Advances in Epilepsy Neurodiagnostics and Neuroimaging

- Evolution from 2D to 4D Imaging –

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Conclusions:
- Integration of EEG and neuroimaging can best determine the direction of treatment for patients with epilepsy.
The technological advance allows demonstration of epileptic and normal activities in up to **four** dimensions. This is useful to localize both seizure focus and functionally-important areas.
What would an epilepsy specialist do for patients whose seizures are difficult to control by medications?

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Epilepsy would be evaluated using these modalities.

Long-term Video-EEG

MRI

PET
Long-term video-EEG

Generalized epilepsy
>Medications. Diet.

Focal epilepsy
>Medications.
If fail, surgery.
MRI can often tell us the underlying cause of focal epilepsy.

(Tumor) (Focal cortical dysplasia) (Hippocampal sclerosis)

(Asano and Chugani, 2005)
MRI may reveal a giant lesion causing focal seizures particularly in children.

Porencephaly

Hemimegalencephaly
Glucose PET shows us the integrity of brain metabolism.

In-between seizures, the seizure focus generally appears cold on PET, since it does not utilize the energy.

PET may tell us the location of the seizure focus, even if MRI is read as normal.
A 3-year-old girl with uncontrolled seizures.

“MRI read as normal”

(Chugani, Juhasz, Asano, Sood, 2008)
PET can also give us the general idea if the seizure focus can be removed safely.
Functionally-important brain pathways on 3D MRI
Motor pathways on 3D MRI

(Jeong et al, 2013)
Integration of EEG, PET, and 3D MRI
Integration of EEG and imaging in four dimensions will increase our understanding of seizure generation and normal function in patients with epilepsy.
4D mapping of seizure generation in a 9-year-old girl with seizures.
4D mapping of language activity in a 16-year-old boy with seizures.
4D mapping of language activity in a 16-year-old boy with seizures.
4D mapping of short-term memory.
New technology for automatic detection of seizure focus and important areas.
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MRI localization of important function
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Localization of memory function
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