Epilepsy in Childhood
Amy Kao, MD

1. A 7-year-old girl with right hemiplegic cerebral palsy presents the Emergency Room with first seizure, described as right body jerking for 3 minutes. She is afebrile and back to her baseline mental status and function. Which of the following would be the MOST APPROPRIATE evaluation?

A. Head CT with contrast in the ER
B. EEG in the ER
C. Physical exam, cbc and electrolytes, lumbar puncture
D. Reassurance only, as this is likely an isolated event which will not recur
E. Outpatient EEG, nonurgent brain MRI

Correct Answer: E

References

Rationales
Option A is not correct. A noncontrast CT may be considered for emergency patients presenting with seizure, especially if there is an abnormal neurologic examination, predisposing history, or focal seizure onset. Patients less than 6 months are very likely to have significant abnormality. In an evidence-based review, 3 to 8% of pediatric patients had a CT abnormality which changed acute management, including hemorrhage, tumor, cysticercosis, and obstructive hydrocephalus.

Option B is not correct. Immediate EEG is not recommended, and findings in the first 24 to 48 hours after seizure may be transient.

Option C is not correct. Bloodwork and spinal tap are unlikely to be abnormal in a child older than 6 months old and without suggestive findings on history or examination.

Option D is not correct. Option E is correct. Practice parameter recommends EEG to assist with determination of epilepsy syndrome and prognosis regarding recurrence of seizures, as well as MRI on a nonurgent basis if cognitive/motor impairment, exam abnormality, seizure of partial onset, under 1 year of age, or focal EEG findings not suggestive of a “benign” syndrome.
2. A 7-year-old developmentally-normal boy with past history of a prolonged febrile seizure now has complex partial seizures which have not responded to 3 antiseizure medications. A 3-Tesla brain MRI is performed. Which of the following would be the epilepsy syndrome MOST LIKELY associated with a focal structural abnormality?

A. Childhood absence epilepsy  
B. Lennox-Gastaut syndrome  
C. Benign rolandic epilepsy  
D. Temporal lobe epilepsy  
E. Dravet syndrome

Correct Answer: D

References

Rationales
Option A is not correct. Childhood absence epilepsy is characterized by seizures which are considered to be primary generalized in onset. Although there is evidence from functional MRI and PET studies which support involvement/origination of absence seizures in the corticothalamic circuits, MRI of the brain is expected to be normal.

Option B is not correct. Lennox-Gastaut syndrome is an epilepsy syndrome with varied etiologies, which by definition is characterized by mental retardation, multiple seizure types (including absence, drop seizures, generalized-tonic-clonic, complex partial), and slow spike-wave activity on EEG.

Option C is not correct. Benign rolandic epilepsy is characterized by independent bilateral central/temporal spikes on EEG and a normal brain MRI. Recently discovered in some patients is a mutation in GRIN2A, encoding an NMDA receptor subunit, making this a channelopathy.

Option D is correct. Febrile status epilepticus is associated with increased risk of epilepsy, namely temporal lobe epilepsy. A large multicenter prospective study has shown that children with febrile status epilepticus are at risk for acute hippocampal injury and also have greater frequency of developmental abnormalities in the hippocampus.

Option E is not correct. Dravet syndrome is the clinical syndrome most often associated with mutation in sodium channel SCN1A. Focal abnormalities have been reported, however seizures are often primary generalized in this diffuse channelopathy.
3. You review images from a brain MRI performed in an “open” scanner on a 7-year-old girl with anxiety and seizures which have persisted despite 3 antiseizure medications. EEG has shown right temporal epileptiform discharges. There is possible “fuzziness” in the right lateral temporal cortex. Of the following, which is the MOST REASONABLE recommendation?

