ISCHEMIC PEDIATRIC STROKE: CLINICAL AND RADIOLOGICAL FINDINGS

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ABSTRACT

Background: Children presenting with acute hemiplegia/ hemiparesis can be diagnostically challenging. Causes of acute cerebrovascular stroke in children are diverse and more complex than those in adults. Stroke is more common than brain tumors in children. **Objectives:** To identify clinical presentation and role of diagnostic radiology in early detection of cases with ischemic stroke. **Patients and Method:** Forty patients were enrolled in this descriptive study(1months to 12 years of age) who presented with acute onset of sudden neurological deficit. All patients were admitted in Al-Hussein and Sayed-Galal University Hospitals over aperiod of 8 months from February 2016 to September 2016.All patients were submitted for full history taking and complete neurological examination. Also, patients were investigated by C.T. scan and MRI. **Results:** We studied 40 cases, 28 males and 12 females. Their ages at presentation ranged from 1 month to 12 years. Hemiplegia/paresis was the most common clinical picture present in all patients; right sided were 25 cases (62.5%) and left sided were 15 cases (37.5%). Upper motor neuron facial palsy, seizures and disturbed level of consciousness all were observed in 13cases (32.5%). Aphasia was founded in 10 cases (25%), and headache was observed in 6 cases (15%).The present study revealed that cardiac diseases congenital acquired were the most frequent risk factors identified in this study (17/40- 42.5%) followed by hematological ones (13/40-32.5%). **Conclusion:** Hemiplegia was the most presenting symptom. Cardiac disorders were the most prevalent risk factor. Magnetic resonance imaging with diffusion weighted is the best imaging modality for early diagnosis of ischemic cerebrovascular accident.

Key words: Cerebrovascular accidents - Arterial ischemic stroke.

INTRODUCTION

Stroke is defined as a clinical syndrome of rapidly developing focal or global disturbances of brain function lasting more than 24 hours or leading to death with no obvious nonvascular cause. This definition should be integrated by a reference to neuroimaging **(Ciccone et al., 2011).**

Stroke is a major cause of disability and death. It can have devastating consequences for families and enormous costs to

society. Stroke is more common in children than brain tumors. Numbers of children suffering from stroke will die. As a result, many survivors are left with significant neurological disabilities, learning difficulties or seizures **(Mackay and Gordon, 2007).**

In pediatrics, the diagnosis of stroke is frequently delayed or missed. This is due to subtle and non specific clinical presentation, a complicated differential diagnosis and a lack of awareness by primary care pediatric physicians. The acute onset of a focal neurological deficit is stroke until proven otherwise **(De veber and Kirkham, 2008).**Arterial ischemic stroke is reported to be more common than hemorrhagic stroke in children **(Lynch et al., 2013).**

The incidence for pediatric stroke has increased, and is attributed to the increase in sensitivity and specificity of noninvasive imaging methods, i.e. C.T. scan that can demonstrate larger mature stroke and exclude hemorrhage. **(De veber and Kirkham, 2008).**

The aim of this work was to identify clinical presentation and risk factors of cerebrovascular accident in a cohort of acutely ill children with a sudden neurological deficit, and to assess the role of diagnostic radiology in early detection of cases with ischemic stroke.

PATIENTS AND METHODS

Forty patients were enrolled in descriptive cohort study. All were admitted from pediatric emergency room and pediatric neurology patient clinic, Al-Hussein and Sayed-Galal University Hospitals over period of 8months from February 2016 to September 2016. They were twenty eight males and twelve were females at age group from 1months to 12 years.

The ethical committee of Faculty of medicine, Al-Azhar University approved this study. A written consent was taken from all patients.

Inclusion Criteria: Patients aged from 1 month up to 12 years old with acute onset of neurological deficit.

Exclusion Criteria:

1. Patients below 1 month and above 12 years old.

2. Patients who developed stroke in association with CNS infections and trauma. In addition, patients with perinatal and neonatal stroke, epilepsy, birth asphyxia, ADEM, and those with hemorrhagic strokes.

All patients were subjected to the following:

Full history taking with special emphasis on the onset of stroke, distribution of the weakness, other presenting symptoms such as facial involvement, seizures, aphasia and vomiting, history of previous similar attacks or history of a chronic systemic illness.

