



Original Article

Epidemiology, Clinical Presentation, and Prognosis of Posterior Circulation Ischemic Stroke in Children



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ABSTRACT

BACKGROUND: Anterior and posterior circulation strokes are often different in terms of presentation and recurrence risk, but there are few studies that focused on posterior circulation stroke. **METHODS:** We performed a longitudinal retrospective study of children, birth to 18 years, with posterior circulation ischemic stroke at the Children's Hospital Winnipeg from January 1992 to December 2012. Clinical and radiological features and outcomes were collected using standardized tools. **RESULTS:** Of the 158 children with arterial ischemic stroke, 23 (14.5%) children, 21 non-neonates, and 11 males were identified. For posterior circulation ischemic stroke, mean crude incidence of 0.38 and crude mortality rate of 0.11 per 100,000 person-years was estimated. The crude total period prevalence rate for the study period was estimated as 8.1 per 100,000 children. Nonspecific symptoms before stroke presentation were present in 38% and impaired consciousness in 71%. Identifiable risk factors were present in two thirds: vasculopathy 24%, infection 19%, trauma 14%, and congenital heart disease 9.5%. Average Pediatric National Institutes of Health Stroke Scale score at presentation was 11. Poor outcome was noted in 45%. Outcome did not change significantly between 12 and 24 months. Aboriginal ethnicity ($P = 0.01$), high Pediatric National Institutes of Health Stroke Scale score ($P = 0.001$), bilateral infarction ($P = 0.001$), and large caliber artery territory infarction ($P = 0.02$) predicted poor outcome. **CONCLUSIONS:** Our hospital-based incidence and outcome data provide valuable information to help direct treatment strategies and prognosticate children with posterior circulation ischemic stroke. Our study calls for close observation and early management of children with posterior circulation stroke, in particular with aboriginal ancestry and bilateral and large artery territory infarction.

Keywords: cerebrovascular disorders, ischemia, posterior circulation stroke, epidemiology

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Introduction

Limited data exist regarding incidence and prognosis of posterior circulation ischemic stroke in children. Childhood arterial ischemic stroke (AIS), involving both anterior and posterior circulations, has incidence ranging from 1.7 to 3 per 100,000 children per year.¹⁻⁴ Current literature indicates 15% to 22% of all pediatric AIS involve posterior circulation.^{5,6} In an international sample of children with AIS, 22% of children had posterior circulation involvement and 11% involved both anterior and posterior circulations.⁵ In adults, AIS involves posterior circulation in 25% (range 17% to 40%), with an annual incidence of 18 per 100,000 person-years.⁷⁻¹⁰ In

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children, available literature sheds more light on stroke presentation, topography, and mechanisms of posterior circulation stroke.^{5,6} Similar to adults, the clinical presentation of posterior circulation stroke in children is variable with nonspecific presenting symptoms, including ataxia, vertigo, vomiting, and altered consciousness. These atypical symptoms, combined with young age and inability to express symptomatology, are frequent causes of mistaken or delayed diagnosis of posterior circulation stroke in children.^{6,9,11-16} In addition, computed tomography (CT), the commonly used initial imaging modality in emergency departments and is inferior to brain magnetic resonance imaging (MRI) in demonstrating posterior fossa involvement.^{1,3,5,14,17} Cerebral CT and magnetic resonance angiographies are comparable in identifying vascular involvement in posterior circulation stroke but have their own limitations.^{3,5,6,18} Hence, conventional catheter angiography remains the gold standard for vascular imaging of both circulations.^{3,18,19}

Frequently noted adult risk factors for posterior circulation stroke, such as hypertension and atherosclerosis, do not apply to children.^{9,11} Risk factors seen in both adults and children include coagulopathies, vasculopathies, raised intracranial pressure, cardiac disease, and vasculitis.^{1,5,6,20,21}

Treatment of pediatric AIS is challenging owing to lack of randomized controlled trials and standard accepted approaches to treatment.^{21,22} Although it is not shown in children that anticoagulants have prognostic benefit for posterior circulation strokes, current practice is to use these agents in most instances of posterior circulation stroke.^{1,21,22} In addition, posterior circulation stroke patients manifest increased intracranial pressure, often limited to posterior fossa, owing to the crowded nature of this region. It, therefore, becomes imperative to closely monitor patients with posterior circulation stroke. Furthermore, posterior circulation stroke is known to frequently recur in the acute period, making clinical and radiological monitoring even more important.^{6,21}

