



HEART &
STROKE
FOUNDATION

CANADIAN
Stroke
BEST PRACTICE
RECOMMENDATIONS

CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Summary of Pediatric Recommendations Across Modules

5th edition

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Canadian Stroke Best Practice Recommendations – Pediatric Recommendations

Introduction

Stroke happens at any age. Current rates for stroke in children are >1 in 2,500 live births (among newborns, defined as age 0 to 28 days), and 2-5 / 100,000 among children age 28 days to 18 years. Stroke in infants and children has become increasingly recognized and their care specialized in some areas of Canada. There are limited studies in the literature regarding care of children in the acute stages and in post-stroke recovery, but quality research is emerging.

The Canadian Stroke Best Practice Recommendations development process is to include guidance for specific subgroups, including pediatric patients, within each specific topic area where appropriate. Therefore, for topics where recommendations for children differ than adults (such as dosing of antiplatelets), additional pediatric-specific statements have been integrated into the recommendations for each module. At present, some of these additional statements are based on a moderate to strong evidence base, and in other cases it based on strong expert consensus.

This document is a summary of the pediatric recommendations that are currently included within each of the CSBPR modules. Readers should also refer to the full set of recommendations for each topic, as other recommendations exist that apply to all populations, and need to be considered along with these pediatric-specific recommendations to have a comprehensive understanding of comprehensive evidence-based stroke care across stages and settings.

SECONDARY PREVENTION OF STROKE¹

Section 3.0: Prevention – Blood Pressure and Stroke Prevention

3.2 Blood pressure management

Blood pressure should be managed in all patients to reach optimal control as follows:

- vii. For children, blood pressure should be targeted below the 95th percentile for age, height and gender [Evidence Level B].

Section 6.0: Prevention – Antiplatelet Therapy in Ischemic Stroke and TIA

- 6.0 All patients with ischemic stroke or transient ischemic attack should be prescribed antiplatelet therapy for secondary prevention of recurrent stroke unless there is an indication for anticoagulation [Evidence Level A].
 - v. In children with stroke the usual maintenance dosage of acetylsalicylic acid is 1 to 5 mg/kg per day for the prevention of recurrent stroke [Evidence Level B]. The usual maximum dose is 81 mg/day.
 - vi. The evidence for clopidogrel use in children is sparse at this time. Clopidogrel may be considered an alternative for adolescents at a dose of 1 mg/kg/day up to a maximum of 75 mg/day. Younger children may have higher anti-platelet effects of clopidogrel, and the suggested doses should be considered within the range of 0.2 – 0.5 mg/kg/day [Evidence Level C].

Section 10: Prevention – Sleep Apnea and Stroke

- 10.3 **Paediatric Considerations:** There is no direct evidence available to demonstrate a connection in children regarding sleep apnea and stroke. However, it is recommended that children with

stroke be screened for signs and symptoms suggesting sleep apnea [Evidence Level C], or conditions predisposing them to sleep apnea, such as obesity, sickle cell disease, severe strokes, or structural airway problems (e.g., enlarged tonsils) [Evidence Level C].

- i. Any child with suspected sleep apnea should be referred to a paediatric sleep specialist [Evidence Level C].

HYPERACUTE STROKE MANAGEMENT²

Section 2.0 Hyperacute: Emergency Medical Services Management of Acute Stroke Patients

Clinical considerations:

In regions with a specialized paediatric hospital every attempt should be made to transport children with symptoms of stroke to that specialized paediatric hospital.

