

Imaging in Epilepsy

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Nothing to disclose

Outline

- Role of Imaging and pitfalls
- Imaging protocol
- Case scenarios

Clinical &
Electrophysiologic
diagnosis

The diagram consists of two large circles, one light blue on the left and one light red on the right, connected by a yellow plus sign. Below the blue circle is the word 'CLINICAL' in blue, and below the red circle is the word 'IMAGING' in red. The text inside the circles describes the respective fields: 'Clinical & Electrophysiologic diagnosis' for the blue circle and 'Identify and Locate Structural Abnormality' for the red circle.

CLINICAL

Identify and
Locate Structural
Abnormality

IMAGING

IMAGING IN EPILEPSY:

Structural/Anatomical vs Physiologic

CT

SPECT

PET

MRS



Conventional MRI

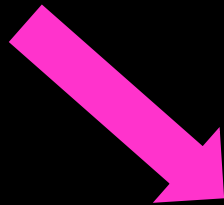
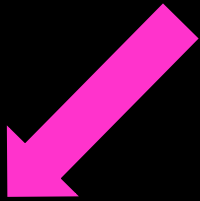
MEG

fMRI

DTI

IMAGING: conventional study

Identify and Locate
Structural Abnormality



**Visible
abnormalities**

**Invisible
abnormalities**



- **Too subtle to identify:** microdysgenesis/ molecular or chemical abnormalities
- **MRI pitfalls:** widespread abnormalities, multiple lesions, dual pathologies

EPILEPSY

```
graph TD; A([EPILEPSY]) -- MEDICATION --> B[Fail medication]; B --> C[Identify localization related epilepsy]; C --> D[Surgey]
```

The diagram illustrates the treatment pathway for epilepsy. It begins with a large yellow oval labeled 'EPILEPSY'. Below this, the word 'MEDICATION' is written. A green arrow points down from the medication stage to a pink box labeled 'Fail medication'. From there, another green arrow points down to a blue box labeled 'Identify localization related epilepsy'. Finally, a third green arrow points down to a blue box labeled 'Surgey'.

MEDICATION

Fail medication

Identify localization related epilepsy

Surgey

EPILEPSY

```
graph TD; A([EPILEPSY]) --> B[MEDICATION]; B --> C[Fail medication]; C --> D[Identify localization related epilepsy]; D --> E[Negative conventional MRI]; E --> F[Functional Imaging: Combine physiologic data: SPECT, PET, DTI Higher Magnet field];
```

MEDICATION

Fail medication

Identify localization related epilepsy

Negative conventional MRI

Functional Imaging:
Combine physiologic data: SPECT, PET, DTI
Higher Magnet field

CT vs MRI

Sensitivity

MRI 95%

vs

CT 32%

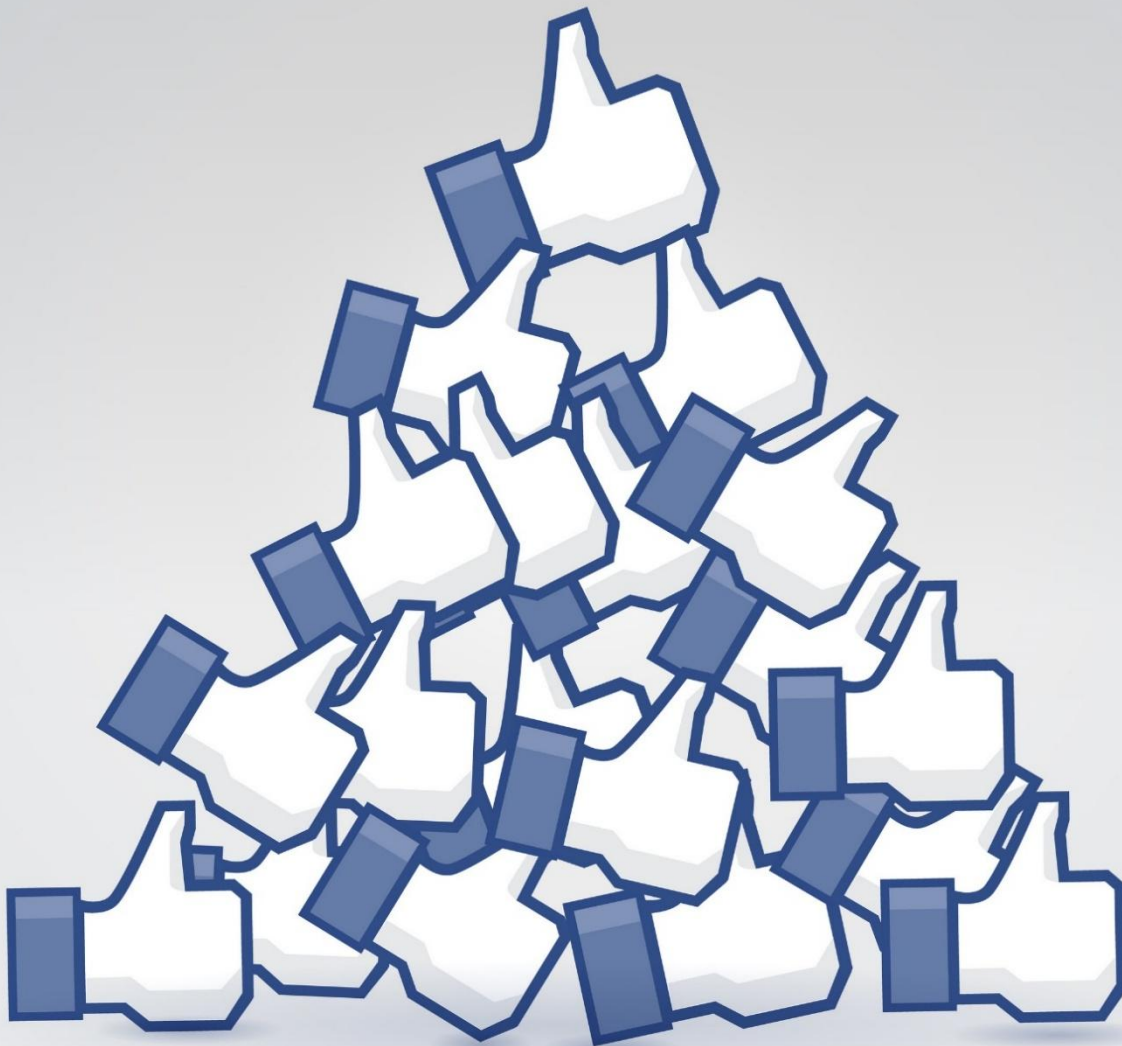
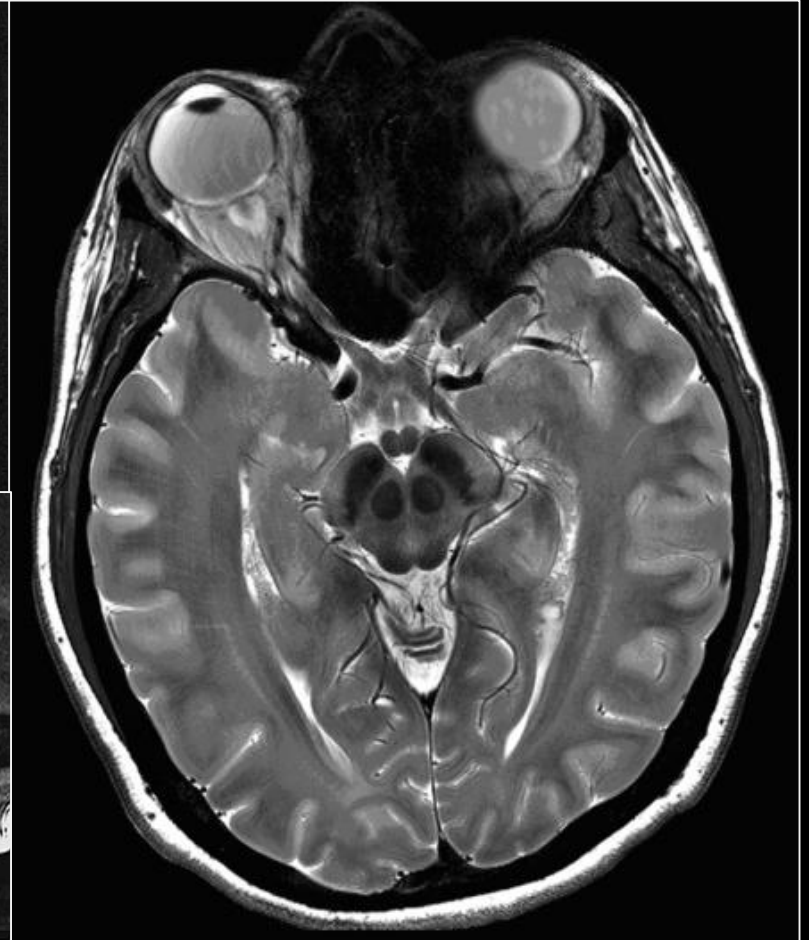
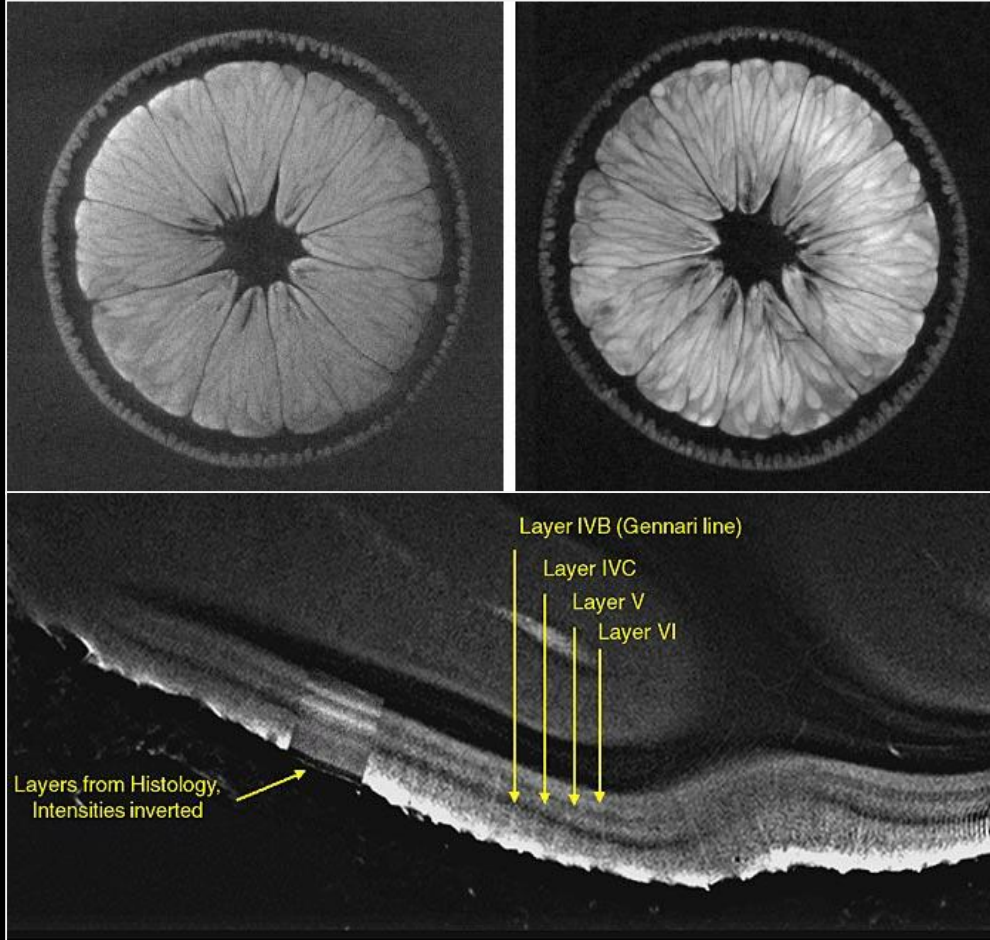