A. Fluorodeoxyglucose-PET  
B. Higher-resolution MRI and evaluation at a multidisciplinary epilepsy center  
C. Additional medication trials while awaiting maturation and improvement of her anxiety  
D. Referral to neurosurgery

Correct Answer: B

References

Rationales
A generally-accepted definition of medically refractory (intractable) epilepsy is epilepsy characterized by persistent seizures despite trials of more than 2 antiepileptic medications, either alone or in combination. A sentinel study found that 47% of patients diagnosed with epilepsy, became seizure-free during treatment with their first antiseizure drug. Fourteen percent became seizure-free during treatment with a second or third drug. Only 3 additional percent were controlled with combination of 2 drugs. Due to the decreasing likelihood of seizure control with subsequent medication trials, it is encouraged that patients with medically refractory epilepsy be referred to an epilepsy center, to be evaluated for candidacy for non-pharmacologic treatment options. These may offer increased likelihood of benefit.

FDG-PET can assist the non-invasive identification of a seizure focus in patients with cortical dysplasia, in particular for patients with nonconcordant test findings or with normal MRI scans, however clarification of lesion by higher-resolution MRI would be the most reasonable next step.

MR Imaging in Pediatric Epilepsy
Gilbert Vézina, MD

4. In pediatric epilepsy, the most common structural lesion identified at pathology is:

A. Tumor  
B. Hippocampal sclerosis  
C. Focal cortical dysplasia  
D. Polymicrogyria  
E. Encephalomalacia

Correct Answer: C
References

Rationales
In children and adolescents, cortical dysplasia is the most frequent etiology (42%) followed by tumor (19%), atrophy/stroke (infections and other forms of brain damage; 10%), and hippocampal sclerosis (6%).

5. The transmantle sign is characteristic of:
   A. Polymicrogyria
   B. Ganglioglioma
   C. Dysembryoplastic neuroepithelial tumor (DNET)
   D. Focal cortical dysplasia type 1
   E. Focal cortical dysplasia type 2(B)

Correct Answer: E

References

Rationales
Type 2(B) focal cortical dysplasia is one of the main causes of extratemporal drug-resistant partial epilepsy that is surgically curable. It is characterized by the transmantle sign, defined as a subcortical white matter signal intensity change, tapering toward the ventricle. The transmantle sign has not been described in other developmental or acquired cortical lesions (except for tuberous sclerosis).

6. Magnetization transfer T1 weighted images show a decrease in signal of water molecules that are:
   A. Interacting with adjacent “free” (mobile) protons
   B. Interacting with adjacent “bound” (less mobile protons)
   C. Intracellular in location
   D. Extracellular in location
   E. Influenced by susceptibility gradients
Correct Answer: B

References

Rationales
Magnetization transfer (MT) is based on the interaction between mobile free (mobile) water protons and macromolecular bound (less mobile) protons. With MT imaging, an off resonance RF pulse is applied to saturate protons bound to macromolecules, mainly the myelin sheath covering axons. Due to spin spin interactions, there is a transfer of the saturation effect from the macromolecular bound hydrogen molecules to the nearby free protons. This results in a decrease in signal from the mobile proton and suppression of signal from background brain tissue. In the case of a lesion that contains abnormal myelination (e.g. as seen in cortical dysplasia), the signal suppression will be lessened compared to that observed in the healthy white matter; the lesion is revealed as a T1 bright focus of abnormal signal.

Challenging Cases in Epilepsy
Jason Murnick, MD, PhD

7. This is a T1 magnetization transfer image of a patient with epilepsy. What is the most likely diagnosis?
   A. Neurofibromatosis type I
   B. Tuberous sclerosis
   C. Neurocysticercosis
   D. Rasmussen’s encephalitis

Correct Answer: B

Rationales
Correct Answer: B. Tuberous sclerosis. Magnetization transfer imaging is among the most sensitive sequences for detecting the cortical tubers of tuberous sclerosis. Other answers:
A. Neurofibromatosis type I. NF1 is characterized by T2 hyperintense hamartomas in the deep gray structures, brainstem, and cerebellum.
C. Neurocysticercosis. Most common cause of epilepsy in the developing world. T2-hyperintense cysts and/or enhancing nodules at the gray-white junction.
D. Rasmussen’s encephalitis. Unilateral hemispheric atrophy with multifocal T2 hyperintensities in the affected hemisphere.

