

Mini Review

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Stroke Mimics in the Pediatric Population

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ABSTRACT

Pediatric stroke is a very rare condition and it is a cause of significant morbidity and mortality. It is among the top ten causes of death in the pediatric population, and over half of stroke survivors experience long-term disabilities. One major challenge in the diagnosis of stroke is the fact that there are many conditions that may mimic stroke. In the pediatric population the incidence of stroke mimic is around 79-93% of all presentations of acute focal brain dysfunction. The most common diagnosis in children is complicated migraine, seizures disorders, Bell's palsy and conversion disorders. The aim of the evaluation of these conditions is to rule out the diagnosis of acute stroke and the computed tomography (CT) is the modality of choice as is more accessible in the Emergency Departments (ED).

KEYWORDS: Stroke mimics; Children; Stroke.

ABBREVIATIONS: CT: Computed Tomography, ED: Emergency Department, MRI: Magnetic Resonance Imaging.

INTRODUCTION

Pediatric stroke is an uncommon condition and it's a cause of significant morbidity and mortality. It is among the top ten causes of death in the pediatric population, and over half of stroke survivors experience long-term disabilities.¹ Children with stroke experience impairments that interfere with normal development and living.^{2,3}

The incidence of pediatric stroke is rare with an estimation of 2 to 3 per 100, 000.⁴ Due to the rarity of the condition, recognition and diagnosis of pediatric stroke is often delayed. Studies locally and overseas have consistently demonstrated a considerable time lag of more than 20 hours.⁵⁻⁸

Besides pediatric stroke being rare, another major challenge in the diagnosis is the fact that there are many conditions that may mimic stroke. Stroke mimics are defined as non-vascular conditions with a stroke-like presentation that are suggestive of acute focal brain dysfunction.⁹ In the adult population the stroke mimics account for approximately 30% of patients that are assessed for focal brain dysfunction of apparently abrupt onset. Brain attacks is the named given for this condition in the adult literature.¹⁰ According to some case series, in the pediatric population the incidence of stroke mimic is 79-93% of all presentations of patients with acute neurological symptoms.^{11,12}

CLINICAL RELEVANCE

From the many patients that present with neurological symptoms in a pediatric ED, there are the ones who require neuroimaging in order to rule out a diagnosis of stroke. Within this pool of patients, there are a small number of actual stroke cases. Thus, there is a need to differentiate these stroke mimics, primarily important for the acute treatment and for the rapid management of the actual stroke cases.

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Currently, there is a lack of data in the literature describing pediatric stroke mimics and there are only few studies published.¹¹⁻¹³ In the study by Shellhaas, et al., they compared benign diagnoses (one third of mimics) with non-benign diagnoses within the “mimics” group, and found no difference except for the presence of seizures in benign disorders. The main presenting signs were seizure, focal weakness and headache. Diagnoses of the mimics were diverse and included complicated migraine, seizures disorders, psychogenic diagnoses and musculoskeletal abnormalities. Limitations noted by the author’s were that not all stroke mimics were referred to the stroke team for evaluation. Additionally, the number of mimics included in the study (n=30) was small, and it wasn’t a representative sample.¹¹

In the study by Mackay, et al., they review prospectively all patients that presented to a pediatric ED with brain attacks and found that the spectrum of diagnosis in children is different from adults; being the most common diagnosis in children complicated migraine, seizures disorders, Bell’s palsy and conversion disorders. This data was more representative with 301 consecutive presentations of brain attacks in a pediatric ED where immediate decisions need to be made for imaging and acute management.¹²

Reported incidence of these stroke mimics in adults range from 4.8% to 31%.^{9,10,14,15} A paper on adult stroke mimics lists intracranial mass lesions, seizures with post-ictal states, migraines, psychiatric disorders, hypoglycemia and encephalopathy as mimics of stroke in adults.¹⁶

Another study in adults by Vroomen, et al., looked at the incidence and scope of stroke mimics presenting to a stroke department. In those patients younger than 50 years old, a fifth had a stroke mimic. In this age group, the main mimics were conversion disorder and migraines. In those above 50 years old, mimics were much less common (3%). Besides conversion disorder and migraines, epilepsy was also a major stroke mimic in this age group.¹⁵

