



ศูนย์โรคลมชักคณะแพทยศาสตร์โรงพยาบาลรามาธิบดี
Ramathibodi Multidisciplinary Epilepsy Center (RMEC)

Presurgical evaluation for epilepsy surgery

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Objectives

- Introduction to presurgical evaluation for epilepsy surgery
 - basic concepts for neurology residents
 - selection of surgical candidates for epilepsy surgery

Introduction

- The management of patients with epilepsy is focused on three main goals: controlling seizures, avoiding treatment side effects, and maintaining or restoring quality of life.
- Epilepsy surgery is a well-accepted treatment for drug-resistant epilepsy and should not be a last resort.

Initial clinical evaluation in epileptic patients

- A comprehensive evaluation is essential in epilepsy patients.
 - history from patient and caregivers
 - physical examination
 - laboratory tests

History from patient and caregivers

- Seizure
 - etiology?
 - how many seizure types?
 - duration of seizure?
 - seizure frequency?
 - seizure precipitating factors?

History from patient and caregivers

- review of past and current medications
- impacts of seizure on quality of life
- past medical history
- psychosocial issues
- behavioral problems

Review of past and current medications

- Anti-seizure medications
 - drug A: seizure control?
 - age?
 - adverse effects?
 - correct dosages?
 - drug interaction?
 - maximum tolerated doses?
 - comorbidity?

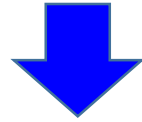
Physical examination

- Specific neurologic disorders
 - epilepsy syndromes
- Focal neurologic deficits
- Evidence of diffuse cerebral dysfunction
- Comorbidity

Clinical laboratory tests in epileptic patients

- Routine laboratory tests for diagnosis and baseline
 - blood tests
 - electroencephalography (EEG)
 - neuroimaging

Initial clinical evaluation(1st OPD visit)



What is the most appropriate treatment for each epileptic patient ?



treatment



goals of epilepsy treatment?

Treatment of epilepsy

- The management of patients with epilepsy is focused on three main goals:

- ☒ 1. no seizures of any type (seizure freedom)
- ☒ 2. no adverse effects from anti-seizure medication, and/or treatment
- ☒ 3. normal quality of life

Presurgical evaluation for epilepsy surgery

Patient information

1. What is the objective of the evaluation?

- diagnosis
- surgical candidate
- goals of epilepsy treatment

2. What is the best treatment options?

3. Benefits, risks, and adverse effects of epilepsy surgery

23 yo right-handed male with atonic seizure

Previous AEDs

- PB → rash

- Topamax → rash

Current AEDs: LEV, VPA, LTG, GBP

Underwent for anterior corpus callosotomy

Basic concepts of presurgical evaluation for epilepsy surgery

The importance of presurgical evaluation

To have accurate localization and delineation of the extent of the epileptogenic zone

To detect any comorbidities

To predict and minimize the postoperative neurologic deficits



complete and safe resection of the epileptogenic zone

postoperative seizure freedom

normal quality of life

Definition of abnormal brain areas

	Definition	Measures
Epileptogenic zone	The area of brain that is necessary and sufficient for initiating seizures and whose removal or disconnection is necessary for abolition of seizures.	theoretical concept
Irritative zone	area of cortex that generates interictal EEG	EEG
Ictal onset zone	area of cortex where seizures are generated	EEG
Epileptogenic lesion	Structural abnormality of the brain that is the direct cause of the epileptic seizures.	neuroimaging, tissue pathology
Symptomatogenic zone	Portion of the brain that produces the initial clinical symptomatology.	behavioral observation and patient report
Functional deficit zone	cortical area of non-epileptic dysfunction	neurologic exam, neuropsychological testing, EEG, PET, SPECT

Scientific method

What is your hypothesis?

- Where is the epileptogenic zone?
- Where is the ictal onset zone?

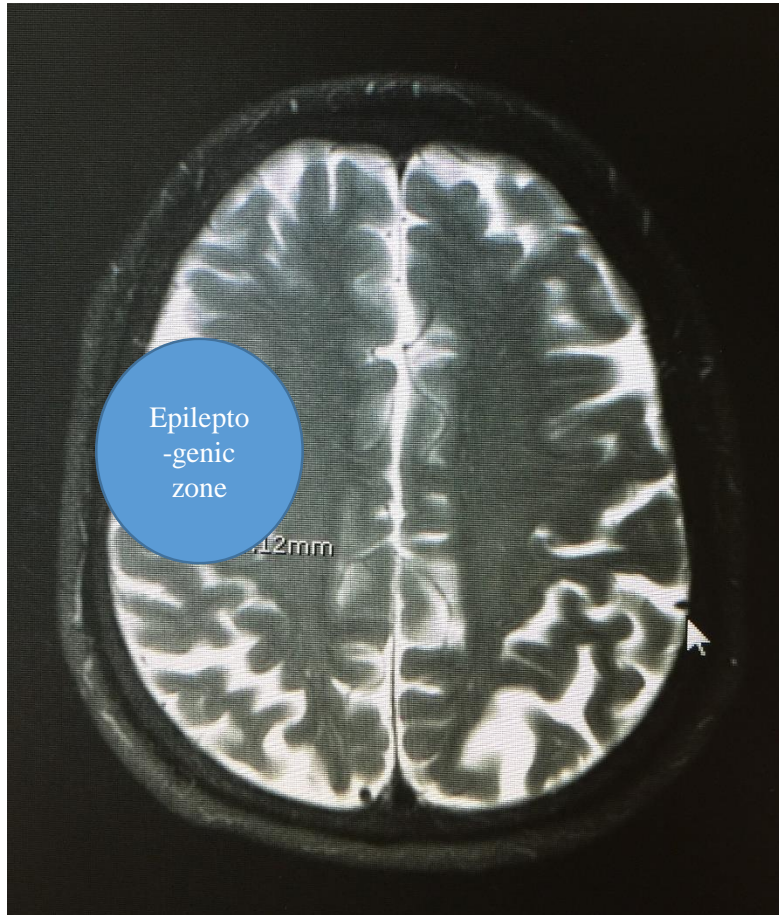
Case#1

- A 65 yo right-handed male presents with first episode of left face tonic-clonic with preserved awareness, lasting 5 minutes. During the event, he was able to understand what was going around himself. But, he had trismus and was not able to talk any single words. No GTCs.
- Neuro exam – mild left facial palsy(UMN)
- Normal EEG

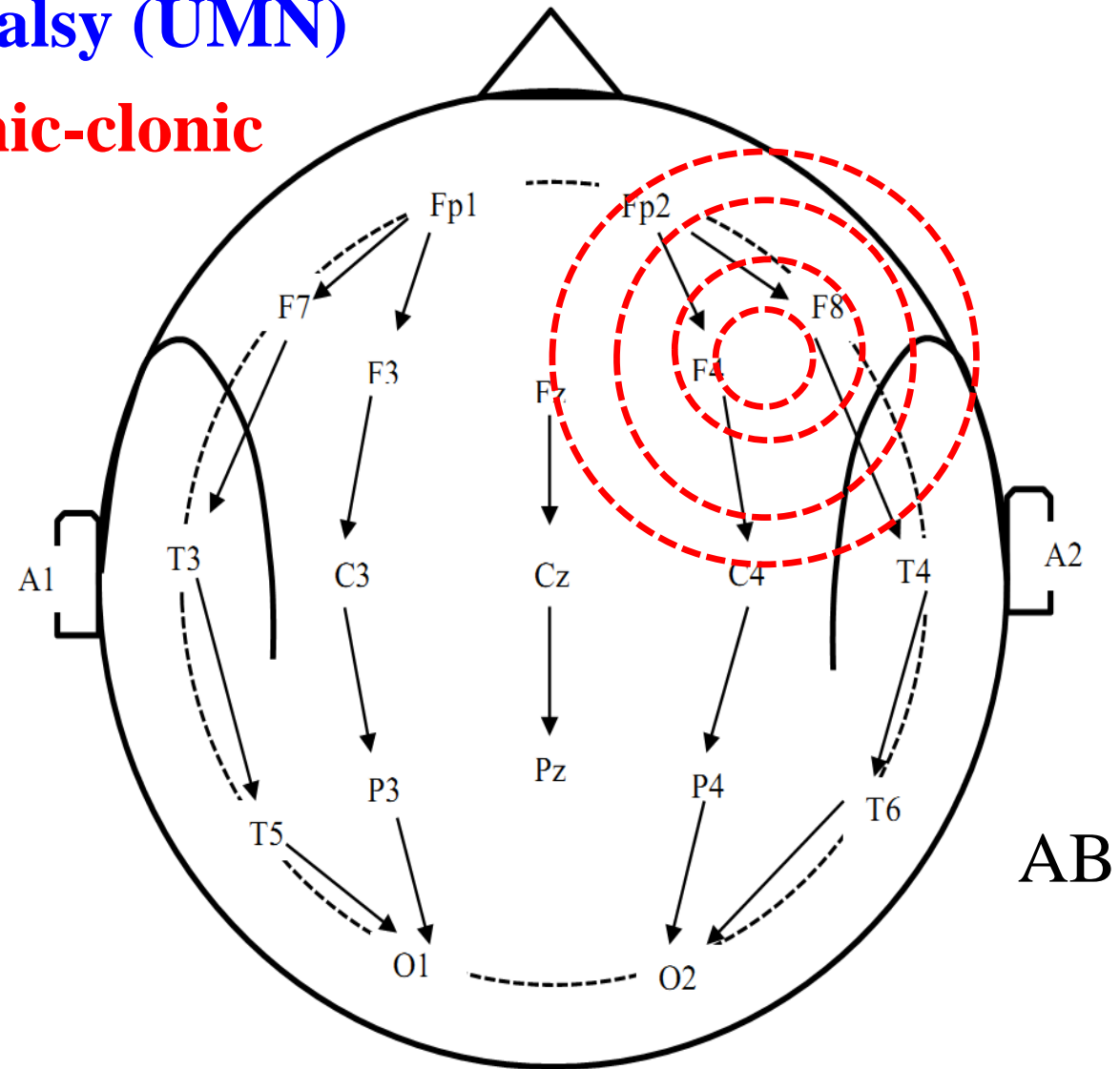
Case#1

left facial palsy (UMN)

left face tonic-clonic



epileptogenic lesion on face area



OR for awake craniotomy and tumor removal

Case#2: mesial temporal sclerosis

- A 39 yo right-handed male with past medical history of left mesial temporal sclerosis who is referred here for presurgical evaluation.
- Seizure began at the age of 15.
- Seizure type 1: eye staring and loss of awareness
Seizure frequency: 10 per months

Seizure type2: GTCs

Seizure frequency: 5 per months

Current meds: depakine, lamotrigine, lacosamide, clonazepam

Neuropsychological tests

- Conceptual ability: impairment of general cognitive ability
- WAIS: impairment in verbal memory
- Attention: impairment in complex attention
- Memory: impairment in immediate, and delayed memory
- Executive function: mild impairment

Treatment of epilepsy

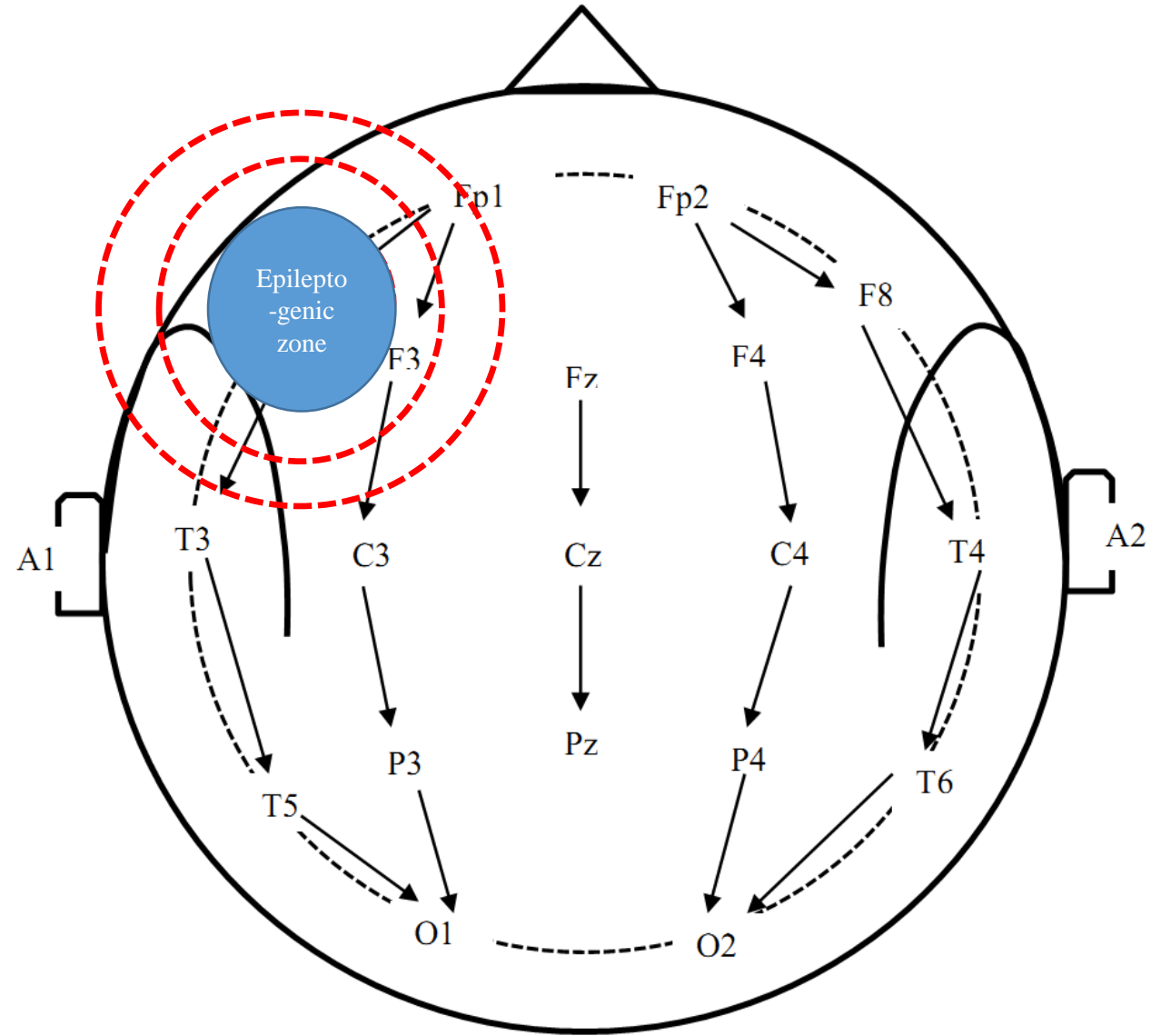
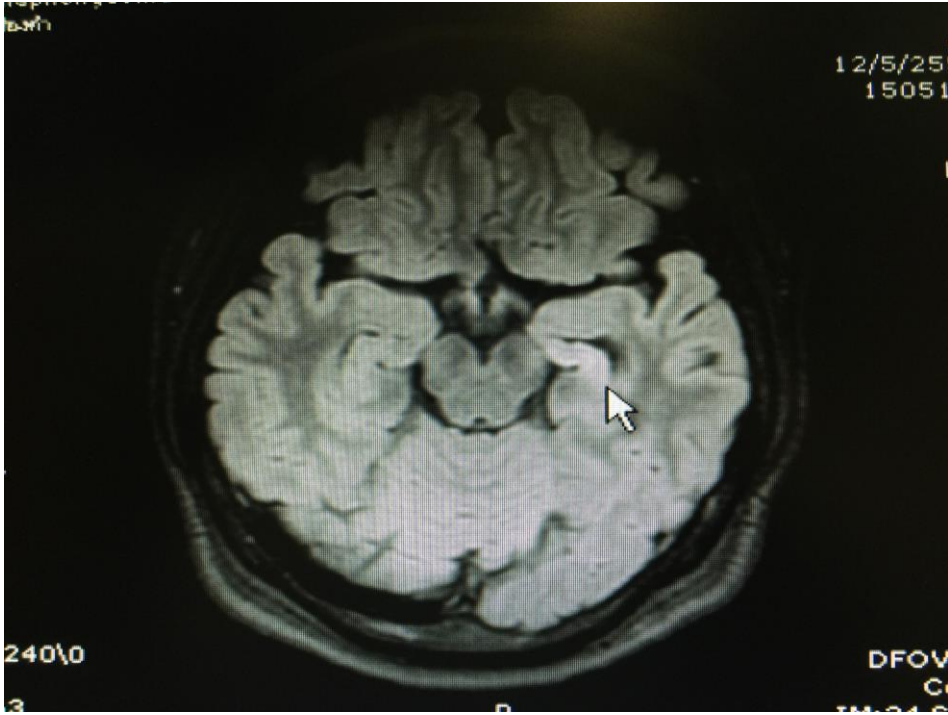
- The management of patients with epilepsy is focused on three main goals:

- ☐ 1. no seizures of any type (seizure freedom)

- ☒ 2. no adverse effects from anti-seizure medication, and/or treatment

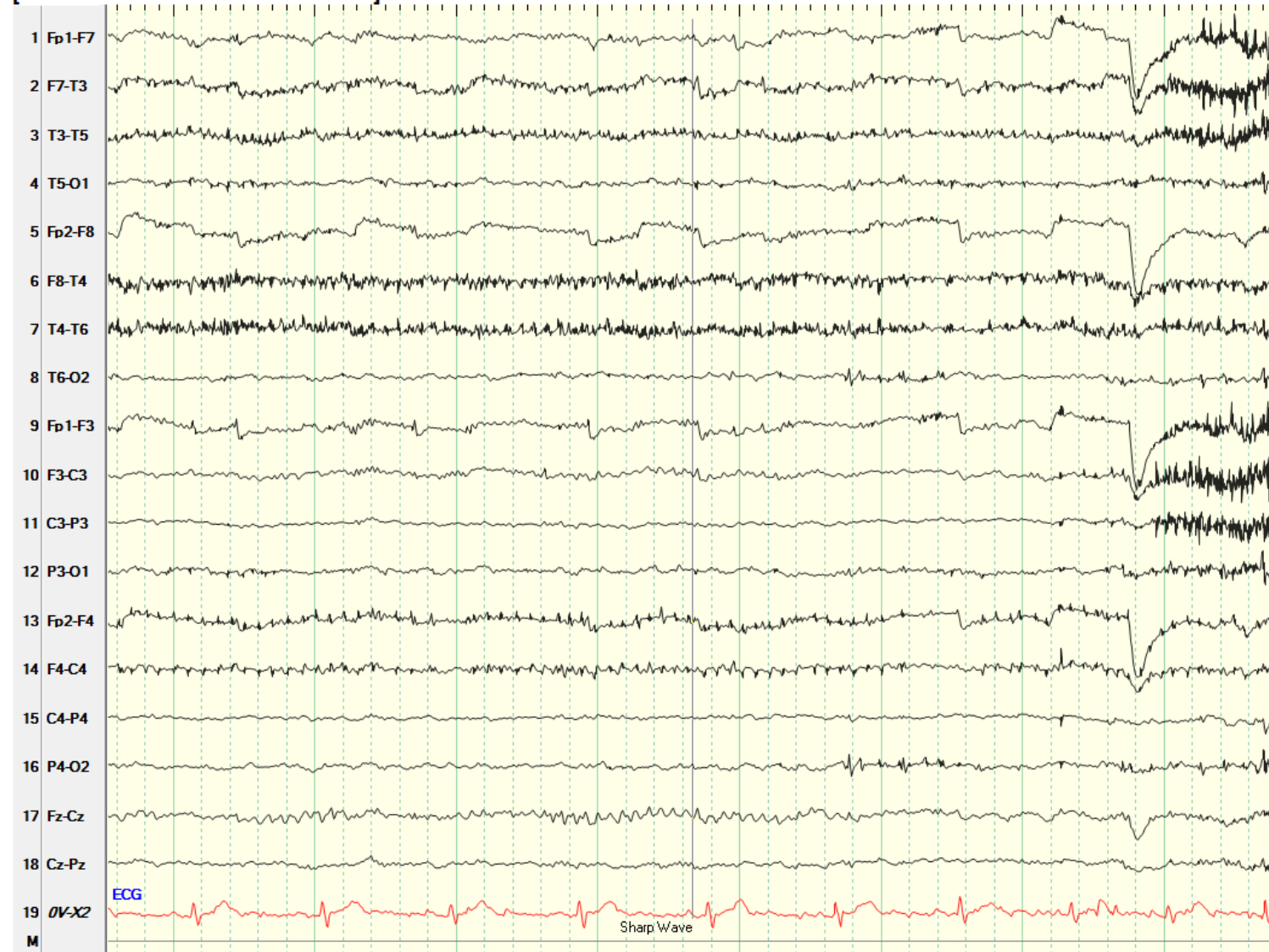
- ☐ 3. normal quality of life

Case#2



Case#2: interictal

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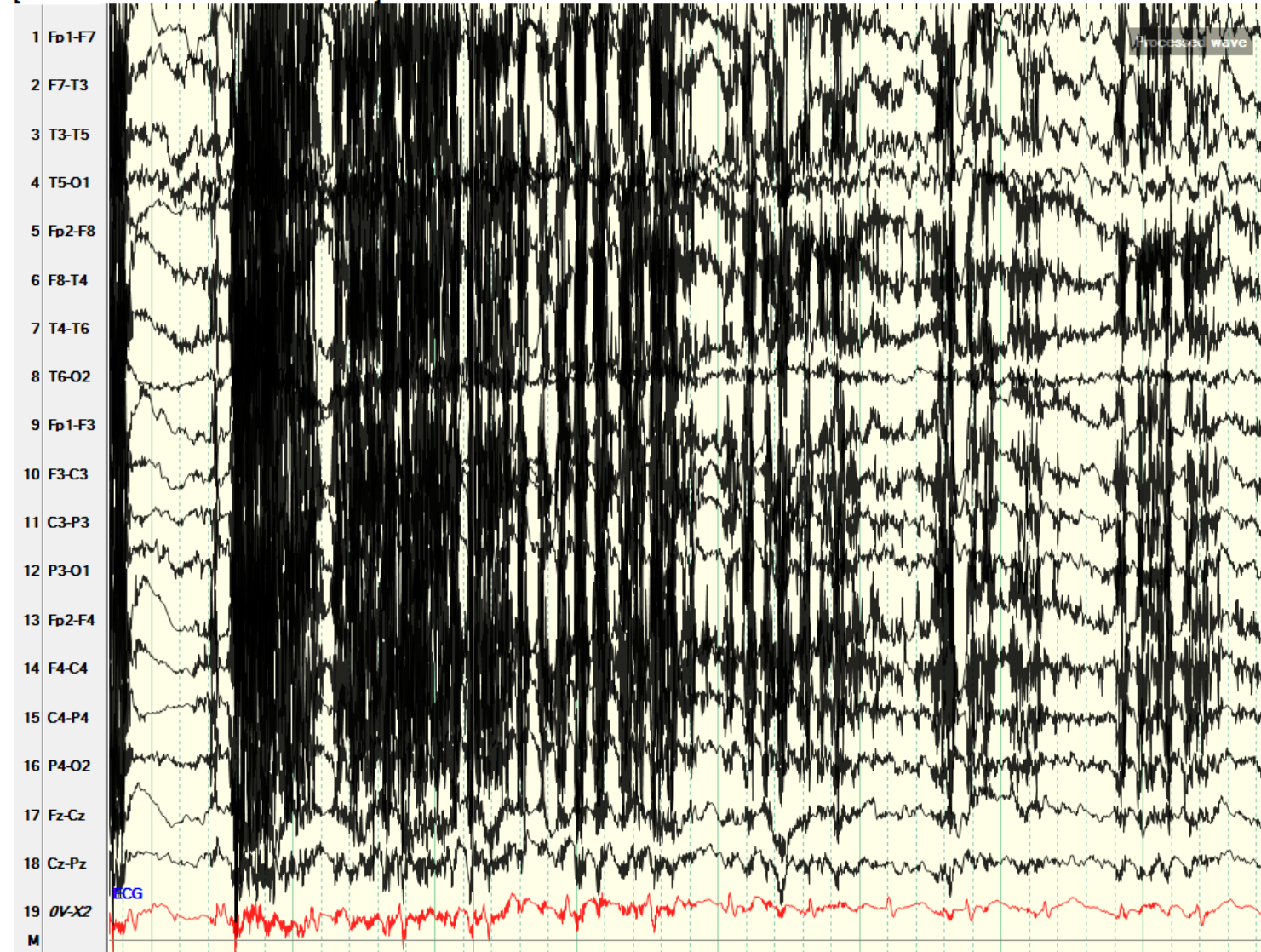
Case#2: EEG onset

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Case#2: 10 seconds later

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Case#2: 20 seconds later



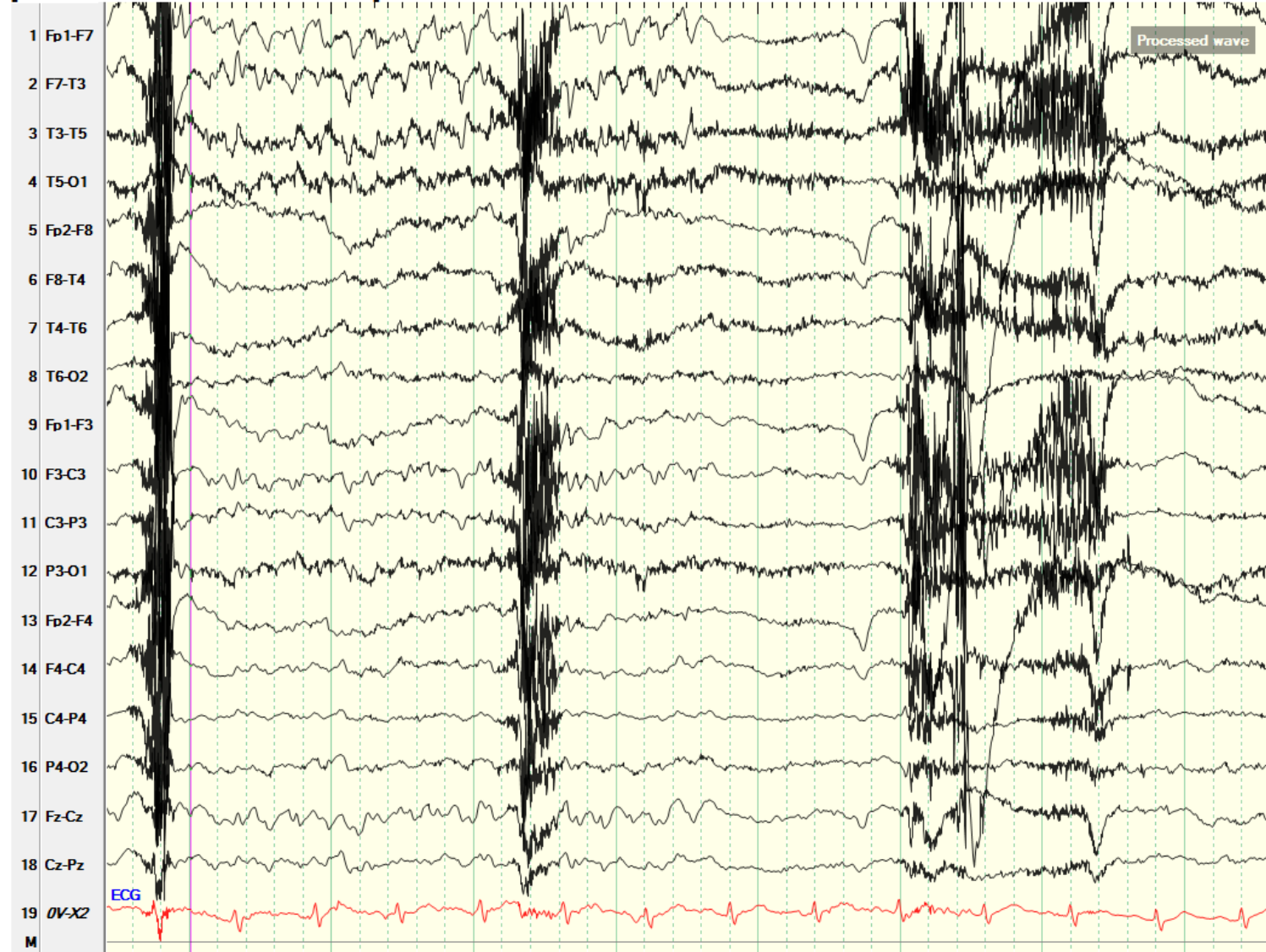
Case#2: 30 seconds later

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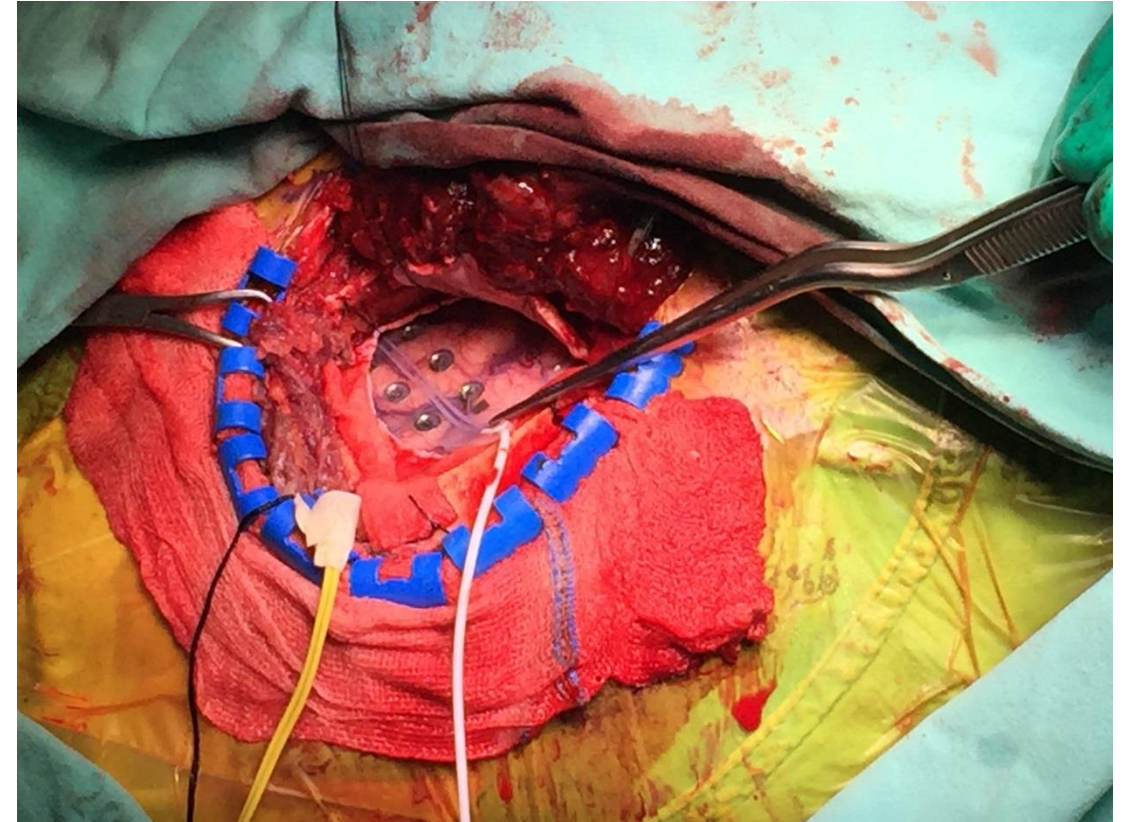
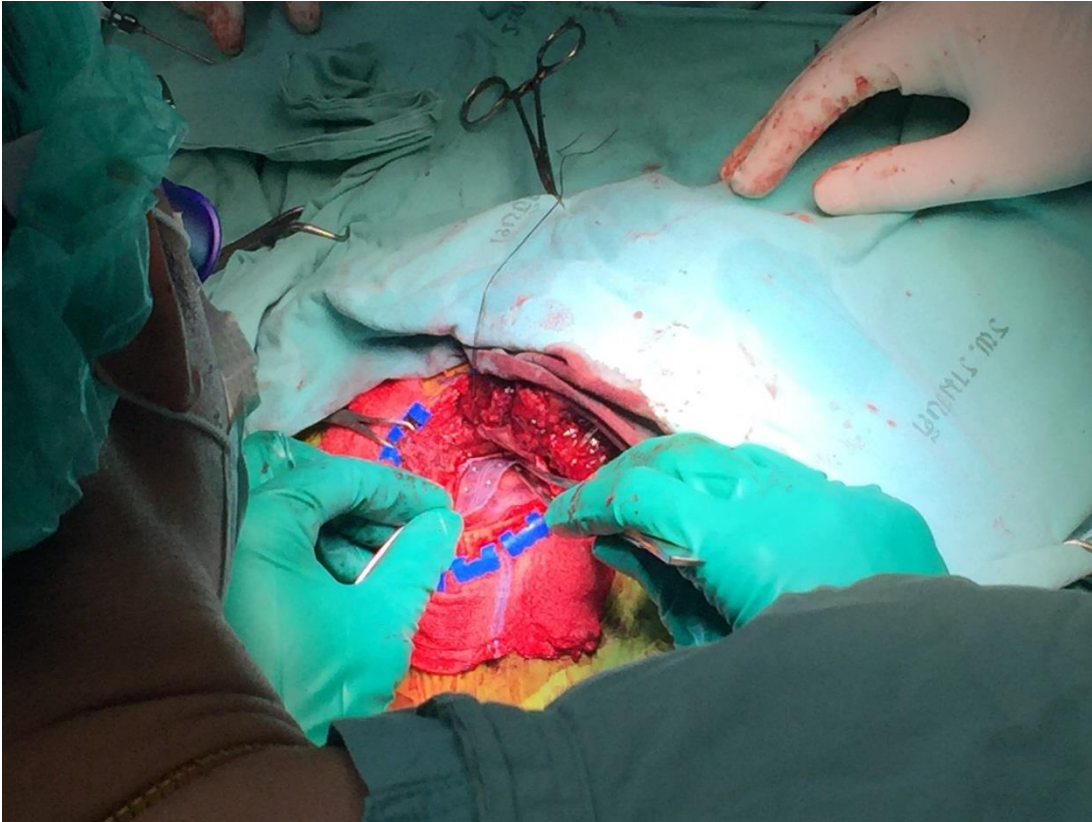


Case#2: 40 seconds later

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Electrocorticography (ECoG) shows interictal spikes at left mesial temporal



Brain pathology is consistent with left mesial temporal sclerosis.

Electrocorticography (ECoG) shows interictal spikes at left mesial temporal



Basic presurgical evaluation

- Clinical history from the patient and relatives
- Physical examination
- Routine EEG
- Video EEG monitoring
- Brain MRI with epilepsy protocol
- Neuropsychological evaluation

Routine EEG

- Objectives
 - areas of neuronal dysfunction during interictal and ictal period
 - seizure type and epileptic syndrome
- Indication
 - all epileptic patients

Long-term video EEG monitoring

- Objectives
 - seizure or not seizure?
 - seizure semiology
 - localization of ictal onset zone
 - electroclinical correlation
- Indications
 - presurgical evaluation for epilepsy surgery
 - diagnosis of non-epileptic events

MRI with epilepsy protocol

- Objectives
 - identify the etiology
- Indication
 - all patients with epilepsy(excepts those with very typical forms of primary generalized epilepsy)
 - all patients with drug-resistant epilepsy
 - focal neurologic deficits

Cognitive and neuropsychological evaluation

- Baseline pre- and post-operation
- To localize or lateralize the functional deficit zone that may help in identifying the region of seizure onset
- To counsel the patient regarding the memory outcome after epilepsy surgery

Cognitive and neuropsychological evaluation

- There is no standardized protocol.
- Objectives
 - to identify the location and extent of the functional deficit zone
 - to evaluate the presence of verbal or nonverbal learning and memory deficits
 - to detect any psychiatric conditions associated with epilepsy
- Indications
 - presurgical evaluation for epilepsy surgery

Neuropsychological tests

Domain	Neuropsychological tests
Visual attention	Trail Making Test, part A&B (TMT)
Auditory attention	WAIS-IV or WISC-IV Digit Span
Motor speed/dexterity	Grooved Pegboard
General verbal ability	WAIS-IV or WISC-IV Vocabulary
General visuospatial ability	WAIS-IV or WISC-IV Block design
Verbal memory	Rey Auditory Verbal Learning test(RAVLT), WMS-IV, Paired Associate Learning

WAIS= Wechsler Adult Intelligence Scale

WISC = Wechsler Intelligence Scale for Children

WMS= Wechsler Memory Scale

Neuropsychological tests

Domain	Neuropsychological tests
Visuospatial memory	Brief Visuospatial Memory Test-Revised(BVMT-R), WMS-IV Visual reproduction
Word retrieval	Boston Naming Test
Executive function	Wisconsin Card Sorting Test

Presurgical evaluation strategy

basic presurgical evaluation



hypothesis

concordance of the data



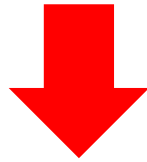
yes



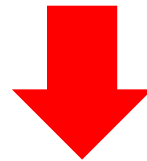
select the best treatment

Presurgical evaluation strategy

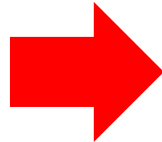
basic presurgical evaluation



concordance of the data



no



additional evaluation
(only in selected cases)



select the best treatment

- This is a 64 yo right-handed male with past medical history of drug-resistant epilepsy who is here presurgical evaluation. The patient has two types of seizure. The history of seizure began at the age of 31.
- Seizure type 1: eye staring, chewing, and loss of awareness
Seizure frequency 1-2 times per month
Seizure duration: 1-2 per minute
- Seizure type2: generalized tonic-clonic seizure
Seizure frequency: 0 per month

- MRI brain (05/2557): diffuse brain atrophy more advanced than age; right hippocampus is smaller than left hippocampus.
- Routine EEG (05/2557): continuous slow, right temporal

- EEG abnormality:

1. Intermittent slow, generalized and lateralized right hemisphere, maximum right frontotemporal
2. Intermittent slow, left frontotemporal
3. Continuous slow, right temporal
4. Sharp wave, right temporal, maximum T4 and F8 – 40% of interictal
5. Sharp wave, left temporal, maximum F7 – 60% of interictal
6. EEG and clinical seizures- left frontotemporal onset

Additional evaluation (only in selected cases)

- Functional brain MRI
- Interictal and ictal SPECT
- PET
- Electrocorticography
- Invasive EEG monitoring
- Cortical stimulation

Case#2

A 22yo left-handed female presents with recurrent seizures.

Seizure type1: left hand and arm tonic with preserved awareness → GTCs

- more than 10 per month
- continuous seizures for 3-4 days during menstruation
- last GTCs was a year ago.

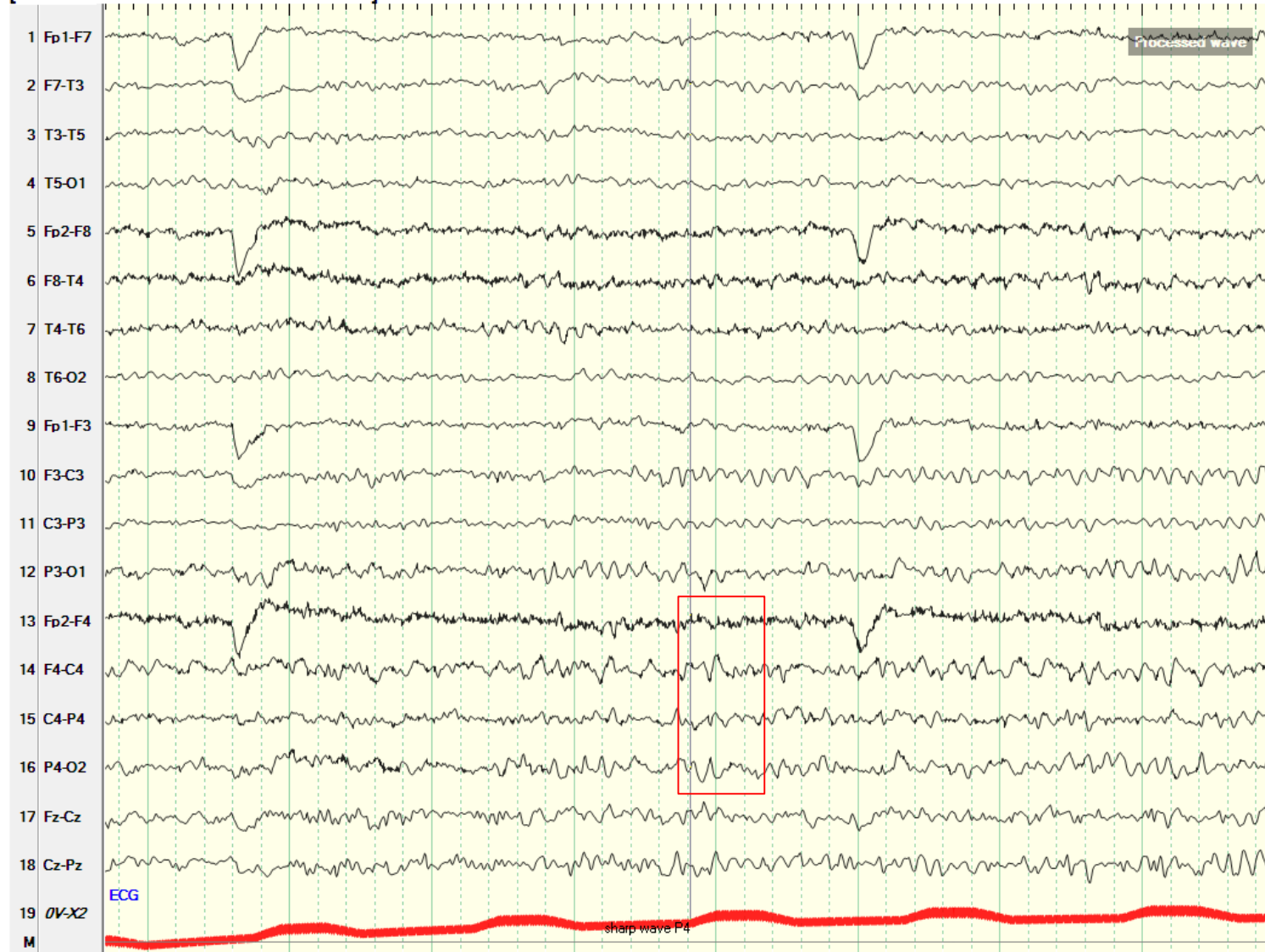
Current meds: phenytoin, levetiracetam

Past AEDs: carbamazepine, clobazam

Brain MRI: normal

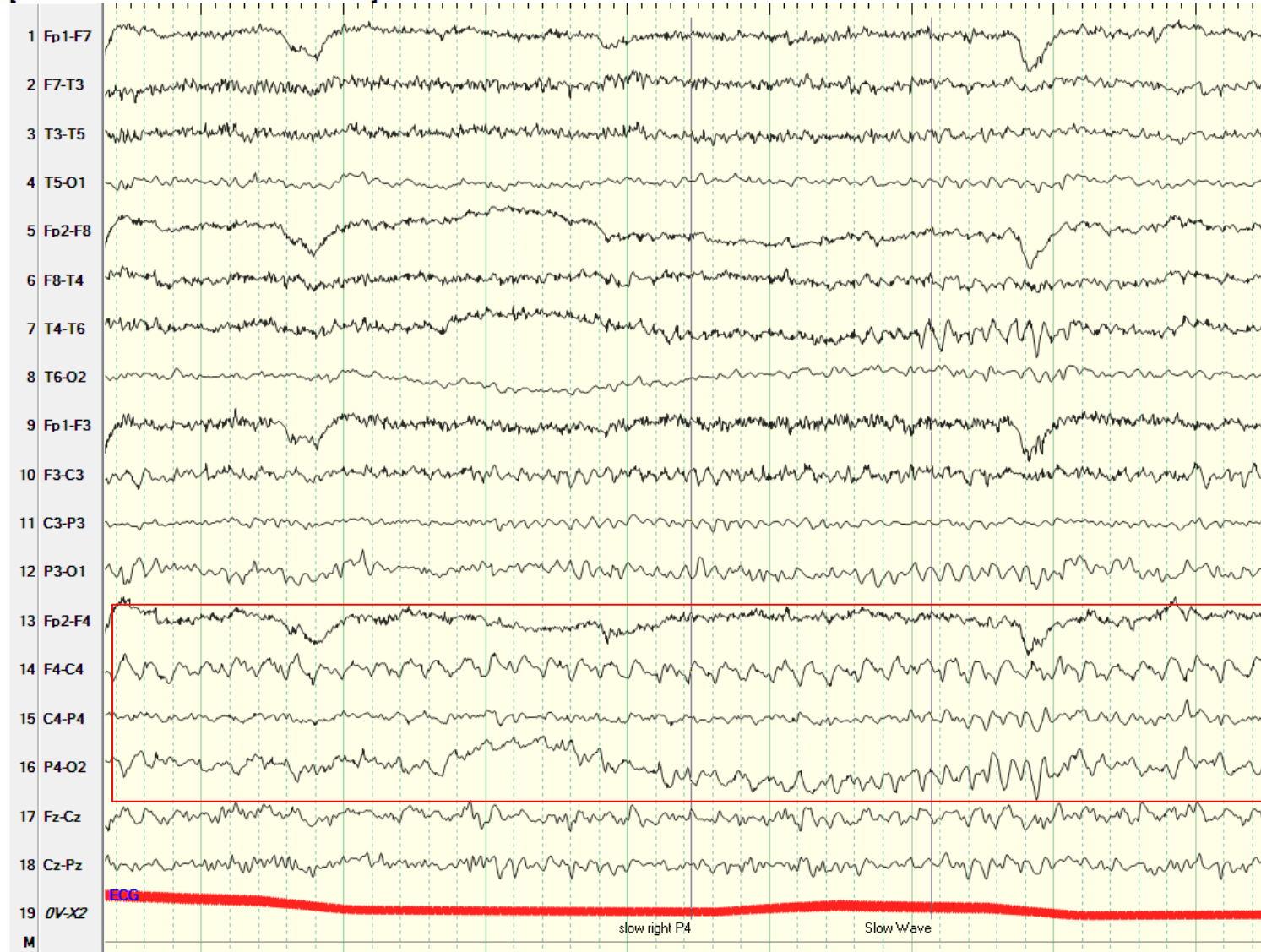
Case#2: interictal EEG

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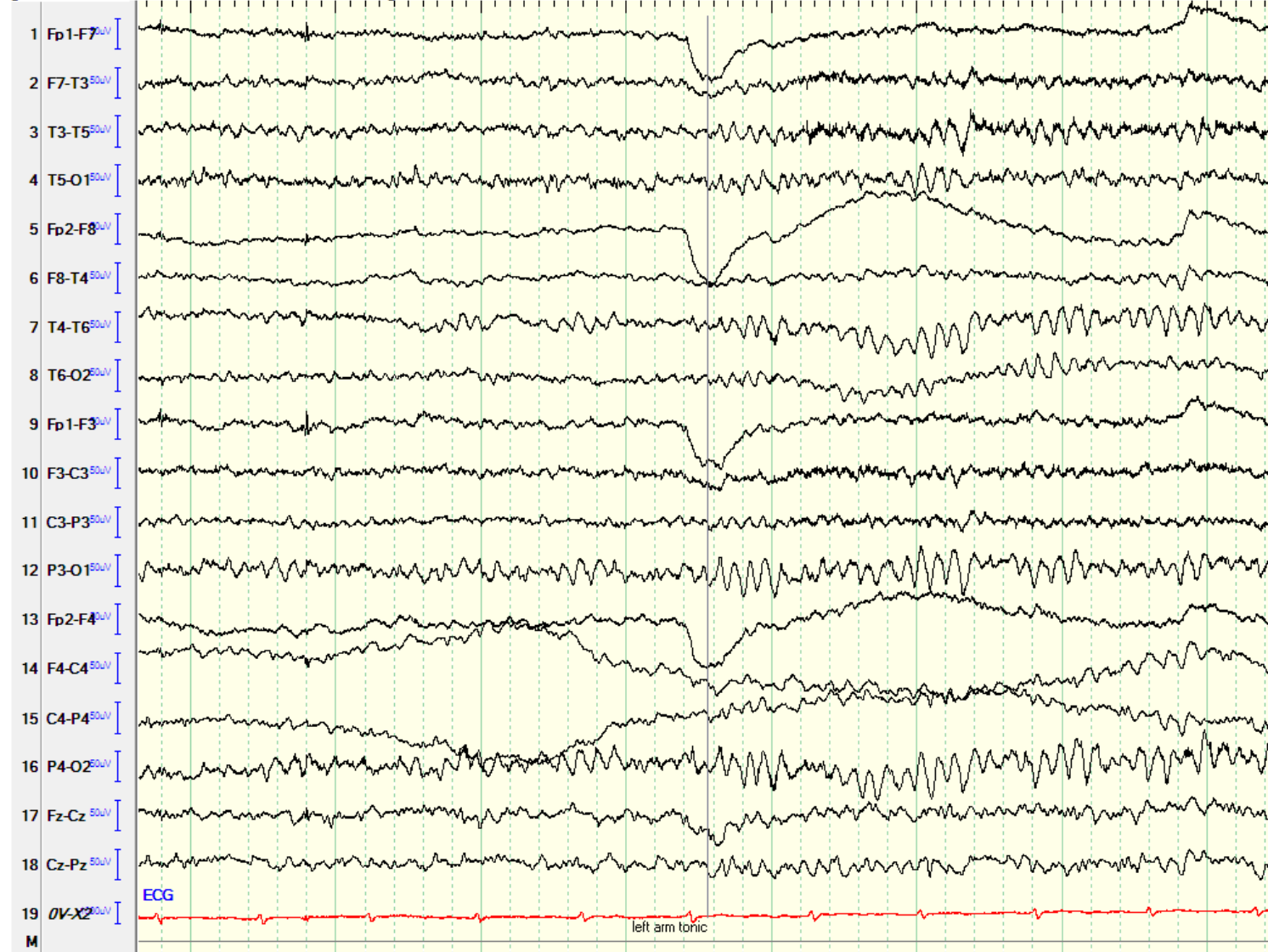
Case#2: interictal EEG

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Case#2: ictal EEG onset

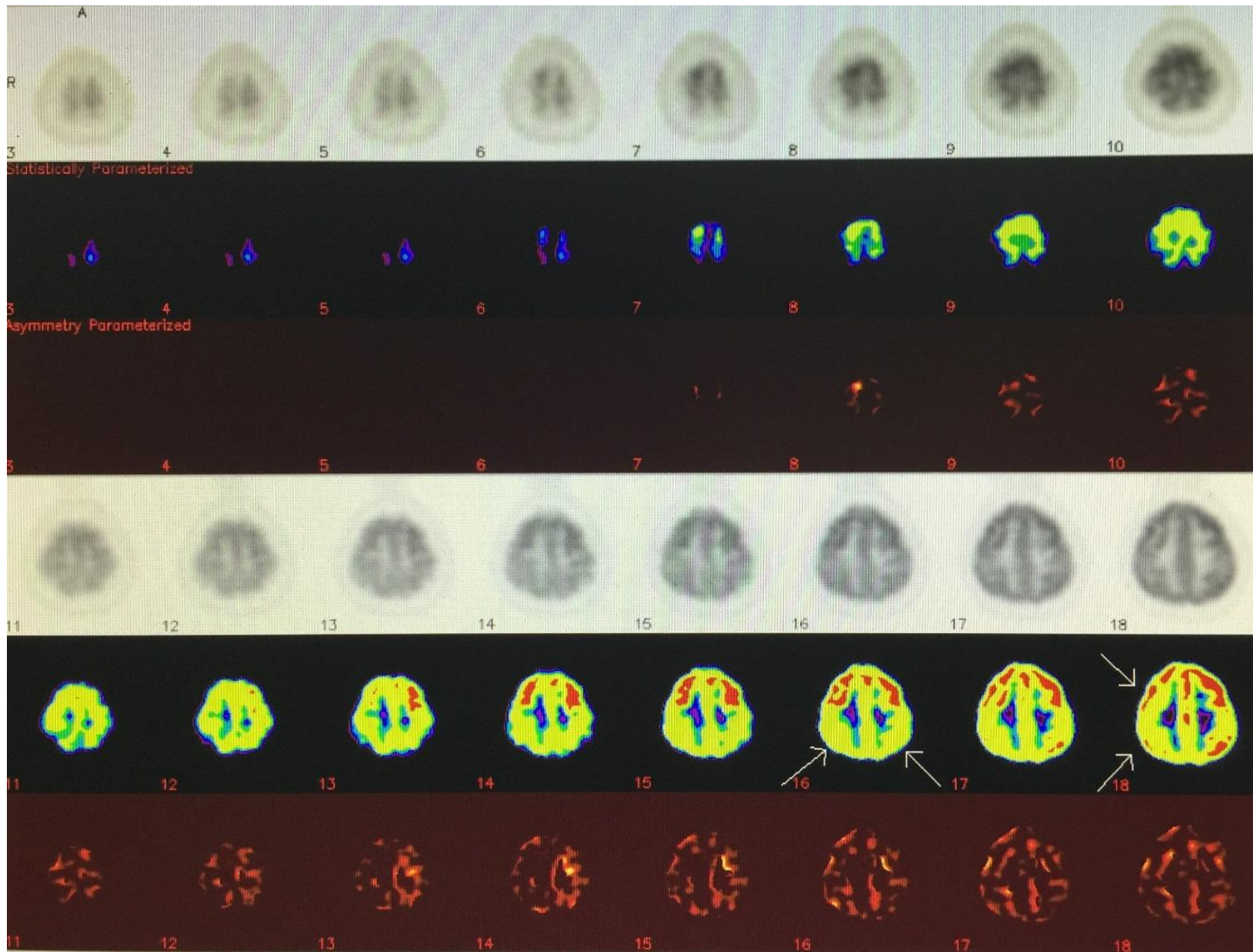
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Case#2: 10 seconds later

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PET: hypometabolism at right parietal lobe

Single photon emission computerized tomography (SPECT)

- Objectives

- localization of epileptogenic zone

- Indication

- discordant results or non-localizing
- guidance in the placement of intracranial electrodes

Invasive EEG monitoring

- Objectives
 - localization of epileptogenic zone
- Indication
 - failed noninvasive tests
 - discordant results

Surgically remediable epilepsy syndromes

- Characteristic features:
 - known pathophysiology
 - predictable natural history
 - unresponsive to pharmacotherapy
 - progressive features (e.g., developmental delay, psychosocial disturbances)
- Epilepsy surgery is the most effective method.
 - 70-90% chance of seizure free

Selection of ideal candidates for epilepsy surgery

- Drug-resistant epilepsy *
- Seizures causing significant disability and impaired quality of life
- Epileptogenic zone can be localized.
- Acceptable risks and benefits of epilepsy surgery

Surgically remediable epilepsy syndromes

- Mesial temporal lobe epilepsy
- Epilepsies due to well-circumscribed resectable lesions
- Epilepsies in infants and young children due to large or diffuse lesions limited to one hemisphere (e.g., porencephalic cysts, Rasmussen's encephalitis, Sturge-Weber syndrome, hemimegalencephaly, and other large malformations of cortical development)

Indications for epilepsy surgery

- Drug-resistant epilepsy *
- Focal epileptogenic structural lesion
- Single epileptogenic focus amenable to resection
- Surgically remediable syndrome **

*Epilepsia. 2010 Jun;51(6):1069-77

**Engel, 1996

Relative contraindications for epilepsy surgery

- Progressive medical or neurological disorder
- Primary generalized epilepsy
- Minor seizures which do not impaired the quality of life.
- Active psychosis that is not related to peri-ictal period.
- Poor contralateral memory function (for temporal lobectomy)

Conclusions

- Epilepsy is a well-accepted treatment for drug-resistant epilepsy and should not be a last resort.
- For epilepsy surgery to be successful, the precise localization and delineation of the extent of the epileptogenic zone, and its complete and safe removal is required in each epilepsy patient.

Thank you

สมาคมโรคลมชักแห่งประเทศไทย Epilepsy Society of Thailand



<http://thaiepilepsysociety.com>