References
8. Which patient would be most likely to benefit from an interictal 18FDG-PET exam for presurgical evaluation?
   A. 2-year-old with intractable epilepsy and known SCN1A sodium channel mutation.
   B. 8-year-old with epilepsy of L frontal onset and L frontal cavernous malformation on MRI.
   C. 5-year-old with intractable epilepsy of L frontal onset and a normal MRI.
   D. 10-year-old with L frontal epilepsy, well-controlled on one medication.

Correct Answer: C

Rationales
Correct Answer: C. Focal epilepsy is likely to be caused by an anatomic lesion, and PET may help to localize it for surgery if it is not apparent on MRI.

Other answers:
A. Patient has a sodium channel mutation causing epilepsy, not a focal anatomic lesion, so is unlikely to be helped by surgery
B. Patient with focal epilepsy corresponding to epileptogenic lesion on MRI (cavernoma) can undergo surgery without further imaging studies
D. Seizures are well-controlled on one medication, so the patient is not a good candidate for surgery

References

9. An 11-year-old boy with intractable epilepsy has this T2-weighted image. Which of the following is the most likely diagnosis?
   A. Hemimegalencephaly
   B. Dysembryoplastic neuroepithelial tumor (DNET)
   C. Focal cortical dysplasia, type II
   D. Benign rolandic epilepsy
   E. Rasmussen encephalitis

Correct Answer: E

Rationales
Correct answer: E. Rasumussen encephalitis is characterized by unilateral cortical atrophy, preferentially involving the insula. Caudate head atrophy may also be present.

Other answers:
A. Hemimegalencephaly also has findings of hemispheric asymmetry, but the abnormal hemisphere is the larger one. Widened gyri, cortical thickening, and gray-white blurring are often seen in the abnormal hemisphere.
B. DNET is a cortically based tumor characterized by T2 hyperintensity and often a multicystic “bubbly” appearance.
C. Focal cortical dysplasia, type II. Typical findings are subtle cortical thickening with T2 FLAIR hyperintensity in the underlying white matter
D. Benign rolandic epilepsy is not characteristically associated with any abnormal MRI findings.
References

Childhood Stroke
Gabrielle deVeber, MD

10. What is the incidence of stroke in children (hemorrhagic and ischemic)?
   A. 1 to 10 per 100,000 children per year
   B. 1 to 10 per 1,000,000 children per year
   C. 1 to 10 per 10,000 children per year
   D. None of the above

Rationales
The correct answer is a) 1 to 10 per 100,000 per year. One estimate is 2.3 per 100,000 children per year with approximately half hemorrhagic and half ischemic. In neonates arterial ischemic stroke affects 1 in 4000 live births.

References

11. What is the condition represented by the Figures below in this child?
   A. arterial dissection
   B. atherosclerosis due to hyperlipidemia
   C. fibromuscular dysplasia
   D. transient cerebral arteriopathy / post-varicella vasculopathy
   E. moyamoya

Correct Answer: D

Rationales
The correct answer is d) transient cerebral arteriopathy, also termed post-varicella angiopathy when chicken pox in the preceding year. This entity combines a basal ganglia stroke with an irregular narrowing of the distal ICA/proximal MCA and / or proximal ACA due to presumed inflammation although intracranial dissection can be the underlying cause in some children. The course is self-resolving over 3-6 months with a residual static mild stenosis over many years.
References
1. Sébire G. Transient cerebral arteriopathy in childhood. Lancet. 2006;

12. The most common presentation for ischemic stroke in newborn infants is:
   A. increased irritability, inconsolability
   B. headache and confusion
   C. seizures
   D. focal neurologic deficit e.g. hemiparesis
   E. all of the above

Correct Answer: C

Rationale
The correct answer is c). Seizures alone are characteristic of neonates with arterial or venous ischemic stroke. The neonatal brain is immature and is less likely to show a focal deficit e.g. hemiparesis than older infants and children.