TABLE 9-3**Sensitivity of CT, Standard MRI, and High-Resolution MRI (Number of Patients)**

Pathology	CT Only	Standard MRI	High-Resolution MRI
Hippocampal sclerosis	0	20	108
Vascular abnormalities	13	14	0
Tumor	4	19	2
Brain damage	18	6	0
Malformations of cortical development	0	13	0
Nonspecific white matter lesions	17	18	0

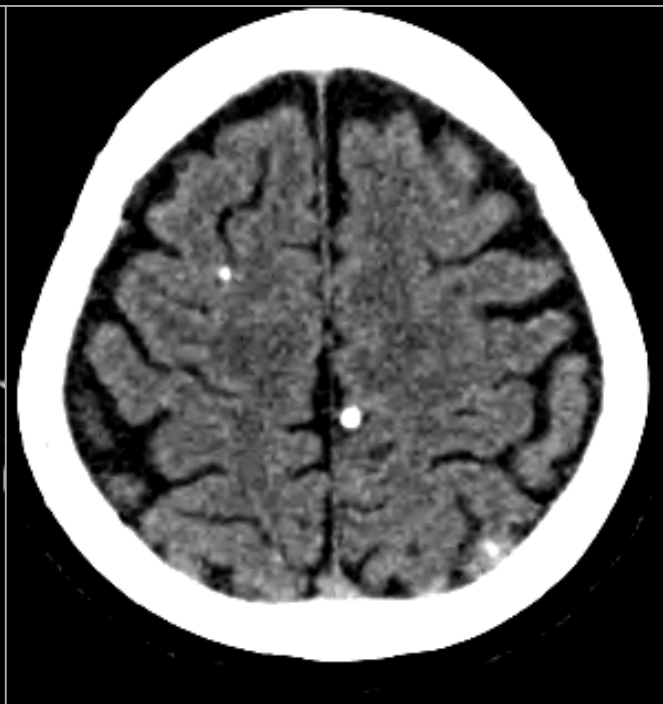
Reprinted with permission from Wiesmann UC. Clinical application of neuroimaging in epilepsy. *J Neurol Neurosurg Psychiatry* 2003;74(4):466–470.

Future



CT

EMERGENCY situation



Role of Imaging

- **Pre-surgery**

- Identify structural abnormality

- **Plan for surgery**

- Help confirm epileptogenicity
- Relationship with eloquent areas
- Predict resectivity and Prognostication

- **Post-surgery**

- Evaluate residual lesion
- Surveillance

MRI protocol

Ideal Imaging

- Distinguish abnormal from normal -> High resolution
- Tell etiology/nature of abnormality -> Good Characterization
- Allow assessment of relationship with eloquent structures -> Functional/Microstructural derangement
- Evaluate epileptogenicity -> Physiologic data

