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Research Article

ETIOLOGICAL FACTORS, CLINICAL FEATURES OUTCOME AND NEUROLOGICAL IMAGING IN CHILDREN WITH ISCHEMIC STROKE

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Abstract:

Aim: The aim was to investigate the etiological factors, clinical features, neuro-radiological results in infants and children with ischemic stroke. **Study design:** This is a descriptive study. **Place and Duration:** In the Pediatric Neurology department of Mayo Hospital Lahore for one-year duration from January 2019 to December 2020. **Method:** The study included children with weakness, sensory convulsions or any focal deficit. All these children underwent computed tomography. People with evidence of myocardial infarction were examined for clinical features, etiologic factors and results. People with neurological infection, trauma, brain tumor and abscess were excluded from the study. SPSS 18 software was used for data analysis.

Results: The study included 30 patients. The age range was from two months to twelve years. The male-female ratio was between 3.3 and 1. Sixteen (53%) were between 6 and 12 years old, 12 (40%) were between 2 and 5 years old, and only 2 (6.6%) was less than one year old. Etiological factors were detected in 12 patients (40%), most of them had cardiac pathology, i.e. 10 (33.3%). There were 2 (6.6%) patients with protein C and S deficiency and no predisposing factor was detected in 18 (60%) patients. The clinical picture was examined and 29 (96.6%) patients with hemiparesis were found. Fifteen children (56%) had facial weakness. While 16 (53.3%) patients had convulsions, 11 (13%) were unconscious. Thirteen (43%) were hectic at the time of application. There were seven (23%) difficulty swallowing, 4 (13.3%) headaches and only 3 (10%) vision problems. Central cerebral artery infarction was more common in 19 cases (63.3%). Anterior cerebral infarction was in 4 (13.3%), and only 2 (6.6%) had posterior cerebral infarction. Complications were also studied in these patients. Eighteen patients (60%) had seizures. Nine (30%) developed mild or severe chest infections, and 10 (33.3%) later developed urinary tract infection. Weight loss was observed in 11 patients (36.6%). The result was tested using Glasgow Coma Scale. Ten (33.3%) patients gave good results, 14 patients (46.6%) had moderate disability, and 4 patients (13.3%) had severe disability, 2 (6.6%) died. **Conclusion:** Ischemic stroke has been found to be not uncommon in Pakistani children. Heart disease is the most important and avoidable factor predisposing to ischemic stroke. Every effort should be made to diagnose and treat congenital heart disease as soon as possible. Middle cerebral artery infarction is the most common infarction. Computed tomography turned out to be a very useful and sensitive test in the diagnosis of ischemic infarction. If possible, brain imaging should be performed in children with suspected stroke. Although the mortality rate was low, the survival rate among survivors was quite high. Because this is a hospital trial and may not represent a general pediatric age group, large-scale population studies for the future should be planned.

Key words: ischemic stroke, children, computed tomography.

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INTRODUCTION:

Ischemic stroke in children is defined as the interruption of blood supply to any part of the brain, which causes tissue death and loss of brain function. Childhood paralysis is becoming a common and serious disorder. In contrast to adult stroke, the study of stroke in children is at a very early stage in research, and there are currently no randomized controlled trials other than sickle stroke. The frequency of ischemic strokes in children exceeds 3.3 per 100,000 children per year, more than twice as expected in recent years. Significant progress has been made in the diagnosis, prevention and treatment of stroke in children¹. The etiologies observed in this age group differ from those commonly observed in adults. Cardiac disorders and hemoglobinopathy are the most common causes of ischemic infarction. In children with interstitial bleeding, various congenital abnormalities or disorders of coagulation and platelet function are often found in the blood vessels². The role of infection and causes of inflammatory stroke is much more important in children than in adults. Cerebral embolism usually occurs acutely with a sudden loss of neurological function. The blood clot can also cause subacute or stuttering with transient ischemic prodromal attacks³. Signs and symptoms depend on the location and size of the occluded vessel, as well as the age of the patient. Exudate from the anterior circulation occurs much more often than from the back, and the left hemisphere is more often affected than the right. Two-thirds of children with acute half-life, convulsions, facial paralysis, visual impairment, drowsiness and coma. Infants may not have clinical symptoms or profound motor weaknesses⁴.