Careful clinical examination was performed to evaluate the state of their neurologic condition with special emphasis on conscious level, cranial nerves examination, muscle tone, muscle power and reflexes in both upper and lower limb, sensory system and as well for evidence of systemic illness.

Baseline investigations included testing for complete differential blood count, C-reactive protein (CRP),erythrocyte sedimentation rate(ESR), prothrombine time (PT), partial thromboplastine time (PTT), blood glucose, serum electrolytes, chest radiography, electrocardiogram, and echocardiogram. Antithrombin III, protein S and protein C deficiencies (Sysmex CE 1500) were done for all patients.

Radiological investigation.
MRI Technique: All patients needed sedation during imaging. Sedation by 10%chloral hydrate (500mg/5ml syrup and dose was 40 mg/kg) was given .while I.V. diazepam (10mg/2ml ampoule by slow intravenously, and dose was 0.2mg /kg) given to hyper alert children. MRI, MR with diffusion weighted, MRA and MRV techniques were performed on 1.5 Tesla unit (cheva 1.5 tesla, Philips Medical systems) using a head coil. MRA and MRV were done to all patients.

Statistical Design: Data collected were reviewed. Coding of the collected data was done manually. These numerical codes were fed to the computer where statistical analysis was done using the statistic package for social science version 22 (SPSS 22) for windows.

Chi-square-test was applied for comparison of qualitative data. The data were considered significant if p value was equal to or less than 0.05.

RESULTS

The present study included 40 children presenting to Al-Hussein and Sayed-Galal University Hospital over 8 month period, between February 2016 and September 2016 with acute onset of focal neurological signs (mainly hemiplegia/ paresis).

Table (1): **Age and gender distribution of ischemic cerebrovascular stroke patients presenting with acute hemiplegia**.

Parameter \ Count	NO	%
Age<1yr.	12	(30%)
1-5	18	(45%)
>5yr.	10	(25%)
Mean ± SD		3.53 ± 3.16
Gender Male	28	(70%)
Female	12	(30%)

This table show that patients included in this study were 28 male (70%) and 12 females (30%). Their mean age at time of presentation was 3.53 ± 3.16 years (ranged between 3 months to 11.58 years.

Table (2):Clinical Presentation in studied children.

Symptoms	No. of cases	%
Right hemiplegia	25	62.5
Left hemiplegia	15	37.5
Seizures	13	32.5
Disturbed conscious level	13	32.5
Cranial nerve affection	13	32.5
Aphasia	10	25
Vomiting	9	22.5
Hemianesthia	8	20
Headache	6	15

This table show that the most frequent clinical manifestation was hemiplegia and hemiparesis (40 cases -100%). The right sided was in 25 cases (62.5%), and the left sided in 15 cases (37.5%). Other different signs and symptoms that the patients presented

with seizures were all forms and mainly focal in 13 cases (32.5%), i.e. disturbed conscious level ("lethargy" in 5 cases, "confusion" in 6 cases, "deep coma" in 2 cases). Cranial nerve affection was in 13 cases (32.5%): (UMN facial palsy in 12 cases (30%), and bulbar affection "dysphagia" in 1 case (2.5%)). Aphasia was in 10 cases (25%), vomiting in 9 cases (22.5%), hemianesthia in 8 cases (20%), headache in 6 cases (15%) (7.5%).

Table (3): Risk factors of acute ischemic cerebrovascular stroke in this study.

Risk factors	No	%
Cardiac diseases	**17\40**	**42.5%**
Cardiac septaldefects "ASD-PFO-VSD"	4\17	23.5%
Rheumatic valvular heart diseases	3\17	17.6%
Infective endocarditis	3\17	17.6%
Fallot's tetrology	3\17	17.6%
Atrial fibrillation	2\17	11.8%
Dilated cardiomyopathy	1\17	5.9%
Epstein anomalies	1\17	5.9%
Hematological diseases	**13\40**	**32.5%**
Protein C deficiency	4\13	30.8%
Sickle cell diseases	3\13	23%
Protein S deficiency	2\13	15.4%
Polycythemia	2\13	15.4%
Anti-phospholipid, anticardiolipin antibodies deficiency	1\13	7.7%
Antithrombin III deficiency	1\13	7.7%
Hypernatremic dehydration	**3\40**	**7.5%**
Metabolic disorders "Homocystienuria"	**2\40**	**5%**
Undetermined	**5\40**	**12.5%**

This table show that cardiac diseases "congenital –acquired" were the most frequent risk factors identified in this study (17/40- 42.5%) followed by hematological ones (13/40- 32.5%).

