Paediatric Stroke – Emergency management in children – Neuroprotective Care

This document forms part of the statewide guideline for Paediatric Stroke – Emergency management in children

Detailed information for the acute management of haemorrhagic or ischaemic stroke

Please also see Neuroprotection Checklist

Airway and Breathing

Management of airway and breathing in stroke is critical. The goal is to direct care to ensure adequate oxygenation and ventilation while preventing aspiration. Intubation and ventilation should be performed if the GCS is <8 or there is hypoventilation or irregular respiration.

Oxygen supplementation should be administered if the child is hypoxic (aim saturations > 94%).

In intubated and ventilated patients, the target CO_2 should be 35-45mmHg except in situations of worsening raised intracranial pressure that is progressing to acute brain herniation.

Acute Brain Herniation
Features include: • Altered conscious state - unresponsive • Cushing's triad – bradycardia, hypertension and irregular respirations • Widened pulse pressure • Decerebrate or decorticate posturing • Dilated or fixed, non-reactive pupil/s • Restricted eye movements - sixth nerve palsy
Acute treatment: • Intubation to secure the airway • Hyperventilation (CO_2 <35mmHg) titrated to reverse pupillary dilation** • FIO_2 100% • Bolus hypertonic saline (target Na 145-155mmol/L) or mannitol – see CREDD for dosing • Urgent CT Head and neurosurgical intervention Hyperventilation reduces intracranial pressure quickly (<1min) hypertonic saline or mannitol takes time to draw up, administer and then cause fluid shift (~20mins) Patients receiving this acute treatment should be discussed with PICU/RSQ immediately for ongoing support and guidance.

Circulation

Currently there is not sufficient evidence to emphatically guide treatment of blood pressure. The target for BP should be within the normal range for age[6].

NORMAL BLOOD PRESSURE MEASUREMENTS – INFANTS AND CHILDREN Systolic Blood Pressure/Diastolic Blood Pressure (mmHg)				
Age	Boys		Girls	
	50th	95th	50th	95th
1-3 months	65-85/35-55		65-85/35-55	
3-6 months	70-90/33-65		70-90/33-65	
6-12 months	80-100/40-65		80-100/40-65	
1	80-89/34-37	98-106/54-58	83-90/38-42	100-107/56-60
2	84-92/39-44	101-110/59-63	85-91/43-47	102-109/61-65
3	86-95/44-48	104-113/63-67	86-93/47-51	104-110/65-69
4	88-97/47-52	106-115/66-71	88-94/50-54	105-112/68-72
5	90-98/50-55	108-116/69-74	89-94/52-56	107-113/70-74
6	91-100/53-57	109-117/72-76	91-98/54-58	108-115/72-76
7	92-101/55-59	110-119/74-78	93-99/55-59	110-116/73-77
8	94-102/56-61	111-120/75-80	95-101/57-60	112-118/75-78
9	95-104/57-62	113-121/76-81	96-103/58-61	114-120/76-79
10	97-106/58-63	115-123/77-82	98-105/59-62	116-122/77-80
11	99-107/59-63	117-125/78-82	100-107/60-63	118-124/78-81
12	101-110/58-64	119-127/78-83	102-109/61-64	119-126/79-82
13	104-112/60-64	121-130/79-83	104-110/62-65	121-128/80-83
14	106-115/60-65	124-132/80-84	106-112/63-66	123-129/81-84
15	109-117/61-66	126-135/81-85	107-113/64-67	124-131/82-85
16	111-120/63-67	129-137/82-87	108-114/64-68	125-132/82-86
17	114-122/65-70	131-140/80-89	108-115/64-68	125-132/82-86

Hypotension

Hypotension must be avoided to maintain cerebral perfusion pressure. In children the suggested target for blood pressure is at least >50th centile for age. This should be initially treated with bolus isotonic fluids. Blood pressure should be closely monitored with an arterial line when Inotropes are required. See CREDD for dosing.

Hypertension

In children with suspected or confirmed arterial or haemorrhagic stroke, the reduction of significantly and persistently elevated blood pressure can be considered at the direction of an intensivist.

If the decision is made to treat hypertension

- BP target should be <95th centile for age

- BP should not be lowered by more than 30% of the targeted drop in the first 8hrs unless there is a medical or surgical emergency.
- There should be close and ongoing monitoring of BP with use of an arterial line
- Hypotension must be prevented
- Long-acting agents should be avoided

Bed Position

If there are signs of raised intracranial pressure or brain herniation the patient should be nursed with the head of the bed elevated 30 degrees. Children with haemorrhagic stroke are most likely to present with these findings.