Advances in neuroimaging as well as laboratory and genetic testing have increased the identification of stroke subtypes and predisposing factors. Computed tomography (CT) and magnetic resonance imaging (MRI) helps to better diagnose and solve this problem, providing reliable non-invasive methods for studying stroke in children. Magnetic resonance angiography (MRA) is sensitive enough to provide adequate initial assessment of childhood arterial brain disease. Cerebral angiography is usually indicated if the exact diagnosis is not based on an MRI⁵. The prognosis for childhood paralysis is variable and depends mainly on the underlying etiology. In the United States, mortality from children in stroke has fallen significantly over the past 20 years⁶. It is important to identify the primary predisposing factors for children because most risk factors are treatable and reduce the risk of another stroke⁷. Currently, data on paralysis in infants and children is limited. In this study, etiologic factors, clinical features, neuroimaging abnormalities and long-term stroke outcomes in children were determined.

MATERIAL AND METHODS:

The study was held in the Pediatric Neurology department of Mayo Hospital Lahore for one-year duration from January 2019 to December 2020. The study was conducted on 30 patients aged over 4 months and under 12 years, including both sexes. These patients were selected based on the history of myocardial infarction, clinical features and computed tomography results. People with signs of injury or infection were excluded from the study.

Patients were examined on the basis of a form containing complete biological data of the child, such as name, age, gender and length of hospital stay. Symptoms such as headache, fever, weakness, and change in sensation, convulsions, vision problems, speech or swallowing problems have been studied. The result of Glasgow coma in patients was achieved to reach a conscious level. A full neurological examination was observed, such as motor weakness, reflexes, planters and cranial nerve palsy. Fundoscopy was performed to detect papilloma edema. An examination of the rest of the system is also documented. Studies involving the results of brain computed tomography were observed in the infarct region. To determine the etiological factors, various studies were performed, including complete blood count with red blood cell count, echocardiography for the underlying structural heart problem, C and S protein levels, antinuclear antibody, rheumatoid factor, ASO for autoimmune problem. . Therapy was used in these patients. The follow-up time for these patients ranged from three to six months, and the result was based on the Glasgow coma score.

COMMA GLASGOW RESULTS SCALE

CLASS V: Good recovery, resumption of normal life.

CLASS IV: Moderate disability, disabled but independent.

CLASS III: Severe disability due to daily support.

CLASS II: Herbal, insensitive and non-verbal condition.

CLASS I: Death.

Various variables are age, gender, etiological factors and neurological state at the time of admission, C.T. screening results and Glasgow coma scale results. The disease studied was ischemic stroke in children, which was defined as interruption of blood flow to any part of the brain, resulting in tissue death and loss of brain function. Data was introduced in SPSS 18, and descriptive statistics were used to calculate clinical characteristics, etiologic factors, neuroimaging and frequency of results. All children who meet at least one of the following criteria are included.

- Over four weeks and less than twelve years.
- Weakness of one or more limbs.

- Cranial nerve palsy.
- Altered sensorium.
- Fits. Any focus signs.
- CT / MRI compatible with myocardial infarction.

Children whose computed tomography was compatible with a tumor, tuberculosis or brain abscess, tuberculous meningitis, head injury and CNS infection.

RESULTS:

Forty patients had symptoms and signs in line with stroke. Computerized brain tomography was performed on all patients. These 30 patients were included in the study. Ten patients were excluded from the study because they had a hemorrhagic stroke or signs of a central nervous system infection. Among them were twenty-three men and seven

women. The male-female ratio ranged from 3.3 to 1. The age range ranged from two months to twelve years. The average age was seven years. Many, i.e. 16 (53%) were between 6 and 12 years old, 12 (40%) were between 2 and 5 years old, and only 2 (6.6%) were less than a year old.

