

Clinical Spectrum of Pediatric Stroke in The Children's Hospital and Institute of Child Health Faisalabad

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Abstract

Background: In different geographical regions, the clinico-etiological spectrum of childhood stroke varies widely, posing significant effects on children.

Objective: To determine etiology, types and symptoms of stroke in children presenting to the Children's Hospital & Institute of Child Health Faisalabad.

Methods: Retrospective analysis was conducted on 108 children who presented with a focal neurological deficit lasting more than 24 hours was done from September 2022 to September 2023. Children were diagnosed with a stroke after a comprehensive clinical history, neurological assessment, and neuroimaging results. Under the direction of imaging data and clinical presentation, investigations were carried out as needed to identify the stroke's underlying etiology.

Results From a total of 108 children, 57 (52.8%) were males and 51 (47.2%) were females. Mean age of the children was 5.08 ± 3.76 years. The most common mode of presentation was seizure 40 (37%) followed by visual disturbance in 24 (22.2%). The right side of the body was affected in 53 (49.1%) children, the left in 49 (45.4%) and bilateral in 6 (5.6%). Site of lesion in 40 (37%) children was frontal, followed by parietal and temporal in 22 (20.4%) children. Causes of strokes were vascular in 38 (35.2%) children, cardiac in 18 (16.7%) and CNS infection and hematological in 17 (15.7%) children respectively. Stroke was infarctive in 90.8% children.

Conclusion: Infarctive stroke is highly prevalent, and vascular etiologies are the most common cause of stroke in children. Frontal area of the brain is affected among significant number of children. Prompt intervention and a multidisciplinary strategy are essential for addressing these problems.

Key words: Hemorrhagic stroke, infarctive stroke, pediatric stroke, children, hospital.

Introduction

Pediatric stroke is characterized by an abrupt focal neurological impairment in a child persisting for over 24 hours until proven

otherwise. The etiology determines whether it is hemorrhagic or ischemic. The ischemic types are arterial ischemic stroke (AIS) and cerebral venous sinus thrombosis. Acute ischemic stroke (AIS) occurs when a small area of the brain is severely damaged by a lack of blood flow, specifically the anterior, middle, or posterior cerebral arteries or any of its branches. Intracerebral bleeding without trauma occurs in hemorrhagic stroke. Childhood ischemic arterial stroke is also common.¹

To address the critical factors contributing to morbidity and mortality the World Health Organization (WHO) investigated how gender and age influence stroke incidence and mortality rate. Cerebrovascular accidents are one of the top 10 causes of death in the pediatric populations with a reported incidence of 1 in 4,000 infants and 2,000 older children each year.² The annual incidence of AIS among newborns and children ranges from

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Authors Contribution

SGN conceptualized the project, did the data collection and statistical analysis. SGN, AB & AOV did the literature search. Drafting, revision & writing of manuscript were done by all authors.

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0.63 to 7.9 per 100,000 children.³ While the incidence of stroke has doubled in low- and middle-income nations over recent decades, it has declined by 40% in high-income countries.^{4,5} The research identified a significant tenfold disparity in both characteristics among nations, with higher values observed in low-income regions such as North Asia, Eastern Europe, Central Africa, and the South Pacific. The incidence of stroke varies by age, with neonates being the most frequently affected. Conversely, non-Hispanic white children exhibit the lowest risk of arterial ischemic stroke, while male children show a higher vulnerability overall.^{6,7}

Pediatric stroke is primarily caused by cardiac diseases, central nervous system infections, arrhythmias, sickle cell disease, iron deficiency, anemia, drug-induced disorders, autoimmune diseases, metabolic disorders, intracerebral vascular abnormalities, and aneurysms. Stroke symptoms include hemiparesis, hemiplegia, slurred speech, seizures, headaches, vision loss, balance issues, walking difficulties, dysphagia, mood changes, cognitive and personality changes.^{5,8} A study in Pakistan identified cardiovascular disease as the most significant and prevalent risk factor for pediatric stroke.⁹