Section 3.0: Hyperacute – Emergency Department Evaluation and Management

3.1 Initial Evaluation

- vii. **Seizure Assessment:** New-onset seizures at the time of an acute stroke, occurring either immediately before or within 24 hours of the stroke onset, should be treated using appropriate short-acting medications (e.g. lorazepam IV) if they are not self-limited [Evidence Level C]. Treatment may be required before completing hyperacute investigations for stroke, including imaging.
 - a. A single, self-limiting seizure occurring at the onset, or within 24 hours after an acute stroke (considered an “immediate” post-stroke seizure) should not be treated with long-term anticonvulsant medications [Evidence Level C].
 - b. Patients that have an immediate post-stroke seizure should be monitored for recurrent seizure activity during routine monitoring of vital signs and neurological status. Recurrent seizures in patients with ischemic stroke should be treated as per treatment recommendations for seizures in other neurological conditions [Evidence Level C].
 - ◆ Seizures are a common presentation with stroke in neonates and children. Consider enhanced or increased seizure monitoring in at-risk populations such as neonates, children with stroke and adults with otherwise unexplained reduced level of consciousness [Evidence Level C];
 - ◆ Electroencephalogram (EEG) monitoring may be appropriate in patients at high risk of seizures, such as neonates and children [Evidence Level C].

3.3 Cardiovascular Investigations

- iii. Perform an echocardiogram in patients where a cardiac cause of stroke is suspected, including in young adults and children who present with stroke, and when infectious endocarditis is suspected [Evidence Level C].

Table 3.2: Recommended Laboratory Investigations for Patients with Acute Stroke or Transient Ischemic Attack

Special considerations for young adults, children, and adults with stroke or TIA in absence of identified etiology and clinical suspicion of rarer causes of stroke, including venous thrombosis:

- ◆ Consider LP for CSF analysis (cell count and differential, protein, glucose, bacterial and viral cultures; possibly cytology/flow cytometry if CNS lymphoma is a consideration)
- ◆ Further genetic tests – CADASIL, Fabry's, MELAS
- ◆ Further blood tests – Lipoprotein (a), Homocysteine
- ◆ Brain biopsy (if vasculitis of the central nervous system or angiocentric lymphoma is a consideration)
- ◆ For patients with cerebral venous sinus thrombosis (CVST), consider additional coagulopathy screening, including protein C, protein S, antithrombin III, prothrombin gene mutation, factor V Leiden mutation. These tests to be completed after the acute phase of stroke (i.e. after three months or so, or as per Hematologist's advice).
- ◆ For patients on dabigatran prior to the index stroke event, consider including a thrombin time if available with rapid access to results

Section 8: Hyperacute – Early Management of Patients Considered for Hemicraniectomy

8.0 Hemicraniectomy should be considered in younger patients in the early stages of extensive (malignant) middle cerebral artery territory ischemic stroke [Evidence Level A].

8.1 Patient Selection

- i. Patients who meet the following criteria alone or in combination should be considered for hemicraniectomy [Evidence Level A]:
 - a. Patients over the age of 18;
 - b. Children under 18 years with progressive extensive (malignant) MCA syndrome [Evidence Level C];
 - c. Extensive (malignant) middle cerebral artery territory ischemic stroke with evidence of edema/mass effect;
 - d. Infarction size greater than 50% MCA territory on visual inspection, or an ischemic lesion volume greater than 150 cm³;
 - e. Worsening NIHSS, CNS, GCS, or PedNIHSS scale scores, or imaging indications of worsening edema at any time from presentation.
- ii. If patient location is initially outside a comprehensive stroke centre, patient should have expedited transfer to a tertiary or quaternary centre where advanced stroke care and neurosurgical services are available [Evidence Level C]

ACUTE INPATIENT STROKE CARE³

Section 1: Acute Inpatient – Acute Stroke Unit Care

- 1.1 Patients admitted to hospital with an acute stroke or transient ischemic attack should be treated on an inpatient stroke unit [Evidence Level A] as soon as possible; ideally within 6 hours of hospital arrival [Evidence Level C].
 - iv. Any **child** admitted to hospital with stroke should be managed in a centre with paediatric stroke expertise when available; if there is no access to specialized paediatric services, children with stroke should be managed using standardized paediatric stroke protocols [Evidence Level B].