Basic etiologic factors were detected in 12 (40%) patients, most of them had cardiac pathology, i.e. 10 (33%). Congenital cyanosis occurred in 6 (20%) of them and 4 (13%) had congenital or acquired cyanosis as a rheumatic heart disease. There were 2 (6.6%) patients with C and S deficiency. None of the children had sickle cell disease or any autoimmune disease. No predisposing factor was detected in 18 (60%) patients, but patients were not evaluated for any unusual disorders, e.g. MELAS syndrome, Moyamoy's disease, homocysteine urea and post varicella syndrome (Table A).

Table A: Etiological Factors of Ischemic Stroke in Children.

No.	Etiological Factors	No of Patients
1.	Idiopathic	18 (60%)
2.	Congenital Heart Disease	10 (33.3%)
3.	Protein C&S Deficiency	2 (6.6%)

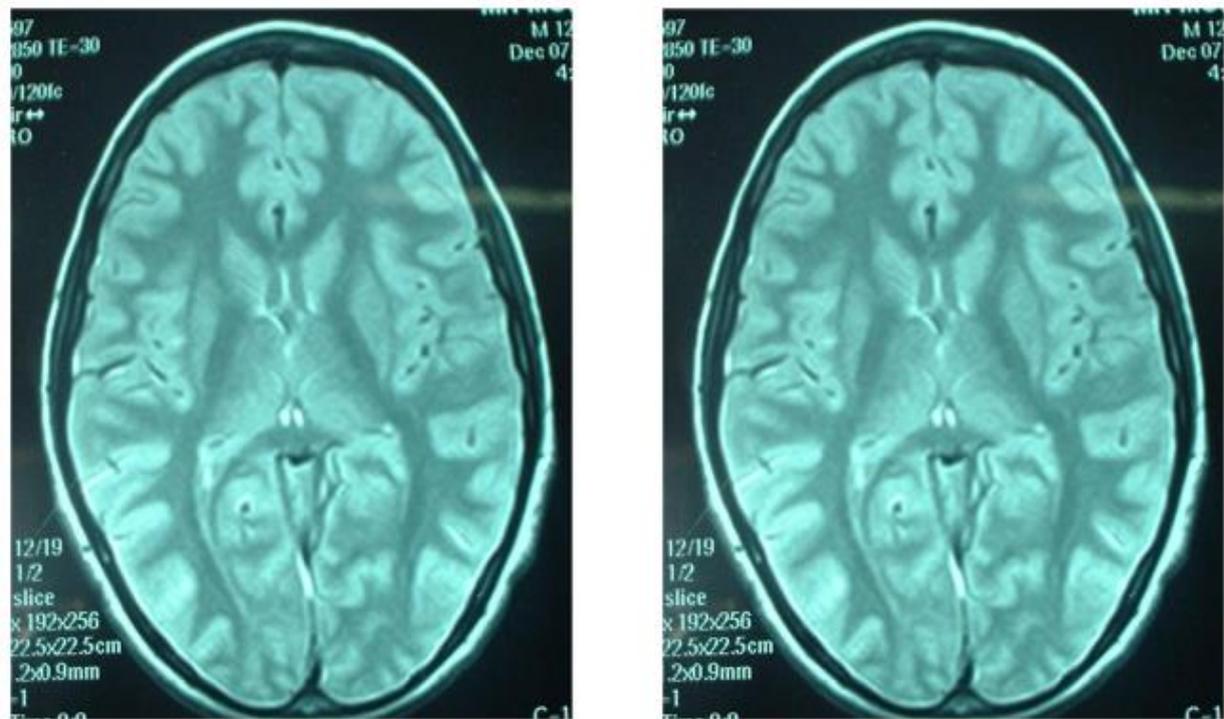
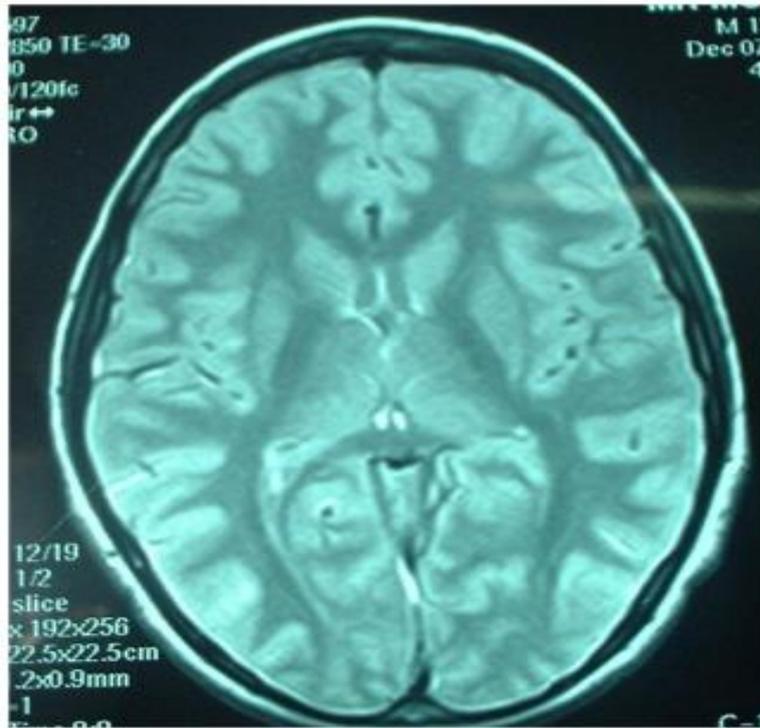


