APPROACH TO THE CHILD WITH A SEIZURE

1. Background

Seizures are the clinical manifestation of aberrant, abnormal electrical activity in the cortical neurons. Thus they can be regarded as a symptom of cerebral pathology and are not in themselves a disease. The term epilepsy is not synonymous with seizures. Epilepsy, which comes from the Greek *epilepsia* meaning “taking hold of”, is a chronic disorder characterized by the tendency for spontaneous, recurrent seizures and requires at least two unprovoked seizures to be considered as a diagnosis.

Seizures occur in 3% to 5% of all children, making it the most common neurological disorder of the pediatric population. Febrile seizures occur in 2% to 4% of the pediatric population whereas epilepsy occurs in approximately 1%.

2. Questions to ask

It is important to get a detailed account of the event or spell from a witness in order to answer the three questions above (Was the spell in question a seizure? What type of seizure? Cause of seizure?).

Start with asking the witness to describe the spell from beginning to end. Then ask focused questions to ascertain details. Questions regarding the possible seizure can be divided into *pre-ictal*, *ictal*, and *post-ictal* categories.

a) Pre-ictal

- Was there any warning before the spell? If so, what was the warning?
- Did the child complain of abdominal discomfort, fear or any other unpleasant sensations before the spell?
- What was the child doing before the spell?
- Was the child asleep or awake prior to the event?
- Was the child sleep deprived prior to the spell?
- Were there any triggers for the spell?
- Was the child well before the spell or was there a fever or illness?

b) Ictal

- Was the child responding during the spell or was consciousness impaired?
- Did the child remember anything that occurred during the spell?
- Were there any repetitive behaviors during the episode, such as lip smacking, pulling at clothing, and constant rubbing of objects.
- Did any body movements occur?
- Was there any perioral cyanosis?
- What was the child's skin colour during the event?
- Did the patient lose continence during the spell?
- How long did the spell last?
- How many episodes has the child experienced?
- How often do the spells occur?

c) Post-ictal

- How did the patient feel after the spell?
- Did the child seem confused and tired after the spell?
- How long did it take for the child to get back to baseline condition?
- Did the child suffer from a headache after the spell?

d) Other questions to ask:

- Has the child ever had any seizures before? Febrile seizures?
- Ask about past medical history, developmental history and current medications to rule out a symptomatic seizure.
- Is there any family history of seizures?

3. Diagnosis

a) Clinical categories

The categorization of seizures is important for determining treatment and prognosis

In order to describe the seizure you need to answer two main questions:

i. Is the seizure *simple* or *complex*?

- **simple seizure** - consciousness is completely intact
- **complex seizure** - consciousness is impaired

ii. Is the seizure *partial* or *generalized*?

- **Partial seizure** - involves a focal area of the brain and therefore affects a specific portion of the body. The clinical presentation of the partial seizure at onset indicates the location of the epileptic focus in the brain.
- **Generalized seizure** - affects the whole body and involves the entire cerebral cortex.

Below follows a description of the different clinical seizure categories:

Partial Seizures	**Simple Partial**	❑ Focal in onset ❑ No impairment of consciousness ❑ Usually short lived, rarely longer than 10 to 20 seconds ❑ Associated with either motor, somatosensory/special sensory, autonomic or psychic (dysphasic, dysmnesic, cognitive, affective, illusions, structured hallucinations) symptoms. ❑ Characteristic EEG demonstrates unilateral spikes or sharp waves in anterior temporal region, but discharges may be bilateral or multifocal on occasion.
	Complex Partial	❑ Focal in onset ❑ Impairment of consciousness either from onset or simple partial developing into complex partial seizure. ❑ Average duration of seizure is 1 to 2 minutes, which is significantly longer than simple partial or absence seizures. ❑ Aura common, signals seizure onset in 30% children, who typically complain of epigastric discomfort, fear, or an unpleasant feeling. Auras occur before impairment of consciousness.

		❑ Automatisms (stereotypical, repetitive behaviors) characteristic of complex partial seizures and present in 50% to 75% of cases. Automatisms occur after impairment of consciousness and include: lip smacking, picking or pulling at clothing, constant rubbing of objects, and walking. ❑ EEG usually shows sharp waves or spike discharges in the anterior temporal or frontal lobe, but may on occasion reveal multifocal spikes.
	Partial with secondary generalization	❑ Focal in onset but then spreads throughout cortex causing a generalized seizure.
Generalized Seizures (all complex)	**Absence seizures** Or **Petit mal** (*Fr.: small bad*)	❑ Seizures typically start around age 5 to 6 years. ❑ Characterized by short (5 to 20 second) lapses in consciousness, speech or motor activity. ❑ No aura ❑ No postictal drowsiness ❑ Automatisms may be present during the seizure and usually involve eye blinking or lip smacking. ❑ Often provoked by hyperventilation for 3 to 4 minutes. ❑ EEG demonstrates 3 cycles per second generalized spike and wave activity. ❑ Atypical absence seizures may involve myoclonic movements of the face or body and may result in loss of body tone causing the patient to fall. Furthermore, the onset and cessation of the seizure may not be abrupt as in typical absence seizure. ❑ EEG in atypical absence seizures often reveals either 2 to 2.5 or 3.5 to 4.5 cycles per second generalize spike and wave activity.
	Tonic-clonic seizures Or **Grand mal** *(Fr.: big bad)*	❑ Characterized by sudden loss of consciousness and tonic-clonic, tonic or clonic contractions. ❑ Tonic contraction is an intense, generalized muscle contraction. ❑ Clonic contractions are rhythmic, often symmetric muscle contractions. ❑ Tonic-clonic contractions start with a tonic contraction and then produce clonic contractions. ❑ Perioral cyanosis may be present. ❑ Loss of bladder may occur. ❑ Seizure is often followed by 30 to 60 minute deep sleep and postictal headache.
	Tonic	❑ Involve intense muscle contraction only.