Good clinical
history and
EEG findings

High
magnet field

Appropriate
protocol

**How to
maximize MRI
sensitivity?**

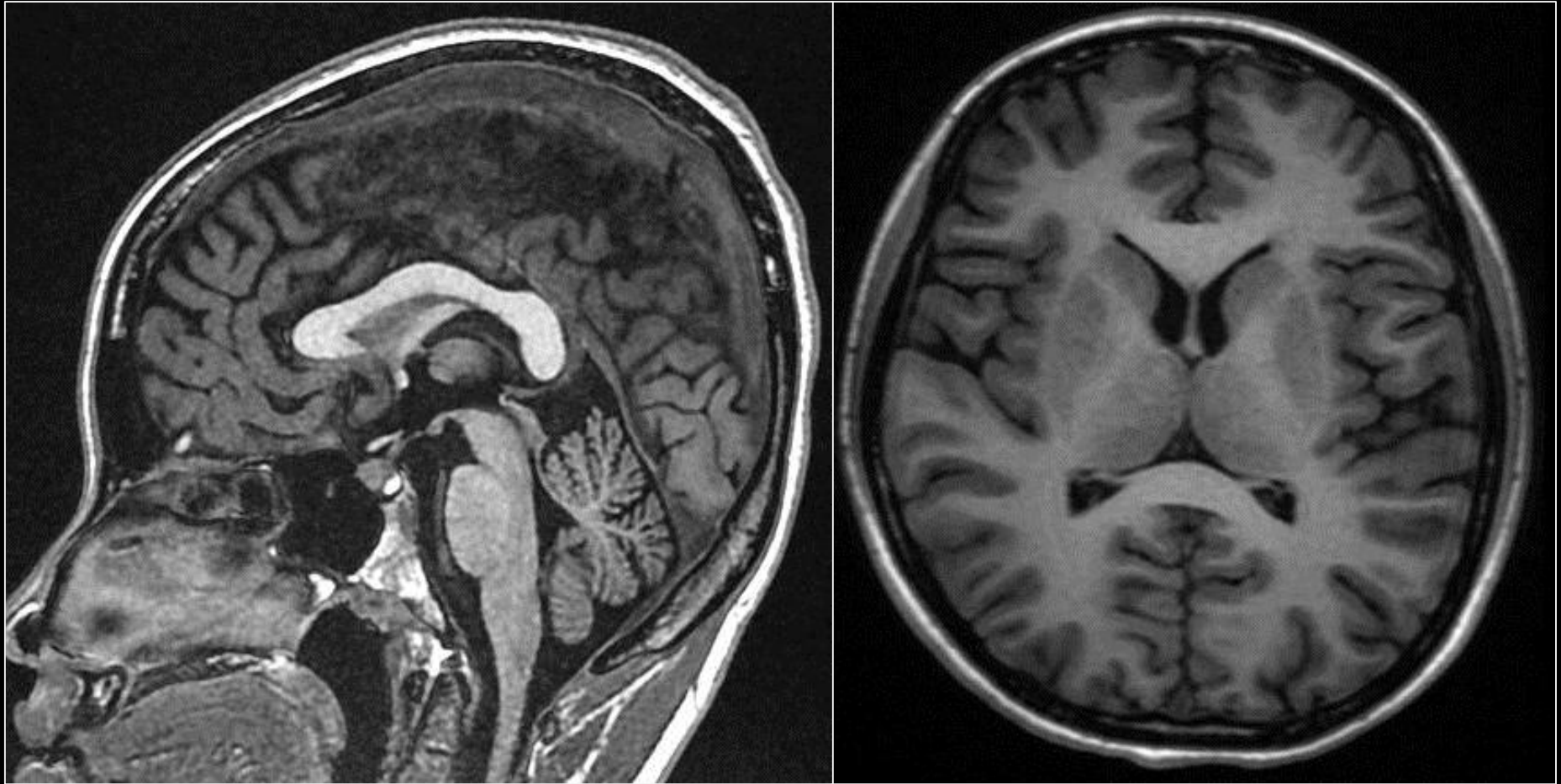
Good
technologist

Experienced
radiologist

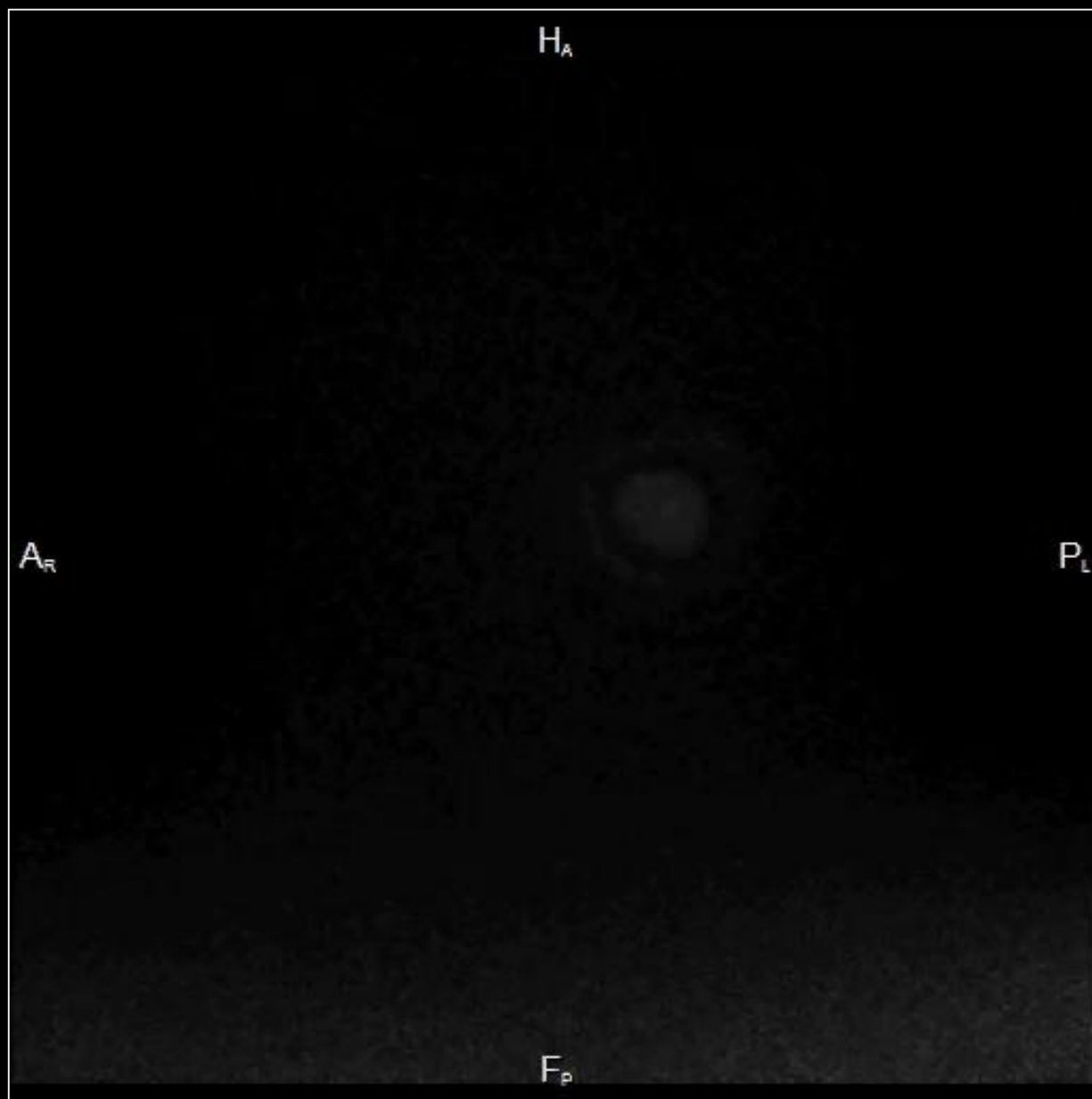
Seizure protocol

- Contrast vs non contrast
- **Standard sequences**
 - Sagittal T1
 - Axial T2, FLAIR, DWI
 - Coronal T2
 - GRE/SWI (axial or coronal)
- **Seizure sequences:**
 - Coronal T2, FLAIR through hippocampi
 - Coronal T1 3D SPGR through hippocampi
- **T1 3D SPGR T1W whole brain ± 3D FLAIR with 3 planes reformation 1- 2 mm thickness**

T1 3D SPGR

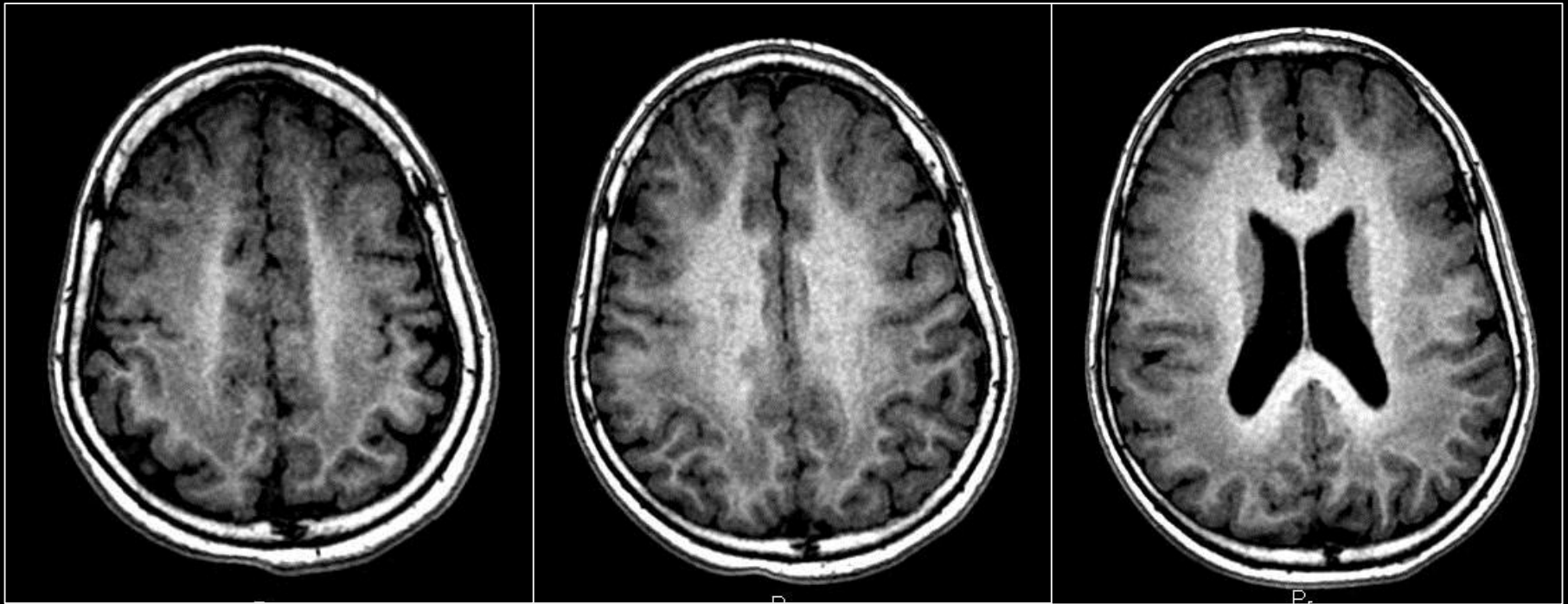


Gray matter dark



Imaging pitfalls

- Widespread abnormalities
- Multiple lesions
- Dual pathologies



Case scenarios

Etiologies/Epileptogenic Substrates Identifiable with MRI

PEDIATRIC

- **Congenital Malformation**
- Inborn-error of metabolism
- Mesial temporal sclerosis
- Birth-related/ post trauma
- Infection
- Neoplasm
- Vascular (malformation)
- Neurocutaneous syndrome

ADULT

- Vascular (Stroke, AVM, cavernoma)
- Tumor (primary and mets)
- Prior brain injury
- Mesial temporal sclerosis