Fig. 1: T2 weighted MRI Image : Normal Anatomy of Brain.

Hemiparesis was found in 29 (96.6%) children with different clinical features. Fifteen children (56%) had facial weakness. While seizures occurred in 16 (53.3%) patients, 11 (13%) were unconscious on arrival at the hospital. Thirteen (43%) were hectic at the time of application. There were seven (23%) difficulty swallowing, 4 (13.3%) headaches and only 3 (10%) vision problems (Table B and Figure B).

Table B: Clinical Presentation of the Patients with Ischemic Stroke.

Clinical Presentation	No of Patients
Hemiparesis	29 (96.6%)
Seizures	16 (53.3%)
Cranial nerve palsies	15 (50%)
Fever	13 (43.3%)
Unconsciousness	11 (36.6%)
Dysphasia	7 (23.3%)
Headache	4 (13.3%)
Visual Disturbances	3 (10%)

**Fig. 2:** MRI brain showing normal anatomy of intracranial structures.

All patients underwent brain computed tomography to find the infarction. Central cerebral artery infarction was more common in 19 (63.3%), 8 (26.6%) had central cerebral artery infarction, 7 (23.3%) had right central cerebral artery infarction and 4 (13.3%) central cerebral artery. He had a bilateral infarction. Anterior cerebral infarction was 4 (13.3%), and only 2 (6.6%) had posterior cerebral infarction (Table C).

Table C: C.T. Scan Findings.

Artery Involved in Infarction	Number of Patients
Middle Cerebral Artery	19 (63.3%)
Lenticulo Striate Artery	5 (16.3%)
Anterior Cerebral Artery	4 (13.3%)
Posterior Cerebral Artery	2 (6.6%)

Complications were also studied in these patients. Eighteen patients (60%) had seizures. Nine (30%) developed mild or severe chest infections, and 10 (33.3%) later developed urinary tract infection. Weight loss was observed in 11 patients (36.6%). Patients were followed up for three to six months and their results were evaluated. During follow-up, 10 patients (33.3%) gave good results (grade 5 as a result of Glasgow). Moderate disability occurred in 14 (46.6%) patients (grade IV according to Glasgow score). Four patients (13.3%) had severe disability (grade

III in Glasgow results). None of the patients was in a vegetative state (Glasgow Score Score, class II). Two (6.6%) patients died (grade I according to the Glasgow result). (Table D).

Table D: Outcome of Ischemic Stroke in Children.

Neurological Grade	No of Patients
5. Good	10 (33.3%)
4. Moderate Disability	14 (46.6%)
3. Severe Disability	4 (13.3%)
2. Vegetative	0
1. Death	2 (6.6%)

DISCUSSION:

Although published literature on Pakistani children is rare, stroke in children is not a rare disease. This study was conducted to determine the incidence, etiology and outcome of ischemic stroke in children. Our study found that ischemic stroke is common among young people between the ages of 6 and 12 compared to young people. These data can be compared with other studies. The etiology appears to be multifactorial in ischemic stroke. Thanks to the presence of more sophisticated laboratory tests, it will be found that more and more children have hidden pathologies. These tests may not be possible for all patients due to the lack of patients or limited financial resources of the facilities. While in our study about half the patients could find the causes, De Veber G et al⁸. A study from the Middle East showed that 65% of children with ischemic stroke have some predisposing causes. Heart disease proved to be the most common cause of ischemic stroke. In our study, about a third of children had congenital or acquired heart disease. Thrombosis and embolism are the cause of artery obstruction and cell death. In a study by Solman GC in 1978, about half of children with stroke had heart disease⁹. Recent studies have shown that around 20% of patients have heart disease. In Western countries, management of congenital heart defects has been significantly improved, resulting in a reduced rate of ischemic stroke in heart patients. In Pakistan, asymptomatic congenital heart disease may remain unrecognized for several years. Even if they are diagnosed early, they are not treated quickly because of financial constraints and healthcare that is not available to everyone¹⁰. Another important reason in our research is hypercoagulation due to the lack of natural anticoagulants of C and S proteins. Deficiency of protein C and S is a rare deficiency. In most studies, people studying its effect on ischemic stroke were not strong enough to identify it as the cause. For this reason, the role of this thrombosis factor in pediatric ischemic stroke is controversial today and is still an active area of research¹¹.

Children with sickle cell anemia are particularly sensitive, with a 200-fold increased risk of stroke. 1/3 of these children with sickle cell disease have a stroke at the age of 8 years. 12% of them manifest

as clinical stroke. It is associated with over 20% of stroke patients equal to heart disease. In our study, no patient had sickle cell disease because it was very rare in the Asian population. However, Islamabad has had a stroke in children with thalassemia¹². The presentation of ischemic stroke varies depending on the occlusion site. Hemiplegia was the most common feature in almost all patients except one who had a posterior cerebral artery infarction. Most heart attacks occurred in the middle cerebral artery, so facial weakness was associated with hemiparesis. This function can be compared with other studies. Other features of the presentation were not specific or due to focal neurological damage, such as vision problems or swallowing problems. Others have reported similar results¹³. In our study, the middle cerebral artery infarction was the most common and occurred much more frequently in the first stroke. Because the middle cerebral artery is a direct terminal branch of the internal carotid artery, it is therefore the most common occlusion region¹⁴. This area covered almost the entire lateral surface of the motor region, the cerebral hemisphere, so most patients showed hemiparesis and facial weakness. Koga M et al. In a study carried out by obstruction of the middle cerebral artery and its branches, this is the most common type of infarction. An isolated posterior cerebral artery infarction is a very rare condition with blindness because it has a short course. Libman et al. Anterior and posterior cerebral arteries have been reported to be a rare site for obstruction. Secondary complications were mainly due to illness or immobilization or hospitalization. Convulsions develop due to a heart attack in others, although they have characteristic features in some patients. Other complications include chest infection, urinary tract infection and weight loss due to inadequate nursing care¹⁵.

Long-term results range from complete recovery to severe disability. While a third of patients recovered without disability, about half of the patients had moderate disability, and only a few had severe disability. The mortality rate was less than 1%. There was no significant relationship between the prognosis of childhood paralysis and the etiology, age of use or gender. In a Canadian study negative

results were observed in 2/3 of survivors, recurrence in 20% and neurological deficiencies. Bjornstad A et al., None of the patients died of ischemic stroke; 27% were completely healed, 41% had benign follow-up, 18% had benign follow-up, and 18% had relapse, Carvalho KS and colleagues reported good prognosis comparable to our study.

CONCLUSION:

Ischemic stroke has been found to be not uncommon in Pakistani children. Heart disease is the most important and avoidable factor predisposing to ischemic stroke. Every effort should be made to diagnose and treat congenital heart disease as soon as possible.

Middle cerebral artery infarction is the most common infarction. Computed tomography turned out to be a very useful and sensitive test in the diagnosis of ischemic infarction. If possible, brain imaging should be performed in children with suspected stroke.

Although the mortality rate was low, the survival rate among survivors was quite high. Because this is a hospital study and may not represent the general age group of children, large-scale population studies should be planned for the future.

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