Section 2: Acute Inpatient – Inpatient Management and Prevention of Complications

2.1 Cardiovascular Investigations

- iii. Children with stroke should undergo a comprehensive cardiac evaluation including echocardiography, as well as detailed rhythm monitoring if clinically indicated [Evidence Level B].

2.8 Seizure Management

- i. New-onset seizures in admitted patients with acute stroke should be treated using appropriate short-acting medications (e.g. lorazepam IV) if they are not self-limiting [Evidence Level C].
 - a. A single, self-limiting seizure occurring at the onset, or within 24 hours after an ischemic stroke (considered an “immediate” post-stroke seizure) should not be treated with long-term anticonvulsant medications [Evidence Level C].
 - b. Patients that have an immediate post-stroke seizure should be monitored for recurrent seizure activity during routine monitoring of vital signs and neurological status. Recurrent seizures in patients with ischemic stroke should be treated as per treatment recommendations for seizures in other neurological conditions [Evidence Level C].
 - 1) Seizures are a common presentation with stroke in neonates and children. Consider enhanced or increased seizure/electroencephalogram monitoring in at risk populations such as neonates, children with stroke and adults with otherwise unexplained reduced level of consciousness [Evidence Level C].

STROKE REHABILITATION⁴

Section 12: Rehabilitation – Pediatric Stroke Rehabilitation

12.1 Organization and Assessment for Stroke Rehabilitation

1.1 Assessment for Rehabilitation

- i. All children with stroke should have an initial assessment to determine the severity of stroke and rehabilitation needs, conducted by medical professionals as soon as possible after diagnosis [Evidence Level B].
- ii. Pediatric acute and rehabilitation stroke care should be provided on a specialized pediatric unit so that care is formally coordinated and organized [Evidence Level B].
- iii. Clinicians should consider standardized, valid assessment tools to evaluate the patient's stroke-related impairments, functional activity limitations, role participation restrictions, mood and behaviour changes, and environmental restrictions [Evidence Level C].
- iv. Individualized rehabilitation plans should be developed and regularly updated based on review of patient status and progress through developmental milestones [Evidence Level C]. Ideally, these reviews should take place annually.
- v. Once a child who has experienced a stroke has undergone assessments, the appropriate setting for rehabilitation (inpatient, outpatient, community, school, and/or home-based settings) may be determined [Evidence Level C].
- vi. At any point in their recovery, pediatric stroke survivors who have experienced a change in functional status, and those who would benefit from additional rehabilitation services, should be offered outpatient support [Evidence Level B].

1.2 Pediatric Stroke Rehabilitation Team

Note: Applicable for all stroke rehabilitation settings (acute care hospital, ambulatory clinic, community-based services and programs)

- i. Stroke rehabilitation should be delivered by a full complement of health professionals, experienced in providing post-stroke pediatric care, regardless of where services are provided, to ensure consistency and reduce the risk of complications [Evidence Level B].
 - a. The core team should include clinicians with expertise/core training in developmental pediatrics and pediatric stroke rehabilitation, including physicians (such as physiatrists and specialized pediatricians), occupational therapists, physical therapists, speech-language pathologists, nurses, social workers, psychologists, and dietitians [Evidence Level B].
 - b. The parent(s) and other family members are also included as part of the core team [Evidence Level C].
 - c. Additional team members may include recreation therapists, vocational therapists, educational therapists, childhood educators, child-life workers, kinesiologists, orthotists, and rehabilitation therapy assistants [Evidence level C].

12.2 Stroke Rehabilitation Therapy for Children

2.1 General Principles

- i. Children who have had a stroke should engage in training that is meaningful, engaging, repetitive and progressively adapted, age appropriate, task-specific and goal-oriented in an effort to enhance motor control and restore sensorimotor function [Evidence C].

