Brain Lesions associated with Epilepsy

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Background—Epilepsy

- Second most common group of neurologic disorders after stroke.
  - ~5-10% of the population will have at least one seizure in their lifetime, with the highest incidence in early childhood and late adulthood
  - Prevalence of epilepsy (two or more unprovoked seizures) is ~5-10 persons per 1000
  - Seizures account for ~1% of ED visits (1 million annually)

• Lowenstein et al., *Harrison’s Principles of Internal Medicine*, Ch 363 17th Edition
Epilepsy has a high social, psychological and economical impact.

About 30% of patients with epilepsy do not respond to medical therapy.

For these patients, surgery may be beneficial, especially if imaging reveals lesions potentially related to the seizures.

•WHO fact sheet on epilepsy (http://www.who.int/mediacentre/factsheets/fs999/en/index.html)
Overview: Common Pathologies Associated with Seizures

- Hippocampal (mesial temporal) sclerosis
- Malformations of cortical development (MCD)
- Dysplastic tumors
- Vascular lesions
- Other mass lesions
- Infections
- Infarction
- Trauma

Pathologies more specifically associated with seizures
Medial Temporal Lobe Epilepsy

- Most common form of epilepsy
- Most refractory to medical treatment
- Surgery is curative in ~60%
- Hippocampal (mesial temporal lobe) sclerosis is most commonly encountered associated pathology
- Finding of hippocampal sclerosis on MRI is correlated with improved outcome after surgery
Hippocampal sclerosis

- Extensive cell loss
- Dispersal of surviving neurons
- Gliosis
- Axon sprouting
- Formation of new excitatory synaptic connections, forming small epileptogenic networks

Dichter Arch Neurol; 66(4) 2009
Patient #1: Hippocampal Sclerosis

- Affected (right) hippocampus
  - is smaller
  - has lost internal structure
  - has high signal on T2-weighted sequences

Coronal T2-weighted image

PACS - BIDMC
Companion patient #1: Hippocampal Sclerosis

Affected (left) hippocampus is smaller and brighter on these T2-weighted sequences.
Overview: Common Pathologies Associated with Seizures cont’d

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Pathologies more specifically associated with seizures
Malformations of Cortical Development (MCD)

- Also commonly referred to as “Cortical Dysplasias” or “Neuronal Migrational Disorders”
- Several common types:
  - Heterotopia (clusters of normal gray matter in abnormal locations)
  - Polymicrogyria
  - Lissencephaly (“smooth brain”—absence of sulci and gyri)
  - Focal Cortical Dysplasia – type II (of Taylor)
Companion patient #2: Subependymal Heterotopia

- **Imaging findings:**
  - nodules of gray matter in wall of lateral ventricles (short arrows)
  - iso-intense to gray matter on all sequences
  - do not calcify and do not enhance with contrast

- Patients may present with epilepsy or with symptoms of developmental delay

- Associated with other developmental anomalies like callosal agenesis or Chiari II malformations.

Companion patient #3:
Subependymal Heterotopia

Axial T1 weighted image  Axial T2 weighted image

Notice again the nodules of gray matter in wall of lateral ventricles that are iso-intense to gray matter on both these sequences.

Malformations of Cortical Development (MCD) cont’d -- Polymicrogyria
Companion patient #2 revisited: Polymicrogyria

- Imaging findings:
  - loss of normal sulci
  - irregular thickening of cortex
- Most commonly encountered MCD in patients with refractory epilepsy
- Bilateral peri-Sylvian distribution is common
- Clinical presentation ranges from developmental delay to epilepsy and can involve focal or diffuse neurological deficits

Axial T1 IR

Malformations of Cortical Development (MCD) cont’d -- Lissencephaly
Companion patient #4: Lissencephaly

- **Image on right**
  - is an example of incomplete lissencephaly (pachygyria)
  - notice the paucity of sulci and thickened cortex

- **Severity of lissencephaly** (complete or incomplete) determines the clinical presentation

- **Several genetic mutations** have been reported as the cause of lissencephaly

Coronal T1 IR

Malformations of Cortical Development (MCD) cont’d – Focal Cortical Dysplasia type II (Taylor)
Overview: FCD type II (Taylor)

- Most common type of focal cortical dysplasia
- Thought to have high degree of intrinsic epileptogenicity
- Surgical treatment is often curative
Patient #2: FCD type II (Taylor)

- Focal area of increased cortical thickness
- Blurring of gray/white Matter distinction
- Extension of cortical tissue with increased signal from cortical surface to ventricle (transmantle dysplasia)
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Pathologies more specifically associated with seizures
Companion patient #5: Dysembryoplastic Neuroepithelioma (DNET)

- **Imaging findings:**
  - Cortical, well defined lesion, involving white matter
  - No surrounding edema or mass effect
  - Contrast enhancement is rare

- Associated with refractory epilepsy
- Typically diagnosed before age 20
- Good prognosis after surgery

Overview: Common Pathologies Associated with Seizures cont’d

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Pathologies more specifically associated with seizures
Companion Patient #6:
Vascular Lesions--AVMs

- “Bag of black worms” appearance due to the flow voids of tightly packed vessels (thin arrow)
- Notice large draining vein (thick short arrow)
- High risk of bleeding

Axial T2-weighted image

Companion patient #7: Vascular Lesions--Cavernomas

- Imaging findings:
  - “popcorn-like” appearance
  - mixed signal core due to blood in different stages of degradation
- Seizures and epilepsy are most common symptomatic presentation
- Carry risk of bleeding and development of focal neurological deficits

Coronal T2-weighted image

Epilepsy is a common disorder that is associated with a number of different underlying lesions, the most common of which is hippocampal sclerosis. MRI is useful in detecting these lesions. MRI detection is a positive predictor of good outcome after surgery.
References


- Barkovich and Kjos; Radiology (1992) 182: 493-499


Thanks!

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