Neoplasm

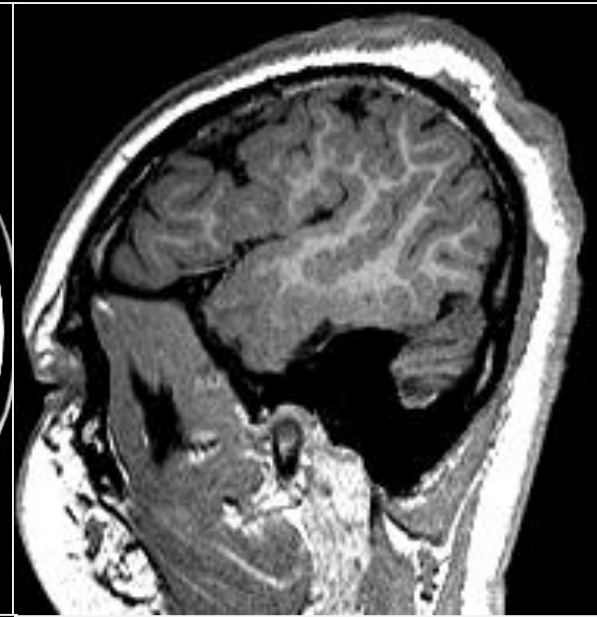
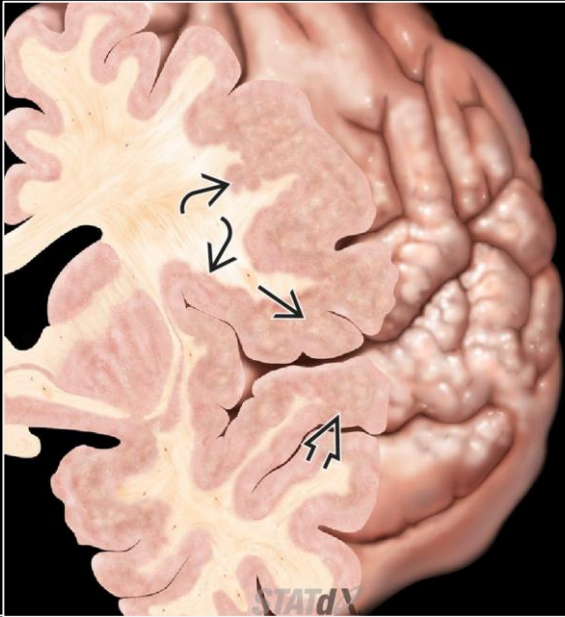
	Seizure frequency
Dysembryoblastic neuroepithelial tumour ^{5,11}	100%
Ganglioglioma ^{5,12}	80–90%
Low-grade astrocytoma ^{12,13}	75%
Meningioma ^{5,12}	29–60%
Glioblastoma multiforme ^{5,13}	29–49%
Metastasis ^{5,12}	20–35%
Leptomeningeal tumour ^{14,15}	10–15%
Primary CNS lymphoma ¹⁴	10%

Cortically based tumor

Table 1: Association between tumour type and seizure frequency

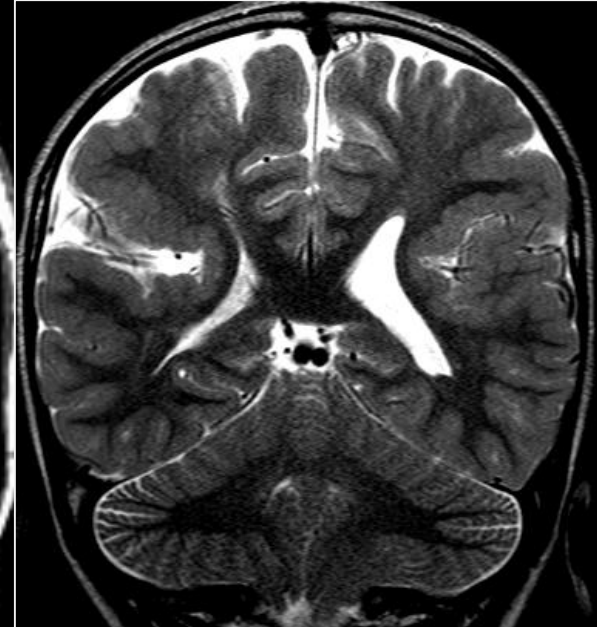
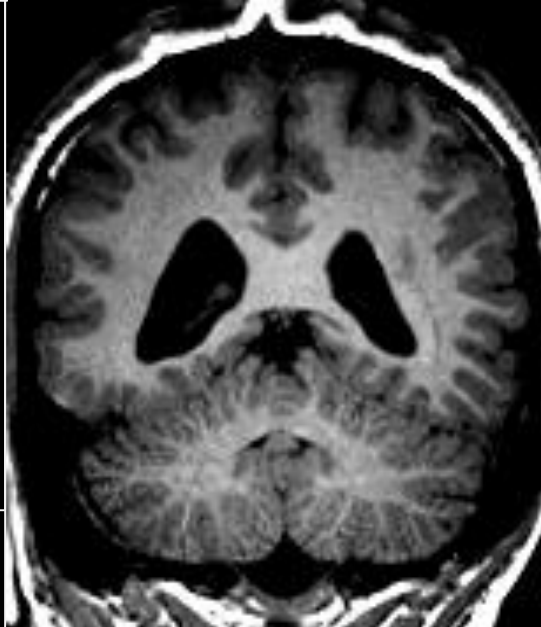
Cortical malformation

Polymicrogyria

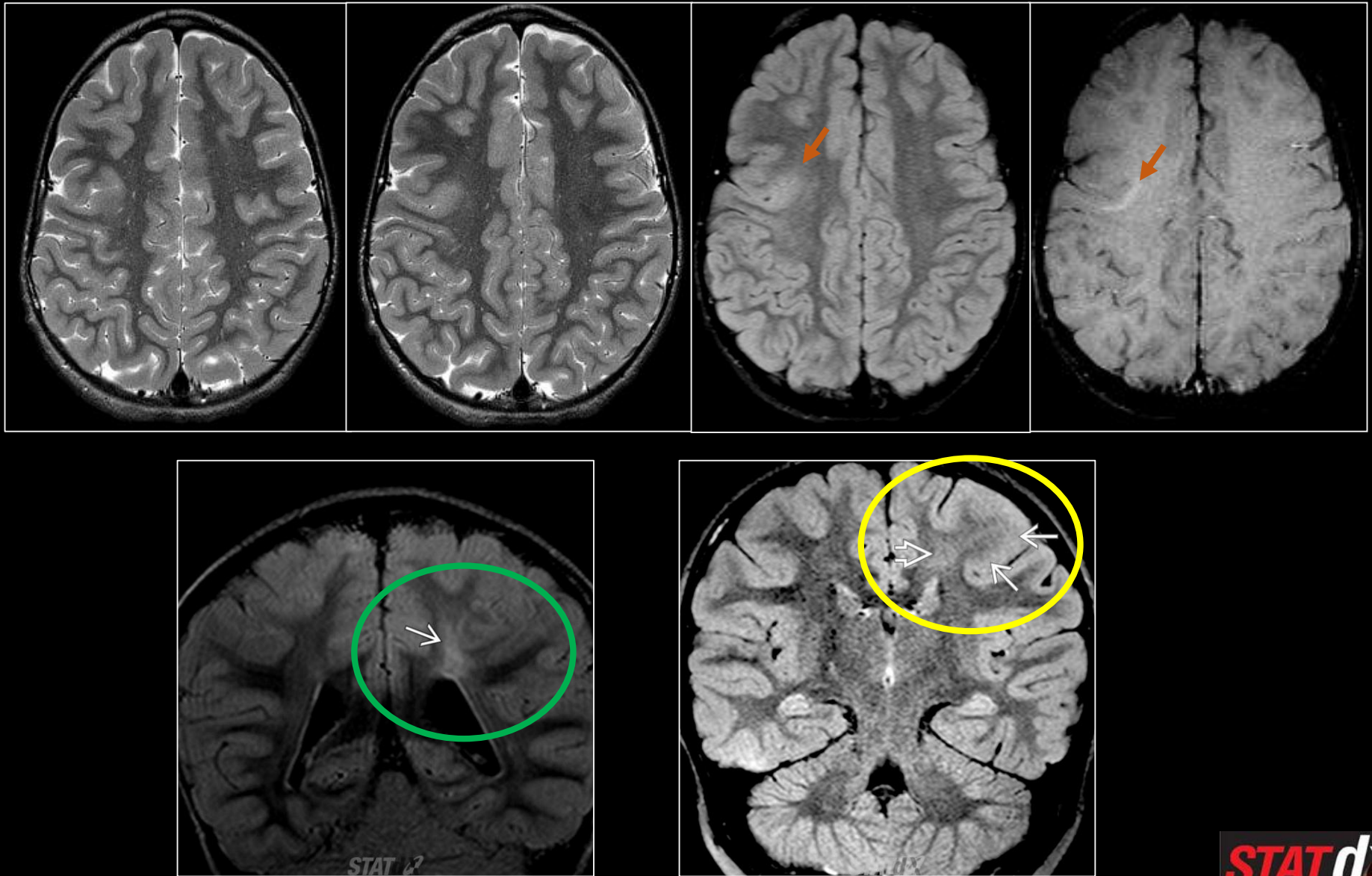


Pachygyria: thick, smooth cortex

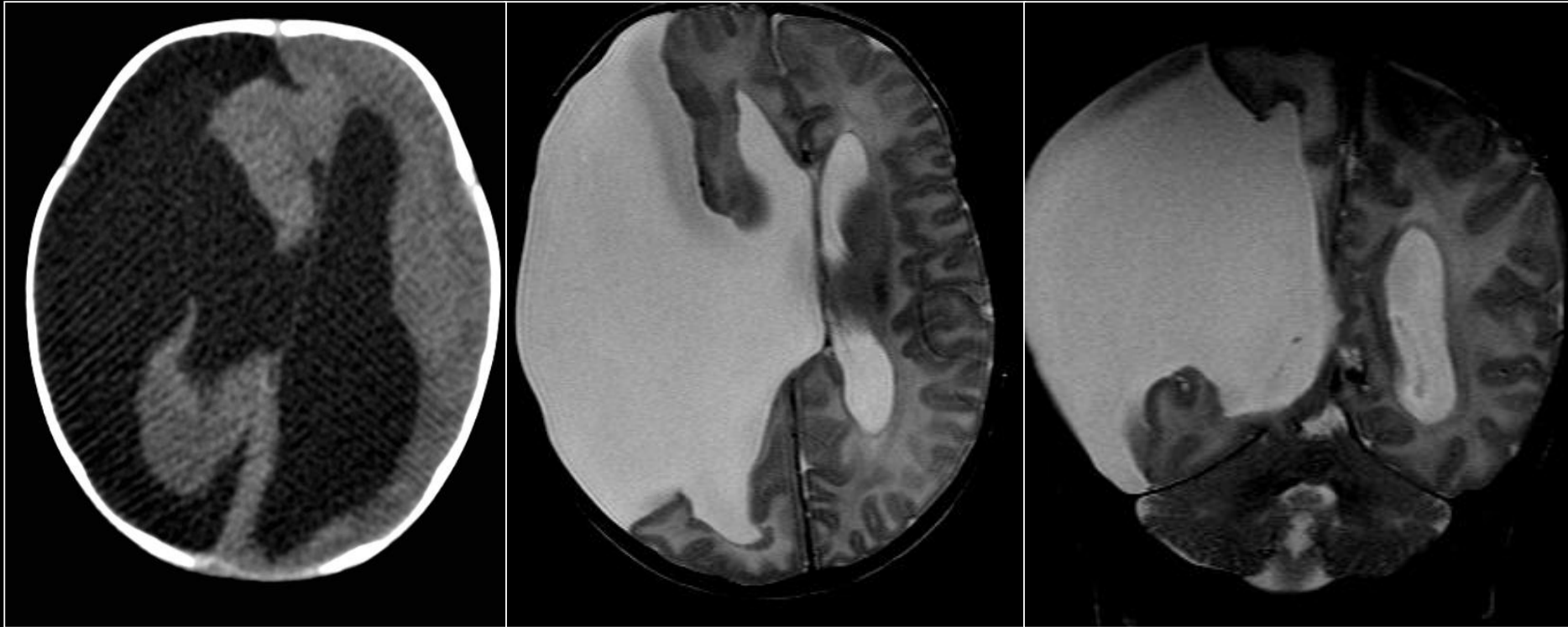
Polymicrogyria: small cobblestone or micronodular appearing gyri



Cortical Dysplasia



Schizencephaly

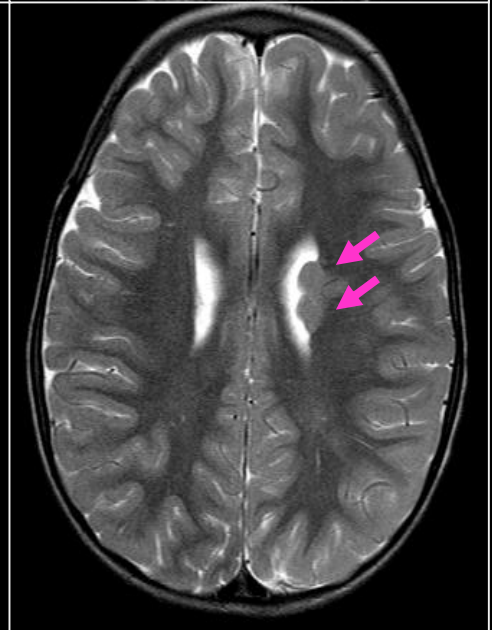
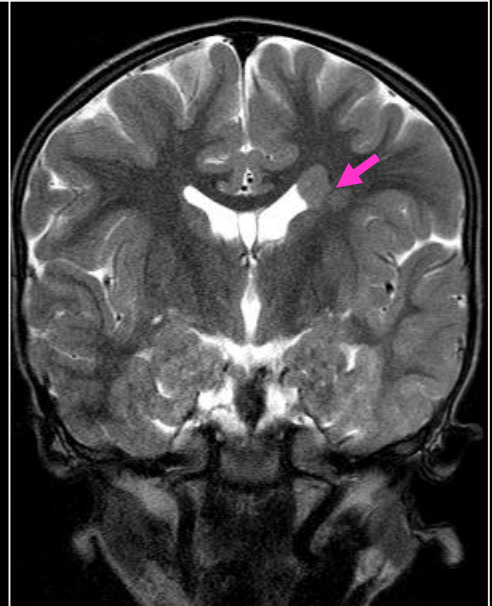
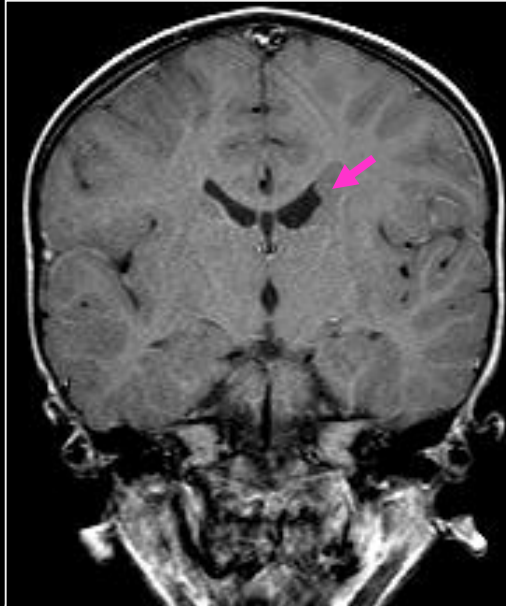
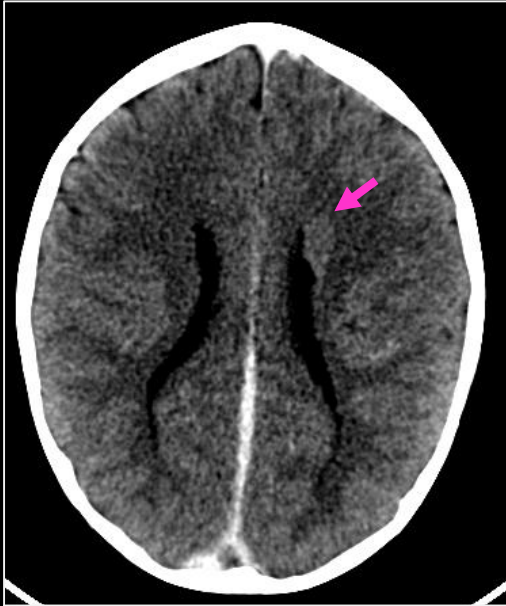


CSF cleft extending to ventricular ependyma

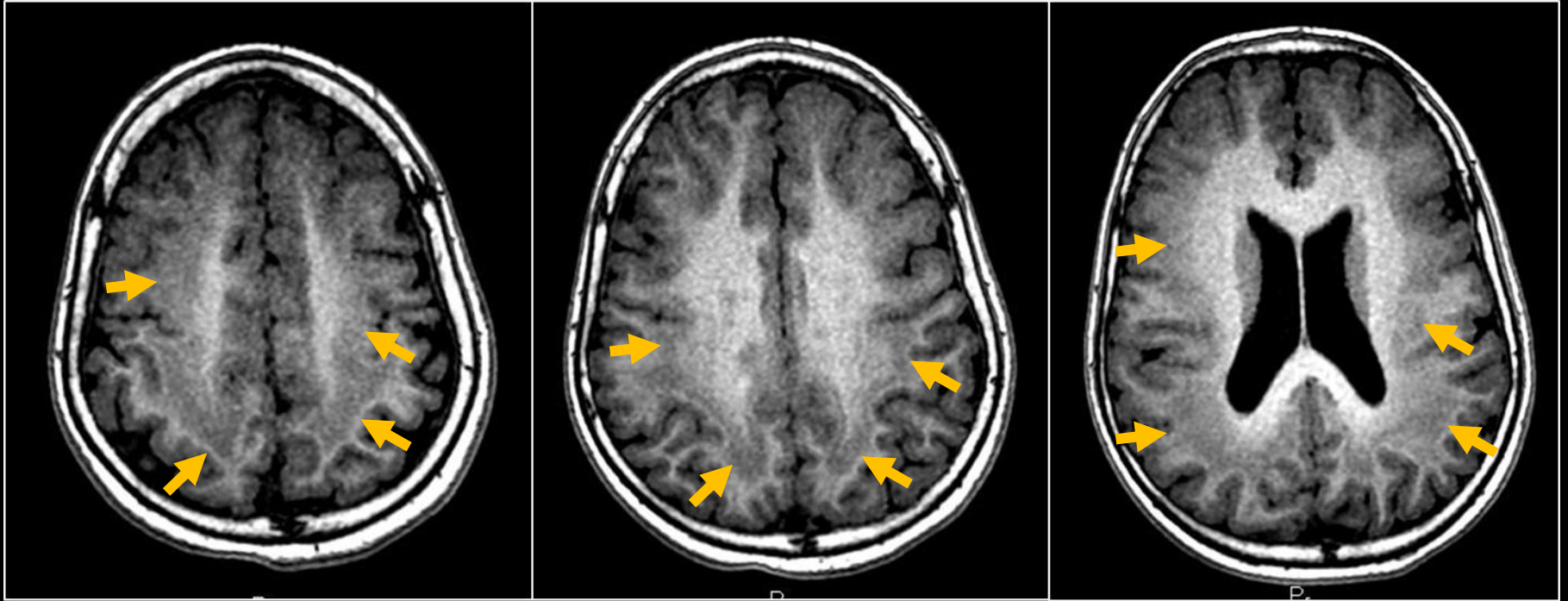
GM lined

Associated with absent septum pellucidum and septo-optic dysplasia

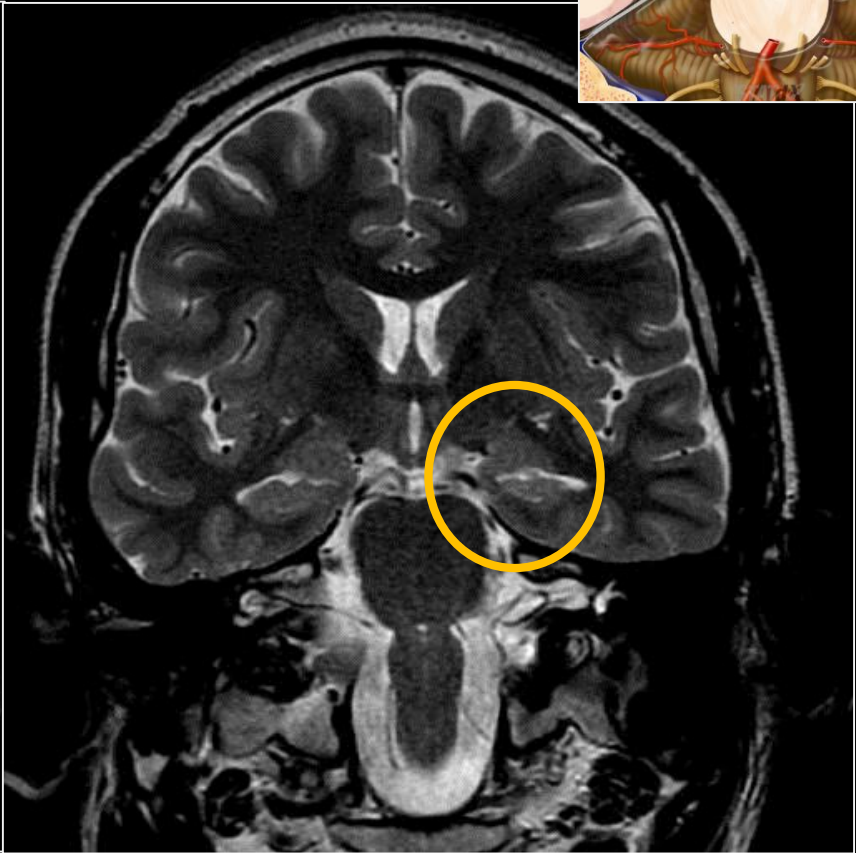
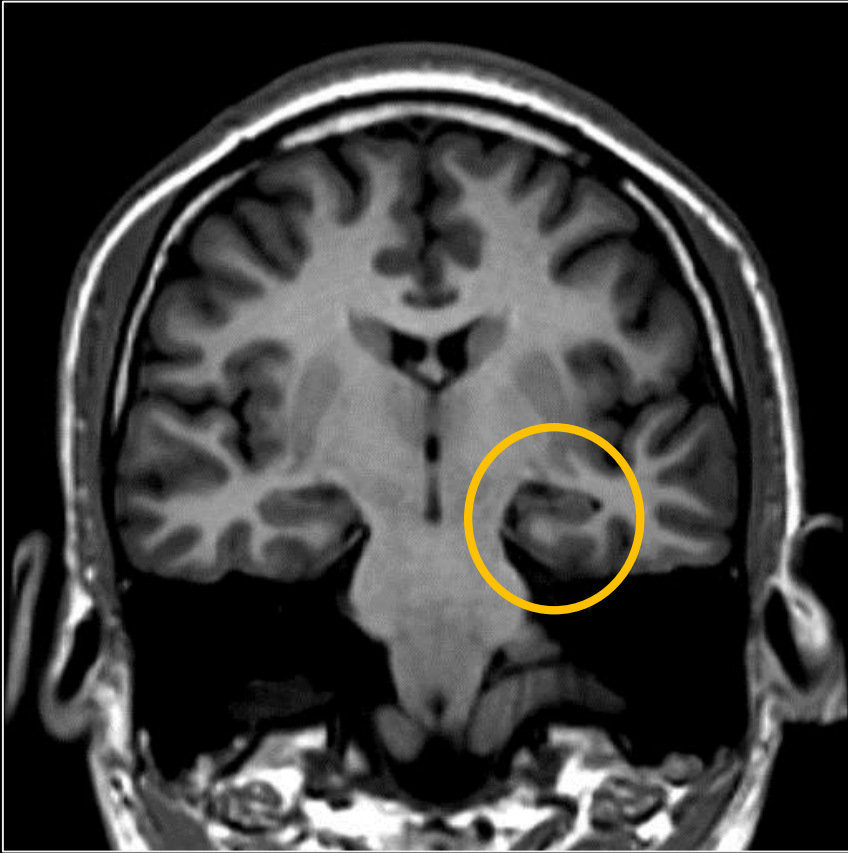
Heterotropia: nodular type



Heterotropia: Band heterotropia



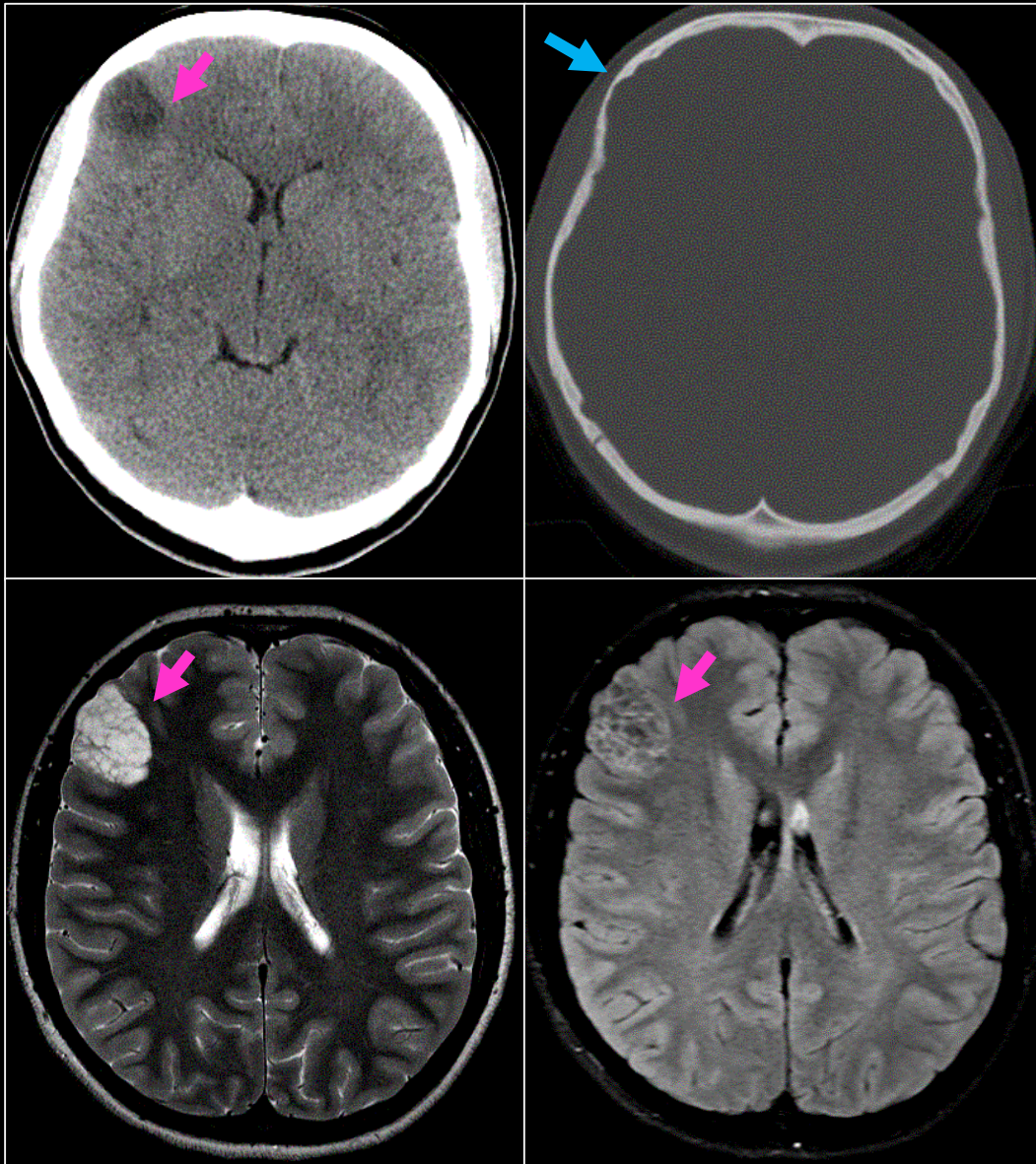
Hippocampal Sclerosis



1st sign: abnormal T2 hyperintensity, hippocampal volume loss/atrophy, obscuration of internal architecture

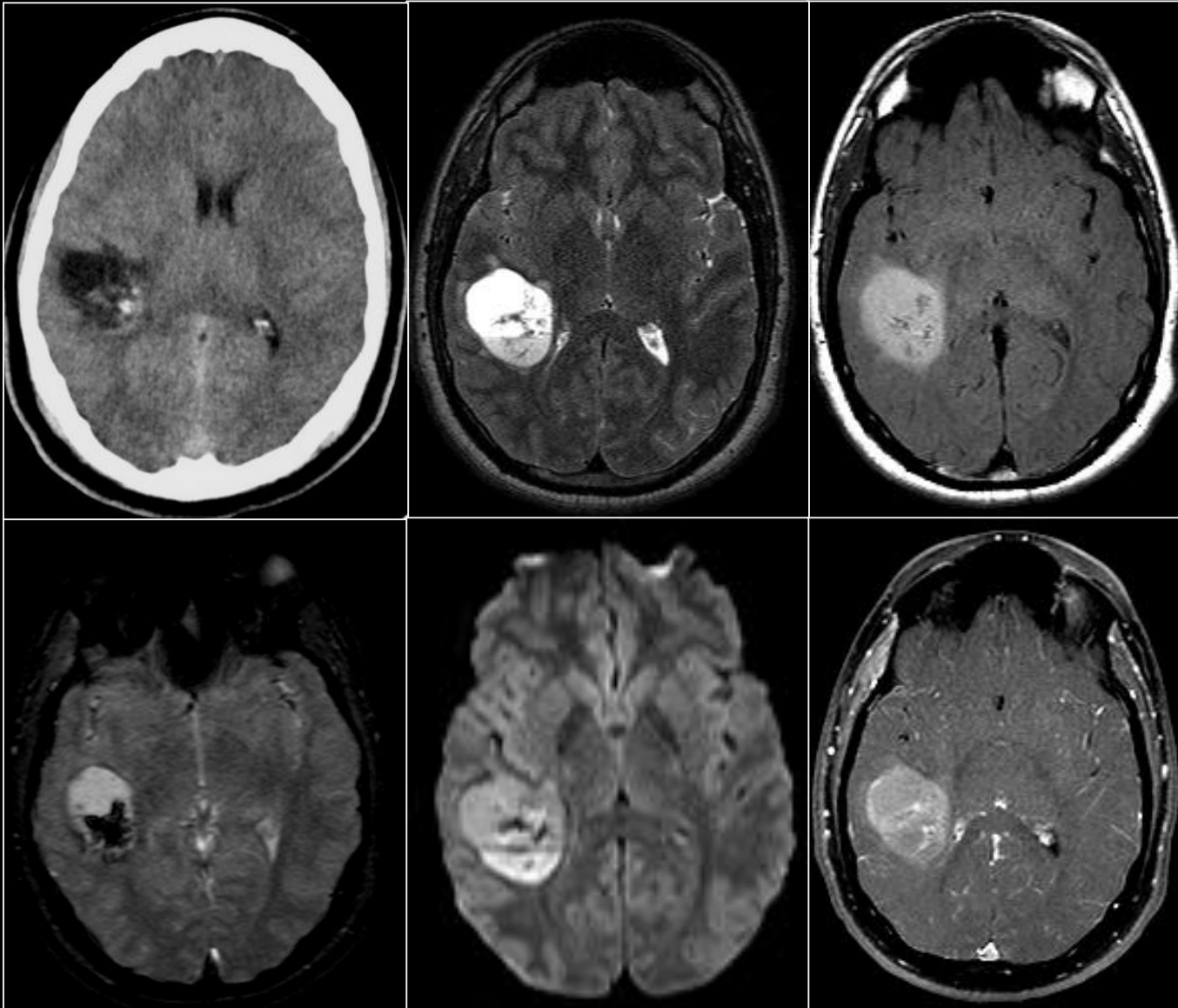
2nd signs: ipsilateral fornix and mammillary body atrophy, enlarged ipsilateral temporal horn and choroidal fissure

Dysembryoplastic Neuroepithelial Tumor (DNET)



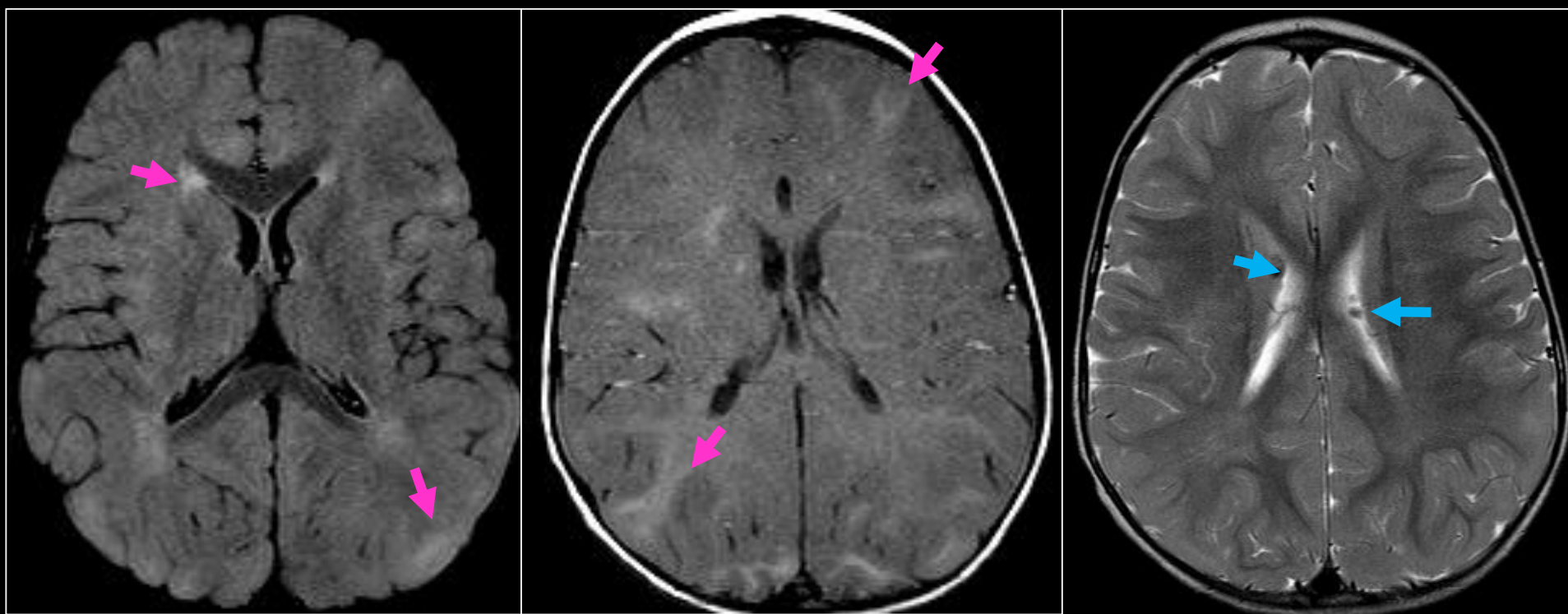
- High epileptogenicity
- Cortically-based tumor
- Medial temporal lobe (MCC location)
- Associated with cortical dysplasia
- **Imaging:**
 - “Bubbly” cortically-based tumor
 - No enhancement or calcification

Oligodendroglioma



Partially calcified subcortical/cortical mass in middle-aged adult

Tuberous sclerosis



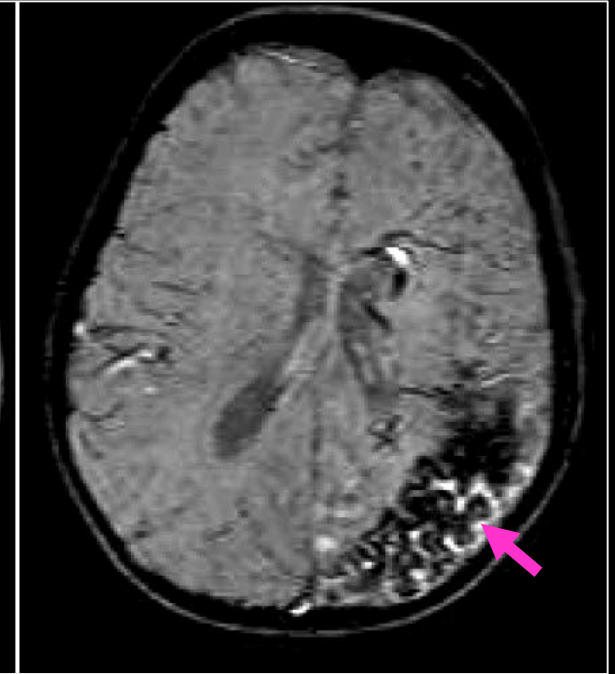
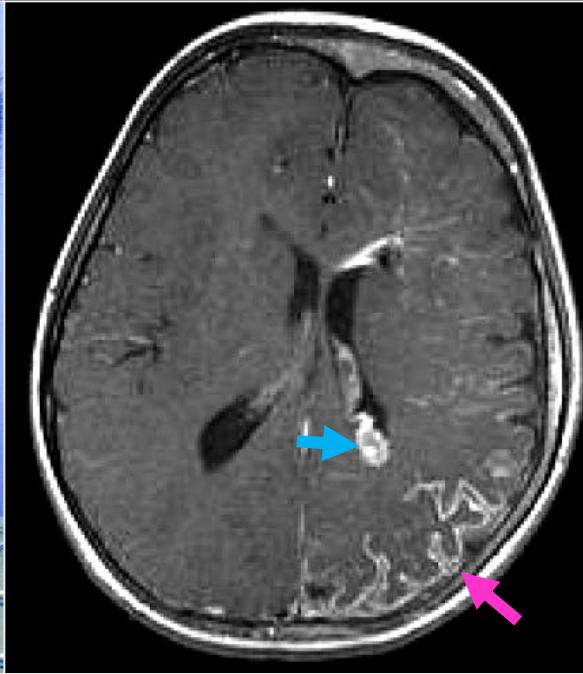
Clinical triad

- Facial angiofibromas (90%)
- Mental retardation (50-80%)
- Seizure (80-90%)

Classic Radiographic Findings:

- Cortical tuber
- Subependymal nodule (<1.3 cm)
- Subependymal giant cell astrocytoma (> 1.3 cm)

Sturge Weber syndrome



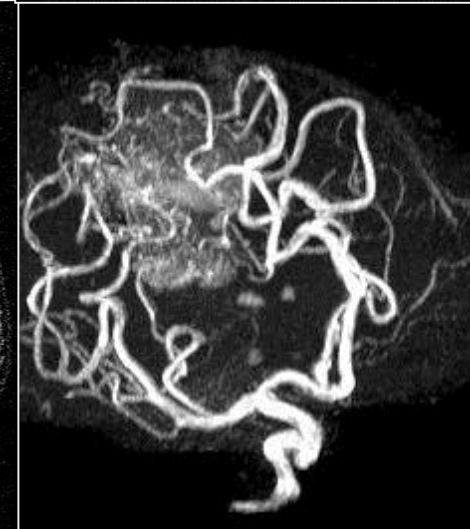
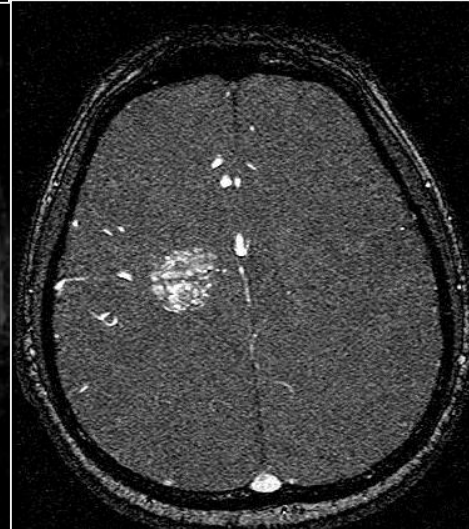
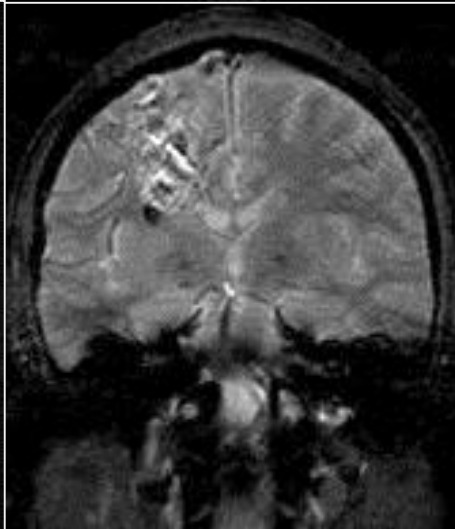
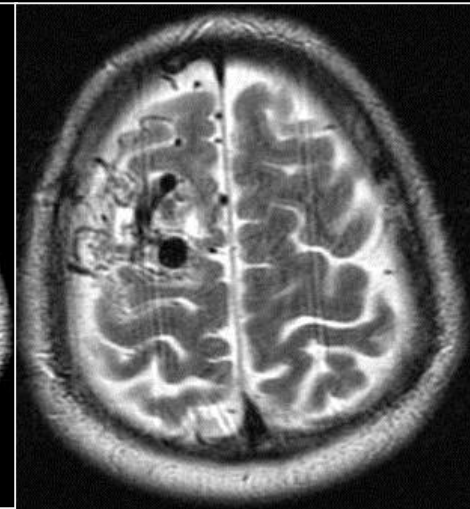
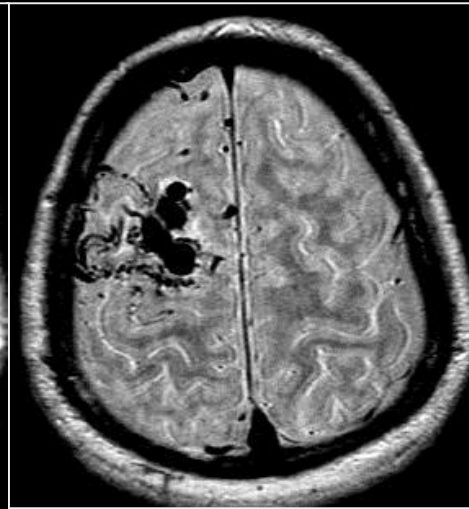
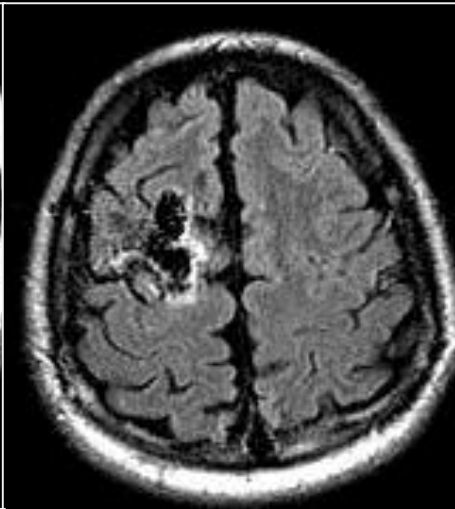
Clinical presentation

- Port wine stain (CN V1 98%)
- Seizure (75-90%)
- Hemiparesis (30-66%)

Imaging findings

- Ipsilateral to port wine stain
- Gyral/subcortical white matter calcifications (tram-track calcification)
- hemispheric brain atrophy
- Serpentine leptomeningeal enhancement
- Engorged/enlarged enhancing choroid plexi

AVM



Summary

Role of Imaging

- **Pre-surgery**

- Identify structural abnormality

- **Plan for surgery**

- Help confirm epileptogenicity
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- Predict resectivity and Prognostication

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Thank you