- ii. Training should encourage the use of patients' affected limb during functional tasks and be designed to simulate activities of daily living appropriate to the patient developmental level [Evidence Level C].
- iii. Objective, functionally-relevant outcome measures should be applied before and after interventions and interpreted in a blinded fashion whenever possible to determine benefit for individual patients [Evidence Level C].
- iv. Therapy should be guided by functionally relevant goals determined by the child and family under the guidance of a knowledgeable therapist [Evidence Level C].

2.2 Specific Therapies for Arm and Hand

- i. **Range of motion** exercises (passive and active assisted) should be provided that includes placement of the upper limb in a variety of appropriate and safe positions within the patient's visual field [Evidence Level C].
- ii. **Hand and wrist splints** and other splints should be considered in appropriate patients, and be customized to individual patients [Evidence Level C]. A plan for monitoring these devices should be put in place.
- iii. **Traditional or modified constraint-induced movement therapy (CIMT)** should be considered for suitable pediatric patients with stroke with upper limb impairment to reduce motor impairment and improve upper extremity function [Evidence Level A].
- iv. **Functional Electrical Stimulation (FES)** may be considered to increase awareness of extremity, reduce motor impairment and improve upper extremity function [Evidence Level C].
- v. **Mirror Therapy** should be considered as an adjunct to motor therapy for select patients. It may help to improve grasp and pinch strength. [Evidence Level C].
- vi. Chemodenervation using **Botulinum Toxin Type A** may be considered to increase range of motion for patients with focal and/or symptomatically distressing upper limb spasticity or dystonia [Evidence Levels C].
- v. **Repetitive Transcranial Magnetic Stimulation (rTMS)** may be considered as an experimental adjunct to upper extremity therapy within a clinical trial [Evidence Level C].
- vi. **Surgical interventions** such as tendon repositioning to promote more functional joint mechanics should be considered in select patients [Level C].

2.3 Lower Limb Mobility

- i. **Range of motion** exercises (passive and active assisted) should be provided as well as physical activity and gait training to promote ambulation [Level C].
- ii. **Ankle-foot orthoses** and other splints should be considered in appropriate patients, and be customized to individual patients [Evidence Level C].
- iii. Chemodenervation using **Botulinum Toxin Type A** may be considered to increase range of motion for patients with focal and/or symptomatically distressing lower limb spasticity [Evidence Levels C].
- iv. **Surgical interventions** such as tendon repositioning to promote more functional joint mechanics may be considered in select patients [Level C].

2.4 Adaptive and Assistive Devices

- i. Adaptive devices including splints and orthoses designed to improve safety and function may be considered if other methods of performing specific functional tasks are not available or tasks cannot be learned [Evidence Level C].
- ii. The need for special equipment (such as wheelchair trays, walkers) should be evaluated on an individual basis. Once provided, patients should be reassessed as they grow and develop to determine if changes are required or equipment can be discontinued with the aim of achieving independent function [Evidence Level C].

12.3 Life Roles, Activities and Family Wellness

3.1 Return to School

- i. School age stroke survivors in the community will require ongoing assessment of educational and vocational needs throughout their development [Evidence Level C].
- ii. Resumption of education should be encouraged where possible and when appropriate [Evidence Level C].
- iii. School-aged children affected by stroke should receive educational rehabilitation and support services to assist with function and safety in the classroom, as appropriate, and individualized educational plans should be created when required to meet the needs of a child who has experienced a stroke [Evidence Level C].

3.2 Leisure Activity

- i. Children affected by stroke should be offered treatment aimed at achieving play and leisure related skills that are developmentally relevant and appropriate in their home, community, and school environments [Evidence Level C].
- ii. Children affected by stroke and their families should be offered information regarding leisure activities and adaptive programs in the community and/or be referred to relevant agencies. Use of peer support groups should be encouraged [Evidence Level C].