In the study by Hand, et al., they also attempted to determine the nature of stroke mimics, in order to allow differentiation between stroke and mimics at the bedside of the patient.¹⁰ In this study, the proportion of stroke mimics was around 30%. One of the strengths of this study was that they found 8 items that independently predicted the diagnosis in “brain attack” patients. This included findings that mimics are more likely with a history of cognitive impairment, loss of consciousness, seizures at onset, no lateralizing symptoms, no focal neurology and signs in non-vascular systems. On the other hand, patients with definite focal symptoms, an exact time of onset and those who were well the week before were more likely to have a stroke.¹⁰ Other strength was that it gives physicians tools to identify the reliable (and unreliable) components of a clinical assessment in the bedside when assessing patients with a possible stroke. One limitation was that the information was obtained only from the

patient and didn’t include the data given by family members or emergency physicians.¹⁰

Children	Adults
1. Complicated Migraine	1. Epilepsy/Seizures
2. Epilepsy/Seizures	2. Systemic Infections
3. Bell’s Palsy	3. Migraine
4. Psychiatric causes	4. Toxic-Metabolic
5. Syncope	5. Peripheral Nervous System/ Mononeuritis
6. Non-specified Headache	6. Psychiatric causes
7. Cerebellitis	7. Encephalopathy
8. Peripheral Nervous System/Mononeuritis	8. CNS Tumors
9. Drug intoxication	9. Vestibular

Table 1: Comparison of Stroke Mimics in order of frequency in adults and children.

Modified from Mackay MT, et al. Stroke and nonstroke brain attacks in children. *Neurology*. 2014 Apr 22; 82(16): 1434-40.¹²

COMMON DIAGNOSIS OF STROKE MIMICS

Migraine

Headaches and migraines are common health problems in children, and have been reported to occur in 10.6% of children aged between 5 to 15 years, and even greater numbers in older children (28% in 15 to 19 year-olds).¹⁷ Some rare migraine variants are found in childhood. These include ophthalmoplegic migraine and alternating hemiplegic migraine. Ophthalmoplegic migraine may involve the 3rd, 4th and/or 6th cranial nerves and generally presents with transient migraine-like headaches with associated nerve neuropathy, such as diplopia.¹⁸ Alternating hemiplegic migraine (or alternating hemiplegia of childhood) is a rare syndrome of episodic hemiplegia lasting minutes to days, with accompanying dystonia, nystagmus, oculomotor abnormalities and cognitive impairment.¹⁹ These syndromes and their associated neurologic deficits may present a diagnostic challenge, especially in the evaluation of a possible stroke.

Bell’s Palsy

Bell’s palsy is a common cause of facial paralysis and is a self-limiting disease that has a generally benign course. While its pathophysiology is unknown, inflammation and compression of the facial nerve in its passage through the facial canal remains the popular theory, but acute immune demyelination triggered by a viral infection may be the reason behind the disease. The sudden onset of Bell’s palsy causes patients to seek medical attention urgently and it is the role of the emergency physician to exclude other neurological causes of facial paralysis, such as stroke.²⁰

Todd's Paresis

Todd's paresis (or Todd's paralysis) is a neurological event in which a period of paralysis, involving usually one side of the body, occurs after a seizure. These episodes may last from minutes to hours and the patient's speech and vision may also be affected. Its presentation is similar to that of stroke and thus careful investigation and differentiation is necessary.²¹

Conversion Disorder

Other mimics of stroke include psychological disorders such as conversion disorder, which is a condition that presents with altered physical functioning, but with an underlying psychological cause. Common presentations are weakness, involuntary movements and sensory disturbances. Children with conversion disorder may have a history of abuse, and some may have family members with conversion disorder. A study in children and adolescents with acute conversion symptoms concluded that reduced effective attention, executive function, and memory are associated in these patients.²²