If an acute ischaemic stroke is suspected (without signs of raised intracranial pressure) evolving evidence suggests that the patient should be nursed with the head of the bed flat[11]. If the patient does not require intubation, but clinicians have concerns about aspiration risk, the patient should be placed in a lateral position.

Analgesia and Sedation

In acute stroke where the child is intubated and ventilated, sedation and analgesia are important components of neuroprotection. These agents reduce cerebral metabolic demand and are an essential therapeutic component of intracranial pressure therapy and targeted temperature management.

Pupil Checks

Pupillary assessment should occur 15 minutely until neuroimaging is complete, and the risks of raised intracranial pressure or brain herniation are further elucidated. Beyond this point, pupil checks may be able to occur hourly if the clinical situation allows.

Temperature

There are good biological reasons and supporting evidence in other paediatric cohorts to suggest fever may adversely affect neurological outcome after injury. Hyperthermia leads to a hypermetabolic state where the demand for oxygen and glucose is increased. In the setting of stroke (ischaemic or haemorrhagic), fever may lead to further injury. In all children with suspected or confirmed stroke, active steps should be made to treat hyperthermia (>37.5 degrees) via administration of paracetamol. Evidence is lacking regarding the effectiveness of prophylactic paracetamol in preventing fever in this setting.

In children with traumatic brain injury, therapeutic hypothermia (target temperatures <34 degrees) has not been shown to improve neurological outcomes above targeted temperature management (target temperatures 34-37 degrees). Currently therapeutic hypothermia in children with stroke should not be administered outside of clinical trials.

In children who are hypothermic, passive warming can be employed in critical care settings to slowly raise temperature to normothermia. There is limited but increasing evidence that active warming may cause harm.

Sodium

Both ischaemic and haemorrhagic stroke patients may have hyponatraemia (serum sodium <135mmol/L) due to syndrome of inappropriate anti-diuretic hormone (SIADH) or cerebral salt wasting syndrome (CSWS)[12].

Ideally for neuroprotection, the serum sodium should be 140-145 mmol/L. However, in virtually all cases an attempt to restore these levels should be achieved slowly with isotonic fluids. Severe hyponatraemia (serum sodium <120mmol/L) should be managed according to the guideline.

Please see CHQ-GDL-04112 Treatment of Severe Hyponatraemia in Children

Hypertonic saline is used in the treatment of raised intracranial pressure and brain herniation.

Glucose

Hypoglycaemia <3mmol/L should be treated with 2ml/kg of glucose 10%. Following this, an infusion of Glucose 10% + Sodium Chloride 0.9% at maintenance should be commenced.

CHQ-GDL-60024 Unexplained hypoglycaemia – Emergency management in children

Hyperglycaemia in stroke – tight glycaemic control is not recommended. If a decision is made to treat hyperglycaemia it should be closely supervised by the treating intensivist and should only occur in a critical care setting.

Fasting Status

Patients with suspected or confirmed stroke should be kept nil by mouth till swallowing status can be assessed.

Seizures

Seizures are a common clinical presentation, occurring in one-third to a half of children suffering stroke. Seizures/status epilepticus should be managed with standard hospital guidelines.

CHQ-GDL-60014 Status epilepticus – Emergency management in children

Prophylactic seizure treatments may be considered by the treating neurologist. Anticonvulsant loading with intravenous levetiracetam as per CREDD should occur in the event of seizures. Phenytoin loading may also be considered.

In suspected or confirmed ischaemic stroke, the neurologist should be notified of seizures. The neurologist may request information to differentiate seizures from signs of raised ICP e.g. decerebrate posturing.

Prolonged or recurrent seizures may herald stroke extension or recurrence, malignant middle cerebral artery infarction or haemorrhagic transformation and should therefore prompt urgent neurological/neurosurgical review.

EEG monitoring (standard or continuous) may be required.

References (Extract)

6. Medley T, Miteff C, Andrews I, Ware T, Cheung M, Monagle P, et al. Australian clinical consensus guideline: the diagnosis and acute management of childhood stroke. *Int J Stroke*. 2019;14(1):94-106.

11. Alexandrov AW, Shearin AJ, Mandava P, et al. Optimal Head-of-Bed Positioning Before Thrombectomy in Large Vessel Occlusion Stroke: A Randomized Clinical Trial. *JAMA Neurol*. Published online June 04, 2025. doi:10.1001/jamaneurol.2025.2253

12. Ehtesham M, Mohmand M, Raj K, Hussain T, Kavita F, Kumar B. Clinical Spectrum of Hyponatremia in Patients with Stroke. *Cureus*. 2019 Aug 2;11(8):e5310. doi: 10.7759/cureus.5310. PMID: 31592365; PMCID: PMC677345