Frontal Lobe Epilepsy Diagnostic Challenge
(video session)

Nirmeen A. Kishk, MD
Prof. of Neurology
Cairo University
Luxor, Feb. 2017
nirmeenkishk@kasralainy.edu.eg
No Disclosure
Inferior orbital aspect

Dorsolateral aspect

Medial aspect

Complex & least understood network
Why Frontal lobe semiology?

- FLE is considered 2nd cause of focal epilepsy.
- Affect all age groups.
- Reflect activation of different structures within dynamic system (Epileptic Network) which lead to:
  - C/P: complex, subtle, Bizarre, mainly nocturnal.
  - Rapid & Unpredicted Propagation
  - Idiosyncratic presentation
- Mimic other disorder (Epileptic & non Epileptic)
• NREM: Neuronal synchronization with thalamocortical networks allowing recruitment of a critical mass of neurons, preserve antigravity muscle tone ------ increase SZ clinical expression.

• REM: Desynchronization, loss of muscle tone.
Can you describe Semiology of the Event?

Epileptic or Not

Hemisphere of onset

Can you Lateralyze?

Can you Localize?

Symptomatogenic zone

Can you comment on EEG?

Patient state?

Ictal EEG?

Post Ictal EEG?
The “gold standard” in finding semiology of localizing value is to analyze seizures in patients who have become seizure-free after a restricted cortical resection. (Quesney LF et al, 1990)
Central sulcus
Lateral sulcus/Sylvian fissure
Pre-central cortex
Premotor Cortex
Supplemental and premotor areas
Primary motor cortex
Hand skills
Head rotation
Contralateral eye movements
Word formation (Broca’s area)
Choice of words
Peripheral (Lips, Vocalization, Jaw, Tongue, Swallowing, Chewing)
Central (Neck, Trunk, Arms, Legs, Fingers, Feet)
Elementary motor & dystonic-BG
Eye fixation
Aversive SZ
Unnatural
Involuntary
Sustained
Forced

10s before G

Head deviation
Eye deviation

Tonic /Dystonic
Unnatural
Involuntary
Sustained
Forced
Posturing
(tonic >3 sec. & rotation)
In extension or flexion
Arm, hand, leg, feet, trunk
Postictal Automatism
Nose wiping
No prolonged postictal confusion

Aversive SZ
Unnatural
Involuntary
Sustained
Forced 10s before G
Head deviation
Eye deviation

Tonic /Dystonic
Unnatural
Involuntary
Sustained
Forced
Posturing
(tonic >3 sec. & rotation)
In extension or flexion
Arm, hand, leg, feet, trunk

Clonic: Myoclonic contractions that recur regularly about 0.2-5 per second
Complex Motor Automatism
Release / disinhibition
Emotional, (objective fear & aggression)

Body (fumbling)
Environment (tapping, grasping)

Autonomic SZ.
Cardiovascular
Respiratory
Gastrointestinal
Cutaneous
Pupillary
Urogenital

Pre-frontal cortex
D.L
O.F
V.M
O.F
What IS The Typical FLE???

• **S**——Sudden onset & offset
• **S**——Semiology variable in different patients
• **S**——Stereotyped within individuals
• **S**——Short duration (few sec to min)
• **C**——Cluster
• **N**——Nocturnal (out of sleep)
• **C**——Confusion postictal?
Case Scenario 1

- E.A, 15 Y.O female, RT handiness , 40kg ,Irrelevant past or Family history.
- Age of onset: 14 Y.O .
- She experienced events  5-7 times /night.
- Brief (less than one min).
- Semiology??.
- Nocturnal early after falling asleep , 6 months later nocturnal and diurnal & ↑ frequency.
Need Help!!