Evaluation and Management

In the evaluation of stroke mimics the main aim is to rule out the diagnosis of stroke and initiate immediate treatment according to the diagnosis suspected. It is well known that in the pediatric population the delays in seeking medical advice, lack of awareness of health workers and the non-abrupt onset of symptoms make the diagnosis of this disease very delayed.^{5,6,23}

Risk factors for pediatric stroke are different from those in adulthood. At initial presentation, approximately half of the children who presented with stroke had no previous positive medical history, but once admitted and when investigations are done some will have unexpected pathologies such as primary cerebrovascular disease or may have modifiable risk factors such as hypertension associated with sickle cell disease.²⁴ In children, a more direct cause-effect relationship between risk factors and stroke events exists, in comparison with adults, in whom risk factors such as smoking, obesity, hypertension, and diabetes cause stroke indirectly *via* the acceleration of atherosclerosis.²⁵

In children, the clinical presentation of stroke is variable and may be non-specific, contributing to decreased recognition by physicians.⁵ Subtle signs and symptoms of in co-ordination, limb weakness and lethargy are easily attributable to conditions besides stroke, such as normal clumsiness and behavioral issues. Presentation of stroke is related to the age of the child and the location of the infarct.¹

In terms of interpreting the signs and symptoms at presentation, it is essential to understand the normal developmental stages of a child. Subtle signs and symptoms in infants and younger children tend to be missed, and stroke is picked up only

when more obvious gross neurological deficits developed. In the younger age group like neonates and infants, the more common symptoms on presentation are seizures and lethargy. For older children, focal deficits like hemiparesis are often the main complaint on arrival.^{7,26,27}

Stroke is diagnosed primarily by neuroimaging evidence of infarction in a cerebral artery territory, considered together with clinical history and examination findings. A systematic evaluation should aim to exclude mimics and to identify the stroke etiology.¹ To this end, evaluation should include taking a detailed personal and family medical history (e.g. coagulopathies, cardiac disorders) and questions about recent events like trauma and infections to assess possible risk factors for stroke. A thorough neurological examination should seek to identify all abnormalities, both gross and subtle. This is especially important in younger patients where subtler signs like limb weakness can be easily missed.

The imaging use to confirm or in this case rule out stroke include Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) scans of intracranial structures and also blood vessels imaging (angiography). Widely available in most emergency department settings, CT is usually helpful for distinguishing the different possible diagnosis.²⁸ However, an early infarct may not show up on CT, thus MRI, whether conventional or diffusion-weighted, is the preferred imaging method in the evaluation of possible stroke.²⁷ If the patient is still in the ED the CT is the modality of choice as is more accessible.

Other studies that are helpful when suspected stroke mimics are electroencephalogram for seizure disorders and evoke potential test for neuropathies or conversion disorders. More evaluations needed should be individualized according to the possible diagnosis suspected by the physician.

The need for early consultation with a neurology specialist might be useful in helping the clinician (usually an emergency doctor) to determine who have a probable stroke. This early assessment will improve the times from onset of symptoms to diagnosis of stroke and will help in initiating treatments of some cute stroke like syndromes in the pediatric population.

CONCLUSION

There is currently not much literature about the incidence of stroke mimics in the pediatric population, their presenting signs and symptoms. Therefore, more studies are needed to help the physician not only to increase awareness about pediatric stroke but also to help differentiate between the mimics and the actual stroke cases.

Adult studies may not be directly applicable for pediatric stroke as there are differences in presentation between adult and childhood stroke mimics. Also, the incidence of adult stroke mimics differ from that in children, with a higher propor-

tion likely in the pediatric population associated to numerous diagnostic challenges in younger patients.

Limited awareness regarding pediatric stroke among physicians and in the community is a major issue in the diagnosis not only of stroke but also stroke mimics. There are no brain attack protocols in children, specifically a well-established diagnostic pathway from pre-hospital setting to the hospital setting. In the future, the initiative of an ED stroke-screening tool in all the acute settings, will aid in the prompt recognition of stroke patients and improvement in their management like using thrombolysis as acute management for this disease as standard practice.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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