Table (4): Neuroimaging diagnostic findings within 24 hours (n= 28) of neurological onset.

Neuroimaging techniques	No. of cases done	+ve findings	%	P value
CT scan	28	15	(53.57%)	
MRI	28	22	(78.57%)	0.018
DWI	28	28	(100%)	

This table show that there was a significant difference between CT and MR with diffusion weighted "DWI". MR with diffusion weighted "DWI" revealed acute ischemic cerebrovascular stroke especially in the first 24 hours of the sudden neurological onset.

Table (5): Neuroimaging relevant diagnostic findings after 24 hours (n= 12) of neurological onset:

Neuroimaging techniques	No. of cases done	+ve findings	%	P value
CT scan	12	8	(88.88%)	
MRI	12	11	(91.66%)	0.9699 (NS)
DWI	12	11	(91.66%)	

This table show that the diagnostic values of CT, MRI and DWI after 24 hours of stroke onset, where they appeared nearly equal. 3 patient presented to us with their C.T brain.

T2-weighted, axial magnetic resonance imaging of a 3-year-old male with sickle cell anemia. Multiple focal hyperintensities (arrows) are revealed in the deep white matter of both cerebral hemispheres, indicating small white matter infarcts.

DISCUSSION

Childhood ischemic stroke is a complex condition with many risk factors. Stroke is a major cause of disability and death. Stroke is more common in children than brain tumors. Forty patients were enrolled in the descriptive cohort study.

About half of the cases (45%) of the present study developed stroke between the age of 1 and 5 years with the mean age at presentation was 3.5 ± 3.16. This was in agreement with **Mackay et al. (2011) and Muwakkit et al. (2011)**who observed that the mean age of stroke was 3.2, 3.7 and 4.6 years, respectively.

Our study showed a male pre-dominance (70% of the studied cases). This was in agreement with **Rasul et al. (2009), Mackay et al. (2011) and Muwakitt et al. (2011)**who reported male predo-minance in 59%-73.3%. However, other investigators reported nearly equal distribution between both sexes **(Lynch et al., 2013, Gobken et al., 2007, Suppiej et al., 2008, and Djordjevic et al., 2009).** Hormonal factors may play a role in this gender disparity. Estrogens havepotent effects on endothelia that promote dilation of blood vessels and therefore may offer females protection against stroke **(Mallick and O'Callaghan, 2009).**

Previous studies noted that hemiparesis and seizures were the most common presenting manifes-tations in pediatric patients with stroke. In their study, on children with stroke, investigators have reported hemiparesis as the main clinical presentation at onset of stroke in 85%-98.4% of patients **(Lee et al., 2008**; **Rasul et al., 2009; Incecik et al., 2010; Mackay et al., 2011; and Muwakitt et al., 2011)**, while seizures were recorded in 19.3% - 33.3% in the studies of**Gobken et al. (2007), Mackay et al.(2011) and Muwakkit et al.(2011).** Additionally**, Mackay et al. (2011)** reported disturbed level of consciousness in38% and 42% respectively, compared to the findings in 32.5% of our cases. Other reported clinical manifesta-tions including aphasia in almost 19% of the patients **(Gobken et al., 2007 and Djordjevic et al., 2009)** which is nearly similar to the current results, i.e. 25%. Persistent headache and vomiting were the most presenting symptoms in cerebral veno-sinus thrombosis in this study like other studies **(Heller, 2010).**

The children in this study had well established risk factors. Cardiac diseases were the most

commonly identified group of risk factors in 42.5%, followed by hematological disorders 32.5%, dehydration 7.5%, and homocystinuria 5%.This finding was in agreement with **Aydinli et al. (2006) and Mackay et al.(2010)** who found that cardio embolic, cardiac septal defects and cyanotic congenital cardiac diseases are the most common risk factors of acute ischemic stroke and accounted for nearly third of cases