3.3 Family Wellness

- i. Simple educational interventions aimed at reducing or eliminating misplaced maternal guilt or parental blame should be provided [Evidence Level B]:
 - a. Parents, and mothers in particular, should be educated regarding the causes of perinatal and childhood stroke and that virtually none are preventable by the parents or otherwise [Evidence Level B];
 - b. Mothers should be directly and repeatedly reminded that they are not responsible: "This is not your fault" [Evidence Level B].
- ii. Families of children who have had a stroke should be offered information and support regarding:
 - a. adjustment to changes in physical needs of the child and possible increased dependency [Evidence Level B];
 - b. changes in social roles of family members, leisure activities, impact on other family members (e.g., living spouse or partner, other children), and potential resource issues [Evidence Level B].

TRANSITIONS OF CARE FOLLOWING STROKE⁵

Section 1: Transitions – Supporting Patients, Families and Caregivers Following Stroke

Box 1: Transitions of Care Checklist

Support for patient, families and caregivers may include

- Counseling, preparation and ongoing assessment for adjustment to change of living setting, change in physical needs and increased dependency, change in social roles and leisure activities, impact on other family members (e.g., living spouse or partner, **children**), loss of home environment, and potential resource issues

Section 4: Transitions – Community Reintegration Following Stroke

4.1 Physical and Psychological Health Management Following Stroke:

- iv. It is recommended that **infants and children** who have experienced a stroke have ongoing surveillance throughout their development, especially if new motor, language, behavioral or cognitive deficits emerge [Evidence Level B].
 - a. Developmental screening and assessments may include cognitive, motor, social, behavioral, emotional and physical aspects, as the full extent of stroke-related deficits may not become apparent until different ages and stages of development [Evidence Level C].

4.3 Reintegration to Social and Life Roles Following Stroke

A. Vocations

- i. It is recommended that patients be asked about vocational interests (i.e., work, school, volunteering) and be assessed for their potential to return to their vocations [Evidence Level C].
- iii. With consent from the patient and where possible, the healthcare team should work with employers/educators to devise an appropriate return to work/school plan at the request of an employer and/or person with stroke [Evidence Level C].
- v. It is recommended that **school age** stroke survivors in the community have ongoing assessments of educational and vocational needs [Evidence Level C].

B. Leisure Activities

- ii. It is recommended that patients who experience difficulty engaging in leisure activities receive targeted therapeutic interventions and individualized plans for participation in leisure activities based on collaborative goal-setting with their healthcare team [Evidence Level: Adult-Level A; **Pediatric-Level C**].
- iv. It is recommended that **children** affected by stroke be offered advice and treatment aimed at achieving play and leisure related skills that are developmentally relevant and appropriate in their home, community, and school environments [Evidence Level C].

Table 2: Patient Education Across the Continuum

Under 'Stroke Awareness and Action'

- Risk of stroke for all age groups from **newborns to children**, young adults and older adults

MOOD, COGNITION AND FATIGUE FOLLOWING STROKE⁶

Section 1: Mood, Cognition and Fatigue – Post-Stroke Depression

1.5 Pharmacotherapy for Post-Stroke Depression

- iii. No one drug or drug class has been found to be superior for PSD treatment. Side effect profiles, however, suggest that some selective serotonin reuptake inhibitors may be favoured in this patient population [Evidence Level A]. *Refer to Table 1B for a summary of suggested pharmacotherapy agents for the treatment of PSD.*
 - a. Choice of an antidepressant medication will depend upon symptoms of depression, potential known side effects of the medication, particularly in the child or older adult, drug interactions with other current medications and underlying disease conditions.

Section 2: Mood, Cognition and Fatigue – Vascular Cognitive Impairment

2.3 Other considerations related to Screening and Assessments

C. Age

- i. Effects of age or developmental stage must also be considered when deciding when and what to assess [Evidence Level C].
 - a. For example, in children with stroke, outcomes will evolve in parallel with development and deficits may not be fully realized until many years later [Evidence Level C].
 - b. In Young adults, decisions about what to assess should take into consideration age-specific goals such as educational and vocational needs [Evidence Level C].

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