References

Stroke Imaging in Childhood
Manohar Shroff, MD, FRCPC

13. Regarding Childhood Arterial Ischemic Stroke (AIS) recurrence, which of the following statements is true?
   A. Risk of stroke recurrence is high even if vascular imaging is normal.
   B. In later childhood AIS, recurrence occurs within five years in 66 % of children when vascular imaging studies identified abnormalities.
   C. Recurrence is common after perinatal stroke
   D. Risk of stroke recurrence is similar in early childhood (perinatal) AIS and later childhood AIS.

Correct Answer: B

Rationale
The correct answer is b) In later childhood AIS, recurrence occurs within five years in 66 % of children when vascular imaging studies identified abnormalities. As per reference mentioned below: Strokes recur in one-fifth of later childhood AIS and recurrence is rare after perinatal stroke. In later childhood AIS recurrence occurred within five years in 66 % of children whose vascular imaging studies identified abnormalities. None of the children with normal vascular imaging had a recurrent stroke.
References

14. What is the most likely diagnosis, in the Figure below in this child? Please be specific.
   A. Presumed Perinatal Ischemic Stroke
   B. Right MCA Arterial Ischemic Stroke
   C. Sequelae of TORCH infection
   D. Periventricular Venous Infarct

Correct Answer: D

Rationale
The correct answer is d) Periventricular Venous Infarct. Note the classic location at superolateral edge of the lateral ventricle, along the course and territory of medullary veins.

References

15. What is true regarding anterior circulation dissection in children:
   A. it occurs more commonly in the cervical portion of the carotid arteries
   B. it occurs more often commonly in the intracranial anterior circulation
   C. neck pain is a common presentation
   D. stroke is not a common complication of anterior circulation dissection in children.

Correct Answer: B

Rationale
The correct answer is b). Arterial Dissections are an important cause of AIS in children. Anterior circulation dissections occur more commonly intracranially in children. Children often present with deficit and adults present with neck pain.

References
16. As opposed to adults where hypertension, diabetes and other chronic diseases are well-known stroke risk factors, no definite underlying predisposing factor is identifiable in the majority of cases of pediatric arterial ischemic stroke (AIS).

A. True
B. False

Correct Answer: B

Rationale
The correct answer is b) False. Approximately 50% of children presenting with AIS have at least one identifiable predisposing cause. Childhood stroke in which no risk factors are identified represent only 10–30% of cases. On the contrary, multiple risk factors are recognizable in the majority of stroke in children; thus, a comprehensive diagnostic evaluation is crucial.

Reference

17. A 17-year old female with sickle cell disease without crisis undergoes a routine annual surveillance brain MRI for detection of stroke. Axial FLAIR images from the scan reveal multiple punctate hyperintense foci (arrows). What is the significance of this finding?

A. Usually unrelated to sickle cell disease
B. Usually benign and of uncertain significance
C. Usually related to multiple blood transfusions
D. Associated with increased risk of new stroke

Correct Answer: D

Rationale
The correct answer is d) Associated with increased risk of new stroke. The hyperintense foci represent silent infarcts and have important clinical sequelae including impaired cognitive functions and increased risk for future classic/overt strokes.

Reference
18. A 3-year-old male with history of infantile spasms fairly controlled with Vigabatrin, otherwise asymptomatic, undergoes an elective brain MRI to evaluate for a possible underlying seizure focus. Based on the history and diffusion-weighted images provided, what is the most likely etiology of the finding?
A. Venous ischemia
B. Arterial ischemia
C. Drug related changes
D. Encephalitis

Correct Answer: C

Rationale
The correct answer is c): Drug related changes. This is a great imaging example of a stroke mimic. Vigabatrin is a very common drug used to treat infantile spasm and is commonly associated with asymptomatic MRI abnormalities as shown in the example above. The key here is that despite dramatic imaging findings, apart from known infantile spasm, the patient is asymptomatic.

References: