDT
  - Lesions at higher risk of early re-bleeding should be treated urgently (i.e, on the initial admission) these include:
    - Ruptured aneurysms
    - Arteriovenous malformations with high risk features

Early functional assessment

- Use of the International Classification of Functioning, Disability and Health (ICF) framework to identify domains for assessment and intervention
  - Body structure and function impairment(s)
  - Activity limitations
- Use of both clinical and instrumental methods to assess body structures, functions and activities as soon as possible during hospital admission (within 72 hours):
  - Swallow safety (ingestion)
  - Hydration and nutrition
  - Pain
  - Motor function / tone / movement
  - Vision and hearing
  - Sleep
  - Sensation and perception
  - Fatigue

When to Refer

Refer urgently to specialist practitioners (eg, Haematology / Paediatric Neurology / Cardiology / Emergency Department / Paediatric / Paediatric Intensive Care Retrieval Team(s)) if:

- Presenting with moyamoya
- Coagulation management is needed due to a known underlying inherited or acquired bleeding disorder
- Initiation of thrombolysis and subsequent retrieval / transfer to regional neurosciences centre post CT / CTA is required
- Discussions around impairment of consciousness level or decline in PedNIHSS in a child with AIS is needed
- Presenting with a PedNIHSS score of > 6:
  - Consider intra-arterial clot extraction with prior IV thrombolysis, unless contraindicated, beyond an onset-to-arterial puncture time of 5 hours if:
    - Proven favourable profile on salvageable brain tissue imaging, in which case treatment up to 12 hours after onset may be appropriate

Escalate care to a paediatric haemophilia CCC if:

- An underlying inherited bleeding disorder (eg, haemophilia) is present in HS patients, who have an intracerebral bleed

‘Safety Netting’ Advice

- If ‘red flag’ signs and symptoms, or sudden / unexpected exacerbation of symptoms, the Medical Team should be contacted

Patient / Carer Information

**Please note: whilst these resources have been developed to a high standard they may not be specific to children.*

- Dealing with a stroke (Web page), Patient
- Stroke (Web page), Patient
- Stroke in Childhood: Guideline for parents, carers, and families of children and young people affected by stroke (Web page), RCPCH parent guideline, Royal College of Paediatrics and Child Health
- Transient Ischaemic Attack (Web page), Patient

Resources

National Clinical Guidance

Stroke and transient ischaemic attack in over 16s: diagnosis and initial management (Web page), NICE guideline CG68, NICE guideline NG78, National Institute for Health and Care Excellence

Stroke in childhood: Clinical guideline for diagnosis, management and rehabilitation (Web page), RCPCH clinical guideline, Royal College of Paediatrics and Child Health

Stroke in childhood: key messages and recommendations (Webinar), RCPCH clinical guideline, Royal College of Paediatrics and Child Health

Medical Decision Support

Stroke diagnosis algorithm pathway (Web page) RCPCH clinical guideline, Royal College of Paediatrics and Child Health

Suggested Resources

**Please note: these resources include links to external websites. These resources may not have national accreditation and therefore PCO UK cannot guarantee the accuracy of the content.*

Blood clots (Web page), the NHS website

Childhood stroke (Web page), Stroke Association

Stroke (Web page), the NHS website

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