	seizures	
	Clonic seizure	❑ Involve rhythmic, often symmetric muscle contractions only.
	Myoclonic seizure	❑ Myoclonus refers to the spasm of a muscle or a group of muscles ❑ These seizures occur either in isolation or in connection with other seizure types. ❑ Clinically characterized by brief, repetitive, symmetric muscle contractions.
	Atonic seizures	❑ Sudden loss of postural tone causes child to fall. ❑ May be difficult to differentiate from other seizure types

b) Etiology

Seizures are either *symptomatic* or *idiopathic*.

1) **Symptomatic** seizures are caused by:

- ❑ CNS Infection
  - Meningitis
  - Encephalitis
  - Abscess
- ❑ CNS Trauma
  - Acute trauma
  - Previous trauma may lead to scar tissue formation
- ❑ Cerebrovascular
  - Infarction
  - Hemorrhage
  - Arteriovenous malformation
  - Venous thrombosis
- ❑ Hypoxic
  - Hypoxic ischemic encephalopathy
- ❑ Metabolic
  - Hypoglycemia
  - Electrolyte disturbances
  - Inborn errors of metabolism
  - Neurologic effects of systemic disease
- ❑ Toxic
  - Drugs

- Drug withdrawal
- Alcohol
- Alcohol withdrawal
- Lead poisoning

- Tumour
- Congenital CNS malformations
  - Cortical dysplasia
  - Lissencephaly
- Neurocutaneous syndromes (e.g. tuberous sclerosis)
- Fever – febrile seizures are discussed elsewhere (link fibrile seizure paper)

2) **Idiopathic** seizures

Idiopathic seizures occur in the absence of any underlying CNS pathology. Patients with idiopathic seizures are thought to have an increased susceptibility for seizures yet have normal brain function. Approximately 50% of seizure disorders in children can be placed in a seizure syndrome with unknown etiology.

The details of all the seizure syndromes are beyond the scope of this paper. See Table I in appendix for a brief reference to five seizure syndromes found in children

4. Differential Diagnosis

Differential diagnosis for seizure includes:

- Syncope
- Breath holding spell
- Aspiration
- GERD
- Panic attack
- Daydreaming
- Conversion or pseudoseizures
- Benign sleep myoclonus
- Benign paroxysmal vertigo
- Complicated migraine
- Motor tics
- Complex behaviors
- Decorticate posturing

5. Physical Examination

All children who present with a possible seizure should have a complete pediatric exam.
Pay particular attention to the following elements of the physical exam:

a) Vitals, including temperature

b) Height, weight and head circumference - plot on a growth chart to determine percentiles

c) Developmental stage of child in gross motor, fine motor, language and social domains. A delay indicates a cerebral insult. The insult may be remote (e.g. cerebral palsy), chronic ongoing (e.g. brain tumour), or may be secondary to another disease. Furthermore, developmental delay may occur in *infantile spasms*, an idiopathic epilepsy syndrome (See Table I).

d) Signs of trauma. Direct trauma to the brain can be a cause or consequence of seizures.

e) Signs of increased intracranial pressure link to Signs of inc_ICP.doc

f) Skin lesions – may suggest a neurocutaneous diseases underlying seizure activity. See the Table II in appendix for neurocutaneous disorders that can cause seizures in infancy.

g) Special tests:
- Fundoscopy – look for papilledema - suggests an increase in intracranial pressure (link to Signs of inc_ICP.doc).
- Neurologic exam - looking for focal deficits - indicates symptomatic seizure. Include components:
  - Mental status
  - Cranial nerves
  - Motor
  - Reflexes
  - Sensory
  - Coordination and gait
- Brudzinski's test and a Kernig's test (link to Kernig.Brudzinski.doc) – positive test suggest meningitis

6. Investigations

The particular investigations for each patient depend on the differential generated after the history and physical examination.

a) Blood tests

In general, all patients should have acute symptomatic causes of seizures ruled out. Therefore all children should have the following tests perforemed:

- CBC and differential
- Electrolytes
- Calcium, phosphorus, magnesium
- Blood glucose level

Additional tests need to be considered when investigating the possibility of the following specific conditions:

- Hemorrhagic basis – INR, PTT
- Toxic basis – blood levels of suspected drugs and metabolites
- Genetic disease – possible karyotype and other tests specific to illness
- Metabolic disease – tests specific to disease, may include:
    - Ammonia
    - Lactate
    - Pyruvate
    - Amino acids
    - Urine organic acids

b) Lumbar puncture

Lumbar puncture is indicated in:

- Infants <12months with a first time febrile seizure to rule out meningitis
- Infants 12 to 18 months with a simple febrile seizure
- Any child with meningeal signs

c) Imaging

- CT scan - indicated if head trauma is present/suspected
- MRI – indicated if the child has new or focal neurological deficits, recurrent seizures and/or papilledema
- EEG - children with their first seizure in the absence of fever (as recommended by the American Academy of Neurology). *** Note that many neurologists feel that this is unnecessary as EEG findings rarely impact treatment recommendations. Most offer EEGs more selectively when the seizure is focal, in a child < 1 year and associated with neurological abnormalities.

Appendix

Table I: Summary of Five Seizure Syndromes found in Children (1)

SYNDROME	CLINICAL DESCRIPTION	EEG FINDINGS	TREATMENT	PROGNOSIS
Infantile spasms	Onset between 4 and 8 months of age. Seizures consist of repetitive volleys of brief flexion or extension contractions of the neck, trunk, and extremities that persist for 10 to 30 seconds per volley. Frequently, loss of developmental milestones with the onset of seizures.	High-voltage bilaterally asynchronous, and irregular high-voltage spike and wave pattern.	• Adrenocorticotropic hormone (ACTH) • Benzodiazepines • Vigabatrin (infantile spasms and tuberous sclerosis) • Epilepsy surgery when focal onset	Guarded; majority have poor outcome with persistent seizures.
Lennox-Gastaut	Common in preschool children. A mixture of seizures, including myoclonic, generalized tonic-clonic, partial, absence, and atonic, is characteristic. Status epilepticus is frequent. Often occurs in children who previously had encephalopathy.	Abnormal background activity, slow spike-waves, and multifocal abnormalities.	• Valproic acid • Benzodiazepines • Ketogenic diet	Unfavorable; high association with mental retardation and behavioral problems
Landau-Kleffner	Average onset between 3 and 5 years of age; more common in boys. Loss of language (slow or rapid) in a previously healthy child. 70% have an associated seizure disorder as well as behavioral problems. Seizures may be focal or generalized tonic-clonic, atypical absence, and partial complex.	High-amplitude spike and wave discharges may be bitemporal, multifocal, or generalized. EEG changes always more apparent during nonREM sleep.	• Valproic acid • Prednisone • Speech therapy • Subpial resection?	Variable; onset before 2 years of age has poor outcome. Most have significant speech dysfunctions as adults.
Benign childhood epilepsy with centrotemporal (rolandic) spikes	Peak onset between 9 and 10 years of age (range, 2 to 14 years). Majority occur during sleep. Child awakened by unilateral tonic-clonic contractions of the face, paresthesias of tongue and cheek, and occasional clonic seizures of ipsilateral upper extremity. Child is conscious but aphasic for several minutes.	Repetitive spike discharges confined to the centro-temporal area with normal background activity.	• Occasional seizures require no therapy • Frequent seizures controlled by carbamazepine	Excellent; spontaneous remission by adolescence.
Juvenile myoclonic epilepsy (Janz syndrome)	Onset between 12 and 16 years of age. Myoclonic jerks on awakening that diminish later in day. Most develop early morning generalized tonic-clonic seizures.	A 4 to 6 per second irregular spike and wave pattern enhanced by photic stimulation.	• Valproic acid	Excellent, but valproic acid is required life-long.

Table II: Neurocutaneous Disorders Causing Seizures in Infancy (2)

Neurocutaneous Disorders Causing Seizures in Infancy

Incontinentia Pigmenti

Seizure type
- Neonatal seizures
- Generalized tonic-clonic

Cutaneous manifestations
- Erythematous bullae (newborn)
- Pigmentary whorls (infancy)
- Depigmented areas (childhood)

Linear Nevus Sebaceous Syndrome

Seizure type
- Infantile spasms
- Lennox-Gastaut syndrome
- Generalized tonic-clonic

Cutaneous manifestation
- Linear facial sebaceous nevus

Neurofibromatosis

Seizure type
- Generalized tonic-clonic
- Partial complex
- Partial simple motor

Cutaneous manifestations
- Café au lait spots
- Axillary freckles
- Neural tumors

Sturge-Weber Syndrome

Seizure type
- Epilepsia partialis continuans
- Partial simple motor
- Status epilepticus

Cutaneous manifestation
- Hemifacial hemangioma

Tuberous Sclerosis

Seizure type
- Neonatal seizures
- Infantile spasms
- Lennox-Gastaut syndrome
- Generalized tonic-clonic
- Partial simple motor
- Partial complex

Cutaneous manifestations
- Abnormal hair pigmentation
- Adenoma sebaceum
- Café au lait spots
- Depigmented areas
- Shagren patch

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