- Patient directed first to psychiatrist rather than to neurologist
Case Scenario

✓ Neurologic exam: Normal
✓ Normal MRI brain (3 Tesla)
✓ Normal Routine EEG
✓ video EEG monitoring for 12 hours:
✓ Record 5 nocturnal events in the form of:
Dramatic reaction to fear with frightened facial expression, screaming & abrupt agitation, **Pseudo purposeful movement** (complex automatisms) ex. kicking, pushing & pedaling (ESCAPE), No postictal confusion. **Autonomic signs**: flushing, tachcardia, Peri-ictal urination.
Video, 4S CNC

- **S**——Sudden onset & offset
- **S**——Semiology Dramatic reaction of fear
  Automatism complex motor & vocal (screaming, Abrupt agitation, apparent semipurposeful)
- **S**——Stereotyped
- **S**——Short duration (30 sec)
- **C**——Cluster (5 times in this night)
- **N**——Nocturnal (out of sleep)
- **C**——Confusion postictal minimal
Can you describe Semiology of the Event?

Can you Lateralize???

Can you Localize???
Can you comment on EEG?

Patient state?

Ictal EEG?

Myogenic artifact during Hyper motor activity masked scalp ictal activity

NREM sleep

Post Ictal EEG?

No postictal Slowing/awake
• Limited access to the scalp during EEG record especially mesial (inter-hemispherical) cortex orbito-frontal, and cingulum.
• Frequent muscle artifacts during motor SZ. Which can obscure the EEG recording.
Nocturnal frontal lobe epilepsy
A clinical and polygraphic overview of 100 consecutive cases

Federica Provini, Giuseppe Piazzi, Paolo Tinuper, Stefano Vandi, Elio Lugaresi and Pasquale Montagna

Summary
Nocturnal frontal lobe epilepsy (NFLE) has been delineated as a distinct syndrome in the heterogeneous group of paroxysmal sleep-related disturbances. The variable duration and intensity of the seizures distinguish three non-rapid eye movement-related subtypes: paroxysmal arousals, characterized by brief and sudden recurrent motor paroxysmal behaviour; nocturnal

that fit the diagnostic criteria for parasomnias. A minority of cases (13%) have personal antecedents (such as birth anoxia, febrile convulsions) or brain CT or MRI abnormalities (14%). In many patients, ictal (44%) and interictal (51%) EEGs are uninformative. Marked autonomic activation is a common finding during the seizures. NFLE does not show a tendency to spontaneous

Normal Ictal EEG in 44% & II EEG in 51%
IIEEG sharp wave RT central & midline central region
Longitudinal bipolar montage

72% DL FLE
33% medial FLE
Case Scenario

✓ R F, 16 Y.O female, RT handiness, 45kg, Irrelevant past or Family history.

✓ She experienced at age of 8 ys a recurrent events of abnormal limb movement & screaming diagnosed as panic attacks?? With no improvement on medication which received by psychiatrist.

✓ At age of 15 ys came to our clinic.

✓ Neurologic exam: Normal
✓ Normal MRI brain (1.5 Tesla)
✓ Normal Routine EEG
✓ video EEG monitoring for 12 hours:
✓ Record 3 nocturnal events in the form of:
Can you describe Semiology of the Event?

Epileptic or Not

Can you Lateralize???

Can you Localize???
Video, 4S CNC

- **S**——Sudden onset & offset
- **S**——Semiology, Rapid unpredictable complex motor behavior.
- **S**——Stereotyped
- **S**——Short duration (30sec)
- **C**——Cluster (3 times in this night)
- **N**——Nocturnal
- **C**——Confusion postictal minimal
Can you comment on EEG?

Patient state?  NREM sleep

Ictal EEG?

Recruiting rhythm over the left hemisphere fronto central region fast activity followed by decreasing in frequency & increasing in amplitude (evolution) then masked by Movement artifact & EMG artifact during SHE.

Post Ictal EEG?

Slowing?
Case Scenario

Normal background alpha rhythm
Video, 4S CNC

- Sudden onset & offset
- Semiology: complex motor & vocal (agitation, apparent purposeful)
- Stereotyped
- Short duration (30 sec) > 3 min
- Cluster
- Nocturnal (out of sleep)
- Confusion postictal minimal

PNES
Hello
my name is

???

TIME FOR CHANGE
Diagnosis of SHE is primarily based on clinical history. The absence of clear I.I & ictal EEG correlates, both during wakefulness and sleep, does not exclude the diagnosis of SHE.
DIAGNOSTIC CERTAINTY Criteria for SHE

Confirmed SHE: A video-EEG documentation of the events during sleep recording with EEG, ECG, oculogram & chin EMG. associated with a clear-cut epileptic discharge or with interictal epileptiform abnormalities.

Clinical SHE: Audio-video documentation of hypermotor events, at least 1 event but preferably 2 entire events should be documented (confirmed to be typical by witness), including the onset & evolution & the offset.

Possible SHE: Eye Witness
Case Scenario 2

- S.E, 18Y.O male, RT handiness, 90kg, Irrelevant past or Family history (apart from occasional Tramadol intake)
- Age of onset: 16 Y.O.
- He experienced events 1-3 times/night.
- Semiology?? GTCs (her mother)
- Preictal H.: -ve
- Ictal H.: GTCs with No tongue biting, urine incontinence
- Postictal H.: -ve
- Nocturnal early after falling asleep & later nocturnal and diurnal & ↑ frequency.
Case Scenario

✓ Neurologic exam: Normal
✓ Normal MRI brain (3 Tesla)
✓ Normal scalp EEG
✓ Video EEG monitoring for 12 hours:
✓ Record 2 nocturnal events in the form of:
Tonic SZ, RT asymmetrical clonic? (M2e sign /Fencing)
Video, 4S CNC

- **S**udden onset & offset
- **S**emiology: asymmetric Proximal tonic/dystonic of Uls then versive head & gaze followed by asymmetric ending (RT, clonic).
- **S**tereotyped
- **S**hort duration (not exceed 1 min)
- **C**luster (2 times in this night)
- **N**octurnal
- **C**ofusion post ictal very short.
Semiology, Dorso-Lateral F Motor Cortex

Focal clonic/ tonic
Jacksonian
Ipsil head version

Asymmetric
Tonic/dystonic
Postural
Proximal, Bil

Version of gaze/head
sustained & extreme
CL to FEF

Facial clonic jerks
Hypersalivation

Speech arrest/
Vocalization

Postictal Todd's
Can you describe Semiology of the Event?

Epileptic or Not

Can you Lateralyze?

Dorsolateral Premotor cortex & SMA

Can you Localize?
Can you comment on EEG?

Patient state?

Ictal EEG?

Ictal paroxysmal fast activity masked by EMG & Muscle artifact Arise from sleep (exclusively NREM) stages I, II.

Post Ictal EEG?
Case 3

✓ Y.A, 44Y.O male, RT handiness, 75 kg, Irrelevant FH
✓ Age of onset: 12 after post meningoencephalitis.
✓ He experienced events 3 times/night.
✓ Semiology?? GTCs & excessive day time sleepiness (his relative)
✓ Preictal H: -ve
✓ Ictal H.: Tonic posturing with No tongue biting, urine incontinence
✓ Postictal H: -ve
✓ Nocturnal early after falling asleep & occasionally diurnal
Case Scenario

✓ Neurologic exam: Normal
✓ Normal MRI brain (1.5 Tesla)
✓ Normal scalp EEG
✓ video EEG monitoring for 12 hours:
✓ Record 2 nocturnal events in the form of:
Rt arm being raised and the head and eyes turned as though to look at hand.
Video, 4S CNC

• S-----Sudden onset & offset
• S-----Semiology: early bilaterals tonic extension of arm RT then LT with rotation of the head & neck to the Rt arm as he grasp something.
• S-----Stereotyped
• S-----Short duration (not exceed 1 min)
• C-----Cluster (2 times in this night)
• N-----Nocturnal (out of sleep)
• C-----Confusion post ictal very short.
Can you describe Semiology of the Event?

Epileptic or Not

Can you Lateralize?

Can you Localize?

LEFT

Bilateral
Asymmetric
Tonic SZ & dystonic
>10s
Abrupt onset
Pseudo purposeful
No postictal confusion

SMA It may be the symmatotagenic zone but may be the Epileptigenic zone outside this area)
Can you comment on EEG?

Patient state?

Ictal EEG?

Post Ictal EEG?
K.E, 14yso male, age of onset 8ys old

Tonic Arm raised up & head raised to see the arm
Can you describe Semiology of the Event?

Epileptic or Not

Can you Lateralize?

Can you Localize?

Gestural automatism directed toward the direction of gaze suggests involvement of the dorsolateral prefrontal seizures with asymmetrical tonic posturing of Uls with asymmetric clonic movement.
<table>
<thead>
<tr>
<th>Clinical Sign</th>
<th>Number of patients</th>
<th>Percent of patients</th>
<th>Lower extremity posture (number of patients)</th>
<th>other comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral tonic arm extension</td>
<td>21</td>
<td>72.4%</td>
<td>bilateral tonic leg extension 15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>bilateral tonic leg flexion 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>bilateral tonic leg flexion and later extension 3</td>
<td></td>
</tr>
<tr>
<td>Asymmetric tonic arm extension combined with opposite arm flexion (figure 4)</td>
<td>17</td>
<td>58.6%</td>
<td>bilateral tonic extension 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>bilateral tonic flexion 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>one leg tonic extension, one leg tonic flexion 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>legs not tonic 4</td>
<td></td>
</tr>
<tr>
<td>Unilateral tonic arm abduction and flexion (M2e)</td>
<td>11</td>
<td>37.9%</td>
<td>unilateral tonic leg extension 1</td>
<td>Always in combination with head turning to the same side</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>legs not tonic 10</td>
<td></td>
</tr>
<tr>
<td>Bilateral tonic arm flexion</td>
<td>10</td>
<td>34.5%</td>
<td>bilateral leg extension 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>bilateral leg flexion 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>one leg tonic extension, one leg tonic flexion 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>legs not tonic 2</td>
<td></td>
</tr>
<tr>
<td>Unilateral tonic arm extension or flexion</td>
<td>5</td>
<td>17.2%</td>
<td>bilateral leg flexion 2</td>
<td>Always in combination with head turning to the same side</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>tonic extension one side other tonic flexion 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>legs not tonic 2</td>
<td></td>
</tr>
</tbody>
</table>
Can you comment on EEG?

Patient state?

Ictal EEG?

Post Ictal EEG?
FIG. 5.  Comparison of the percentage of tonic seizures and auras at the beginning of a seizure sequence in patients with frontal or parieto-occipital lobe epilepsy.
onset?
EYE & head?
Arm & trunk?
Pelvic thrusting?
Peddling?

Last for 15 min
Awake EMG artifact

No Epileptiform discharge
25 ys old multiple Sz semiology diurnal & nocturnal on 2 AED

Background: formed of posterior 9HZ alpha waves
IED: sharp slow wave over RT frontal evident during sleep
6 events during wakefulness: EEG showed movement & EMG artifact
Clenching
Side to side head movement
Varies duration from 10sto 110sec
PNES 10% between Epileptic

<table>
<thead>
<tr>
<th>Diagnostic Level</th>
<th>History</th>
<th>Witnessed event</th>
<th>EEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible</td>
<td>+</td>
<td>By witness or self-report/description</td>
<td>No epileptiform activity in routine or sleep-deprived interictal EEG</td>
</tr>
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<td></td>
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</tr>
<tr>
<td>Clinically established</td>
<td>+</td>
<td>By clinician experienced in diagnosis of seizure disorders (on video or in person), showing semiology typical of PNES, while not on EEG</td>
<td>No epileptiform activity in routine or ambulatory ictal EEG during a typical ictus/event in which the semiology would make ictal epileptiform EEG activity expectable during equivalent epileptic seizures</td>
</tr>
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<td></td>
</tr>
<tr>
<td>Documented</td>
<td>+</td>
<td>By clinician experienced in diagnosis of seizure disorders, showing semiology typical of PNES, while on video EEG</td>
<td>No epileptiform activity immediately before, during or after ictus captured on ictal video EEG with typical PNES semiology</td>
</tr>
</tbody>
</table>

Key: +, history characteristics consistent with PNES; EEG, electroencephalography (as noted in the text, additional tests may affect the certainty of the diagnosis—for instance, self-protective maneuvers or forced eye closure during unresponsiveness or normal postictal prolactin levels with convulsive seizures).

Differentiate semiology of NFLE & NREM Parasomnia

Diagnostic decision tree generated from clinical features

NREM Arousal Parasomnias and Their Distinction from Nocturnal Frontal Lobe Epilepsy

Design. Systematic semiological evaluation of parasomnias and NFLE seizures recorded on video-EEG monitoring.

Patients. 120 events (57 parasomnias, 63 NFLE seizures) from 44 subjects (14 males).

Interventions. The presence or absence of 68 elemental clinical features was determined in parasomnias and NFLE seizures. Qualitative analysis of behavior patterns and ictal EEG was undertaken. Statistical analysis was undertaken using established techniques.

Results. Elemental clinical features strongly favoring parasomnias included: interactive behavior, failure to wake after event, and indistinct offset (all P < 0.001). Cluster analysis confirmed differences in both the frequency and combination of elemental features in parasomnias and NFLE.

A diagnostic decision tree generated from these data correctly classified 94% of events. While sleep stage at onset was discriminatory (82% of seizures occurred during stage 1 or 2 sleep, with 100% of parasomnias occurring from stage 3 or 4 sleep), ictal EEG features were less useful.

Video analysis of parasomnias identified three principal behavioral patterns: arousal behavior (92% of events); non-agitated motor behavior (72%); distressed emotional behavior (51%).

Conclusions. Our results broadly support the concept of confusion arousals, somnambulism and night terrors as prototypical behavior patterns of NREM parasomnias, but as a hierarchical continuum rather than distinct entities. Our observations provide an evidence base to assist in the clinical diagnosis of NREM parasomnias, and their distinction from NFLE seizures, on semiological grounds.
Diagnostic Decision tree generated from the data correctly classified 94% of the events.

Case Scenario

✓ S.A, 12Y.O female, RT handiness, 60kg, history of falling head trauma at age of 6 ys which not followed by Sz or any neurological defect.

✓ Age of onset: 10ys old she developed a single GTC not preceded by aura & associated with tongue biting and postictal sleepiness she received VAP for 6 ms and then discontinuous without medical consultation.

✓ She experienced at age of 12 ys a serial motor SZ with focal onset (aversive head & eye movement to the left with secondary GTCs) and admitted to our unit.

✓ Neurologic exam: Normal
✓ MRI brain:
✓ Video EEG:
IED during sleep in the form of sharp slow waves over the left frontal region. Asymmetric slowing more over the Rt hemisphere.
• Non versive (Early head turn)
  • Duration: not > 2s
  • Severity: not > 30 degree
  • Time: < 60s from the onset
  • ?? Ipsilateral sign

• A versive SZ (sustained, forced)
  • Tilt, rotation, Neck extension
  • Duration: 5-10 s
  • Severity: > 45 degree
  • CL frontal eye field
Details obtained about the seizure semiology may help to suspect FLE & also localize region of onset

Complex motor activity: release of primitive reflex

Tonic posturing
Fencing (M2e sign)

Emotional complex behaviour
ex. Escape reaction
Variable Semiology, Variable etiology, Variable electro-clinical.
Contralateral lateralizing sign ??

- Version CL
- Dystonic posturing CL
- ATLP (extended) CL (fig 4)
- Unilatral Clonic CL
- Unilateral grimacing
- Postictal paresis
- Postictal hemianopia

Ipsilateral lateralizing sign ??

- Late clonic Asymmetric ending.
- Unilateral Automatism (bil but obscured in dystonic limb)
  (ex. Nose wiping within 60s)
- Unilateral blinking
- Postictal tongue biting
Dominant Hemisphere

- Ictal Aphasia/dysphasia
- Ictal coldness & shivering

Non Dominant hemisphere

- Ictal spitting
- Ictal vomiting
- Ictal yawning
- Ictal vocalization (verbal & non verbal)
- Ictal urinary urge
- Postictal coughing
- Postictal flattend affect
- Periictal water drinking
- Verbal memory task
  (central autonomic network)