Investigations for blood clotting include non-invasive methods like cranial ultrasound, blood tests, EEG, echocardiography, CT scan, MRI, MRA, and specific labs. Treatment includes supportive care, hydration, blood sugar control, seizures treatment, and intracranial pressure management. Treatment for stroke includes anti-coagulant therapy, low-dose aspirin, heparin or warfarin, surgical intervention, and interventional neuro-radiology.^{7,10} Children have a higher recurrence rate, and long-term therapy is needed for blood clot prevention.¹¹ Interventional neuro-radiology allows non-surgical diagnosis of A-V malformations and aneurysms by placing a catheter inside the blood vessel. Neuro-rehabilitation, including speech, physiotherapy, and occupational therapy, is performed after 4-6 weeks of stroke, resulting in a range of outcomes including cerebral palsy, epilepsy, and hemiparesis. There is a dire need to determine the clinical spectrum of pediatric stroke in Pakistan given the high prevalence of the condition.¹¹ This research aimed to delineate the clinical spectrum of stroke in pediatric patients at the Children's Hospital and Institute of Child Health (ICH), Faisalabad.

Methods

A retrospective study was conducted to evaluate data from the Department of Pediatric Neurology at The Children's Hospital, Faisalabad and ICH. The patients admitted to the hospital from September 2022 to December 2023 were included in the study. Data of 108 patients admitted from September 2022 to December 2023 was analyzed using non-probability sampling technique to recruit participants.

Children of both genders aged 1 month to 16 years were included if they presented with a focal neurological deficit lasting more than 24 hours and had neuroimaging findings consistent with a stroke. The pre puberty window was defined as 5 to 9 years. This is the stage before any visible signs of puberty. It generally occurs before age 8 and 9 in girls and boys respectively. There were fewer patients in the pre pubertal window in this study. The children with demyelination disorders or CNS tumors were excluded to ensure the sample consisted solely of stroke cases. Children were confirmed as having a stroke based on a detailed clinical history, neurological examination, and neuroimaging findings. Investigations were conducted as necessary to determine the underlying cause of the stroke, guided by clinical presentation and imaging results. Data was collected systematically using a structured performa designed for the study.

Arterial ischemic stroke was identified as ischemia resulting from the blockage of one or more arteries supplying the brain, confirmed radiologically through arteriography. Anemia is defined as reduction of the hemoglobin concentration below the reference range for healthy individuals of the same age and sex. For infants, anemia was classified as hemoglobin levels below 11 g/dL, and for children, levels below 8 g/dL. Iron deficiency anemia was diagnosed when serum ferritin levels were less than 12 µg/dL in children under 5 years of age and less than 15 µg/dL in those over 5 years. Mean corpuscular volume (MCV) was considered low when it was below 70 µm³ for all age groups. This methodology ensured a comprehensive assessment of stroke in the pediatric population, focusing on clinical presentation, associated conditions, and radiological findings, thereby facilitating a better understanding of stroke patterns in children at the study site.

Statistical analysis was performed using SPSS version 25. Continuous variables such as age were presented as mean and standard deviation, while categorical variables such as gender, stroke

type, and associated conditions were expressed as percentages and frequencies.

Results

A total of 108 children presenting with a focal neurological deficit lasting more than 24 hours were included in this study out of which there were 57 (52.8%) male and 51 (47.2%) female. The mean age of the children was 5.08 ± 3.76 years. Out of a total of 108, 57 (52.8%) were male and 51 (47.2%) were female. Regarding residence 72 (66.7%) children were from rural and 36 (33.3%) were from urban areas. Results of the study showed that apart from weakness most common presentation was seizures in 40 (37%) followed by visual disturbance in 24 (22.2%), behavioral change in 16 (14.8%), headache in 14 (13%) and fever in 13 (12%) children. Right-sided weakness occurred in 53 (49.1%) patients, left-sided in 49 (45.4%), and bilateral involvement in 6 (5.6%). The most frequent lesion site was the frontal region (37%), followed by parietal and temporal involvement (20.4%) as described in Table-1.

Table 1: Demographic Features of children.

Variable		n	%
Gender	Male	57	52.8
	Female	51	47.2
Residence	Rural	72	66.7
	Urban	36	33.3
Mode of presentation	Behavioral	16	14.8
	Fever	13	12.0
	Headache	14	13.0
	Seizure	40	37.0
	Visual disturbance	24	22.2
Weakness of body parts		108	100
Affected side of body	Bilateral	6	5.6
	Left	49	45.4
	Right	53	49.1
Area of brain involved	Basal	11	10.2
	Frontal	40	37.0
	Multiple	4	3.7
	Occipital	9	8.3
	Parietal	22	20.4
Temporal	22	20.4	

Chest X-ray findings were normal in 97 (89.8%) children, 6 (5.6%) showed cardiomegaly and 5 (4.6%) displayed boot shape. CBC was normal in 66 (61.1%), anemia was present in 41(38%) and polycythemia in only 1 (0.9%). ECG was normal in 98 (90.7%), LVH in 3 (2.8%) and RVH in 7 (6.5%) children. CSF analysis was not performed in 64 (59.3%) of children. Among those tested results were normal in 21 (19.4%) children, while findings were consistent with CNS infection in 20 (18.5%) and tuberculosis in 2.8%.

Causes of strokes was vascular in 38 (35.2%) children, cardiac in 18 (16.7%) and CNS infection and hematological causes in 17 (15.7%) children each. The stroke type was ischemic in 98 (90.7%) patients and hemorrhagic in 10 (9.3%) as shown in Table-2.

Table 2: Causes and Types of Strokes.

Variables		n	%
Causes of Strokes	Cardiac	18	16.7
	CNS infection	17	15.7
	Hematological	17	15.7
	Unknown	18	16.7
	Vascular	38	35.2
Type of Stroke	Hemorrhagic Stroke	10	9.3
	Infarctive Stroke	98	90.8

Discussion

Pediatric stroke (PS) is a relatively rare condition, with an estimated incidence of 2.5–13 per 100,000 children annually; however, it remains a leading cause of childhood mortality, with an estimated death rate of 0.6 per 100,000 per year.¹² PS is associated with significant morbidity and adverse long-term outcomes. It is gaining increasing attention due to its substantial socioeconomic burden and personal impact. Approximately half of survivors develop neurological or cognitive impairments, while over a quarter develop epilepsy.¹³ Survivors of pediatric stroke may experience lifelong disabilities in motor, speech, cognitive and behavioral functions. So knowledge about the range of preventable risk factors is crucial to prevent the mortality and morbidity related to pediatric stroke.¹⁴

This research examined the clinical presentation and variables associated with the occurrence of pediatric arterial ischemic stroke. A research done in India showed an equal prevalence of the condition amongst males and females.¹⁴ Consistent with previous studies reporting focal deficits in 80% and seizures in 15% of patients,¹⁵ our study identified hemiplegia and seizures as the leading clinical characteristics.

In line with previous findings, the middle cerebral artery was the artery most often affected. MRA is a crucial instrument in diagnosing cerebral arteriopathy and identifies regions of stenosis. The best method for ruling out the underlying cause in the future will be intracranial vascular wall imaging, which is particularly crucial if the cause cannot be identified in the heart or extracranial arteries.¹⁵

In the current study, cardiovascular etiology was found to be the most common cause of

pediatric stroke. Another study in Pakistan reported cardiovascular disease as the most common identifiable etiological factor for pediatric stroke.¹⁶ It was observed in the study that seizures were an extremely common mode of presentation in children with stroke. The frontal lobe was commonly involved, and vascular causes were the most prevalent. These findings align with previous studies.¹⁷⁻¹⁹

The first symptom may manifest as a prevalent issue, such as a headache or exhaustion, and the youngster may not express any complaints. Research indicates that the prevalence of pediatric stroke has almost doubled compared to previous decades.^{20,21} Numerous factors contribute to this, including improved survival rates in children with stroke risk factors like sickle cell disease, leukemia, and congenital heart disease, heightened awareness among patients and clinicians, and easier access to cutting-edge diagnostic and treatment tools.^{21,22}

Though stroke is rare in children but its multifactorial etiology and heterogeneity of clinical presentation makes it difficult to diagnose straight forward, so strong suspicion and methodical etiological survey is crucial to prevent its immediate and long-term morbidity. Childhood stroke is not uncommon in this country but lack of awareness about the presentation and probable etiology delays the diagnosis and ultimately complicates the outcome of disease, so it is very crucial to search the underlying etiology and probable risk factors of recurrence to prevent immediate and late complications.

Conclusion

The most common type of pediatric stroke is infarctive stroke which is mostly linked to vascular cause. Frontal area of brain is mostly involved leading to psychiatric changes affecting behavior. Prompt intervention and a multidisciplinary strategy are essential for addressing these problems.

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Availability of Data: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval: The Institutional Review Board of The Children's Hospital & The Institute of Child Health, Faisalabad approved the study via letter no. 72 dated 02/09/2023.

Conflict of Interest: None declared.

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