Most patients came to the hospital within 24 hours after the onset of neurologic signs. The others came after. There were two patients came beyond a week of the neurological onset. In this study, CT showed sensitivity in the 1st 24 hours in 53.5%. **Gonzalez et al. (2008) and Mulins et al. (2012)** reported positive findings in 18% - 45%, MRI especially with diffusion weighted (DWI) is the most sensitive and specific neuroimaging modality for diagnosing early acute ischemic infarction especially in the 1st 24 hours after infarction. In the current study, the accuracy of conventional MRI and DW were 78.5% and 100% respectively in comparison to the studies of **Gonzalez et al. (2008)and Mulins et al. (2012)** that revealed the +ve findings of

conventional MRI were 41%-86% and DW were 97.7%-100%.

CONCLUSION

We concluded that hemiplegia was the most presenting symptom; Cardiac disorders were the most prevalent risk factor in this study followed by hematological disorders. DWI is the best imaging modality for early and accurate diagnosis of ischemic cerebrovascular accident.

RECOMMENDATIONS

1. Exclusion of a hemorrhagic stroke by emergency CT is mandatory in any case presenting with acute hemiplegia.

2. Magnetic resonance imaging with diffusion weighted (DWI) is the most reliable method to diagnose acute ischemic cerebrovascular accidents with a great ability to detect any recent infracted areas. Therefore, it should be performed to all patients with a sudden neurological deficit.

3. A through investigation for genetic prothrombotic tendencies (i.e. Prothrombin G20210A gene mutation) should be considered in all patients with pediatric ischemic stroke even if no family history or recurrence.

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السكتة الدماغيه في الأطفال: الفحص السريري والتشخيص بالأشعة

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خلفيه البحث: قد يكون الشلل النصفى الحـاد فى مرحلـة الطفولـة علامـة عـرض مـن السكتة الدماغية, ولأن أسباب السكتة الدماغية التجلطية فى الأطفال متنوعة ومعقدة أكثر منهـا فـى كبـار السن. لـذا, يكون تشخيصـها أكثر تحديا. وتعتبـر السكتـة الدماغيـة في مرحلـة الطفولـة شـائعة الحدوث عن سرطان الدماغ وهي إحدى الأسباب الرئيسية العشرة للوفاة في البلدان ذات الدخل المرتفع, كما تعتبر من أحد أهم الأسباب – متزايدة النمو – التي تؤدي إلى الإعاقة والوفاة.

الهدف من البحث: معرفة الصورة السريرية الناتجة عن السكتة الدماغية التجلطية، ودور الاشعة التشخيصية فى تشخيص السكتة الدماغية التجلطية.

المرضي وطرق البحث: أدرجت أربعون حالة يعانون من الشلل النصفى أو قصور الحركة الحاد بسبب السكتة الدماغية التجلطية في دراسة وصفية, أعمارهم تراوحت بين شهرين حتى 12 سنة. نفذت هذه الدراسة فى مستشفى الحسين الجامعى ومستشفي سيد جلال الجامعي على مدى ثمانيـة أشهر فى الفترة مـن ينـاير 2016 حتـى سـبتمبر 2016، وقد خضـع جميـع المرضي للتـاريخ المرضي الكامل والفحص السريري الكامل للجهاز العصبي.

النتائج: وجد أن 70% من المرضي من الذكور 28 حالة،وشملت الأعراض : الشلل النصفى فى الناحيـة اليمنـى مـن الجسـم 62,5%, وفى الناحيـة اليسـرى 37,5%,وشـلل جزئـى فـى الوجـه, وتشنجات, وإضطراب مستوى الوعي 32,5%, كما لوحظ فقدان القدرة علـى الكـلام فـى 25% من الحالات, والصداع فى 15%. وكشفت الدراسة أن أمراض القلب وبخاصـة العيـوب الخلقيـة والأمراض الروماتيزمية كانت في 42,5% مـن الحـالات, تليهـا أمراض الـدم فـى 32,5%.

الإستنتاج: الشلل النصـفي كـان مـن أكثـر الأعـراض، وتعتبـر أمـراض القلـب هـى أكثـر عوامـل الخطورة.كما وجد أن أكثر الوسائل دقة وسرعة فى التشخيص المبكر للسكتة الدماغيـة التجلطيـة هو الرنين المغناطيسي ذو الإنتشار المتقيد.