Little is known about the outcome of posterior circulation stroke in children. deVeber et al.²³ identified predictors of outcome in a Canadian cohort of children using the validated pediatric stroke outcome measure (PSOM). AIS and venous thrombosis were analyzed separately, but outcomes specific to posterior and anterior circulations were not individually assessed. In a study by Ganesan et al.⁶ 55% children with posterior circulation stroke had no residual impairment at follow-up (range six months to 11 years) and recurrence was noted in more than 20%. A study by Mackay et al. provided radiographic data for 27 children with posterior circulation stroke. Their cohort was followed for 12 months after the initial event but clinical outcomes were not presented or correlated to the radiographic data. Intracranial magnetic resonance angiography diagnosis was available for 25 children and was abnormal in 16 (59%), with stable findings in 44% and radiological recurrence in over half of their cohort at six months follow-up.⁵ In adults, isolated posterior cerebral artery involvement²⁴ and the low National Institutes of Health Stroke Scale (NIHSS) score at presentation are linked to better outcomes.¹¹ The pediatric equivalent of NIHSS (PedNIHSS) is not yet shown to predict outcome in posterior circulation strokes specifically.^{25,26} The scarcity of pediatric

data for posterior circulation stroke indicates the need for further study, both in relation to radiographic features and separately from anterior circulation AIS.^{5,6,27-30}

Study objectives

We studied children with a confirmed diagnosis of posterior circulation AIS. The primary aim was to determine the hospital-based incidence and review the clinical characteristics and prognosis of posterior circulation stroke in children with the secondary aim to determine the clinical and radiological predictors of outcome.

Methods

We performed a longitudinal retrospective review of a consecutively enrolled cohort of children, birth to 18 years, at Children's Hospital Winnipeg, with a confirmed diagnosis of posterior circulation AIS. The study duration was from January 1992 to December 2012. The study was approved by the institution's Research Ethics Board.

For complete case ascertainment, study subjects were identified using multiple databases and disease code searches, including the International Classification of Diseases Ninth and Tenth Revision medical records discharge code searches (1992 to 2012) and the locally maintained Manitoba Pediatric Ischemic Stroke Database (2003 to 2012) at the Winnipeg Children's Hospital. All study subjects received medical care at the Children's Hospital Winnipeg, the only children's hospital in Manitoba. AIS involving the posterior circulation was defined by the presence of focal neurological deficit(s) of acute onset and neuroimaging evidence of focal parenchymal infarct(s) limited to the posterior circulation territory. The posterior circulation territory included the brain regions supplied by the vertebral arteries, basilar artery, posterior cerebral arteries, and their branches. The study neurologist (M.F.R.) and the study radiologist (J.W.) reviewed the patient hospital records, including all radiographic reports and films, to confirm and validate the diagnosis. Patients with unclear diagnosis of posterior circulation stroke and with presumed perinatal ischemic stroke were excluded.

Demographic and clinical data collected included age at stroke, gender, ethnicity, clinical symptoms at the time of presentation, including nonspecific symptoms before stroke presentation (vomiting, headache, and dizziness), focal sensorimotor symptoms (ataxia, paresis, speech, visual, and other focal deficits), seizures, altered consciousness, and the presence of associated symptoms (fever, blood pressure abnormalities, dehydration, sepsis, shock, and so forth), neurological examination findings at the time of presentation, severity of symptoms, risk factors (vasculopathy, intracranial/cervical trauma, surgery or tumor, congenital or acquired cardiac disease or intervention, prothrombotic and hematological disorders, and comorbid medical disorders), infarct and vascular characteristics (number and location of infarct, affected arteries, and arterial abnormalities), treatment received (thrombolytic, anticoagulant, or antiplatelet agents), stroke recurrence, and clinical outcome at 3, 12, and 24 months after index event. The PedNIHSS, validated for retrospective scoring, was used to retrospectively score stroke presentation severity (0 to 4, mild/minor; 5 to 15, moderate; and ≥ 15 , severe).²⁵ Recurrent stroke was defined as confirmed recurrent cerebral ischemic stroke event on neuroimaging, either with or without symptoms. Prognostic data were collected using the PSOM, validated for both prospective and retrospective scoring.³¹ For most patients, the prospective outcome data were already available from the aforementioned databases. Patients without available PSOM scores were retrospectively scored by review of their neurology clinic visit information (M.F.R. and S.C.). Outcomes were categorized as *good outcome* (PSOM ≤ 2) and *poor outcome* (PSOM > 2 or death).

At-risk children population for posterior circulation ischemic stroke in Manitoba was determined using the Statistics Canada censuses available online.³² To calculate the crude incidence rates for the present study cohort, methodology similar to the recently reported study from our center for cardioembolic stroke subtype was used.³³ Descriptive statistics were used to determine patient frequencies and characteristics. For assessment of predictors of outcome, the chi-square or Fisher's exact test (for cell count < 5) was used for categorical and nominal variables.

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