Role of the Epilepsy Monitoring Unit (EMU) in Improving Patient Care

2017 OCHSNER REGIONAL NEUROSCIENCES SYMPOSIUM

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What is an EMU?

- The epilepsy monitoring unit is a special environment designed for the evaluation and treatment of people with epilepsy or suspected epilepsy.
Epilepsy

• Epilepsy affects nearly 3 million Americans and 50 million people worldwide.

• There are two types of seizures.

![Diagram of Epileptic Seizures]

**Incidence of Seizure Types**

- All Partial Seizures = 57%
- Simple Partial 14%
- Complex Partial 36%
- Absence 6%
- Myoclonic 3%
- Other Generalized 8%
- Generalized Tonic-Clonic 23%
- Other Partial 7%
- Unclassified 3%

Epilepsy – uncontrolled

– Despite AED therapy, 30-40% continue to have seizure

The facts about drug-resistant epilepsy

– Patients with uncontrolled epilepsy have severe consequences:
  • Interference with school and work, loss of independence and social isolation, increased risk of injury, depression and suicide, sudden unexpected death in epilepsy (SUDEP)
Figure 1. Incidence of Sudden, Unexpected Death in Epilepsy According to Population Type.
Care for patients with Epilepsy

• 2 scenarios:

a. 55 year old male – reports high BP – start lisinopril – f/up in 1 month

b. 23 year old female – reports nocturnal generalized shaking – start leveteracetam – f/up in 1 month

"First do no harm" (Primum non nocere)
- Hippocratic oath
Stereotypical events

• How many are there? How many different types?
• What are the characteristics?
• Are they electrographic seizures? What is the differential diagnosis?
• What is the etiology?
• What type of seizures are they?
• What are the risks to the patient?
What is the differential diagnosis?

<table>
<thead>
<tr>
<th>Type of Paroxysmal Event</th>
<th>Premonitory Symptoms</th>
<th>Spell Characteristics</th>
<th>Usual Duration</th>
<th>Postspell Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absence seizure</td>
<td>None</td>
<td>Staring, automatisms</td>
<td>&lt;10 seconds</td>
<td>None</td>
</tr>
<tr>
<td>Focal seizure with loss of awareness (complex partial seizure)</td>
<td>Variable aura or brief (10–30 seconds) sensory march</td>
<td>Staring, automatisms, variably preserved posture</td>
<td>30–180 seconds</td>
<td>Common; amnesia, aphasia, sleepiness, confusion, variable incontinence</td>
</tr>
<tr>
<td>Tonic-clonic seizure</td>
<td>Aura variable</td>
<td>Brief tonic posturing, ensuing clonic movements</td>
<td>1–3 minutes</td>
<td>Requisite; amnesia, sleep, incontinence, tongue biting/injury</td>
</tr>
<tr>
<td>Psychogenic spell/attack</td>
<td>Variable</td>
<td>Variable responsiveness, nonstereotyped, unusual movements</td>
<td>Often prolonged (&gt;5–10 minutes)</td>
<td>Variable, often none</td>
</tr>
<tr>
<td>Syncope</td>
<td>Frequent: lightheaded, dizziness</td>
<td>Falling, eye closure, variable movements</td>
<td>1–5 minutes</td>
<td>Variable, often none</td>
</tr>
<tr>
<td>Migraine</td>
<td>Prolonged sensory march (minutes)</td>
<td>Often “positive” symptoms (eg, paresthesia, photopsia)</td>
<td>20–60 minutes</td>
<td>Headache</td>
</tr>
<tr>
<td>Transient ischemic attack</td>
<td>Rapid sensory march (1–10 seconds)</td>
<td>Often “negative” symptoms (eg, dead numbness, weakness)</td>
<td>&lt;60 minutes</td>
<td>None</td>
</tr>
<tr>
<td>Parasomnia</td>
<td>None</td>
<td>Vocalization, confusion, ambulation</td>
<td>Minutes</td>
<td>Amnesia, confusion</td>
</tr>
<tr>
<td>Cataplexy</td>
<td>Emotional provocation</td>
<td>Muscle atonia, preserved consciousness or sleep attack</td>
<td>Seconds to minutes</td>
<td>None</td>
</tr>
</tbody>
</table>
ILAE 2017 Classification of Seizure Types Expanded Version

**Focal Onset**
- **Aware**
  - Motor Onset
    - automatisms
    - atonic
    - clonic
    - epileptic spasms
    - hyperkinetic
    - myoclonic
    - tonic
  - Nonmotor Onset
    - autonomic
    - behavior arrest
    - cognitive
    - emotional
    - sensory
  - focal to bilateral tonic-clonic
- **Impaired Awareness**

**Generalized Onset**
- **Motor**
  - tonic-clonic
  - clonic
  - tonic
  - myoclonic
  - myoclonic-tonic-clonic
  - myoclonic-atonic
  - tonic
  - epileptic spasms
- **Nonmotor (absence)**
  - typical
  - atypical
  - myoclonic
  - eyelid myoclonia

**Unknown Onset**
- **Motor**
  - tonic-clonic
  - epileptic spasms
- **Nonmotor**
  - behavior arrest
- **Unclassified**
Benefits of Inpatient 24 hour Video EEG monitoring

• Patients can be clinically examined during their event
  – Physical exam, VS, labs, imaging, telemetry
• Allows for repeated viewing of events
• Accurate diagnosis can lead to:
  – initiation of appropriate treatment
  – discontinuation of unnecessary AEDs
  – lower healthcare costs (fewer ED visits and admissions)
  – minimize social, psychiatric, financial burden on the family
• Monitor and/or alter antiepileptic drug therapy
• Localization of seizures for pre-surgical evaluation
Benefits of Inpatient 24 hour Video EEG monitoring in the EMU

1. 24 hour close observation by trained staff
2. Rapid response by trained nursing staff
3. Availability of Induction procedures / Provocative techniques
4. Rapid availability of benzodiazepines
5. Quality control – improved patient safety
6. Improved quality of video and EEG recording of baseline and events
7. Capability for SPECT studies
Indication for EMU study for patients with Epilepsy

1. Diagnostic evaluation (most common)
   – etiology of recurrent spells
     • Epileptic or nonepileptic
   – classify epilepsy type or syndrome
   – evaluate seizure precipitants
Indication for EMU study for patients with Epilepsy

1. Diagnostic evaluation (most common)
2. Medication adjustment
3. Quantification of seizure frequency
Indication for EMU study for patients with Epilepsy

1. Diagnostic evaluation (most common)
   – etiology of recurrent spells
     » classify epilepsy type or syndrome
   – evaluate seizure precipitants

2. Medication adjustment
   – Hx of status epilepticus
   – Serious adverse drug reaction

3. Quantification of seizure frequency

4. Presurgical evaluation for medically refractory epilepsy
Diagnostic yield
Diagnostic yield in patients with epilepsy

1. Classify epilepsy type or syndrome
2. Evaluate seizure precipitants
3. Quantification of seizure frequency (relative to PNEE)
4. Presurgical evaluation for medically refractory epilepsy
Diagnostic yield

• Physiological nonepileptic events that mimic epileptic seizures:
  • Cardiac
    – Arrhythmia
    – orthostatic hypotension
    – vasovagal syncope
  • Toxic/metabolic
    – hypo- or hyperglycemia
    – drug intoxication
  • Pulmonary
    – Hyperventilation
    – sleep apnea
  • Transient global amnesia
  • Movement disorders
  • Migraine
    – Basilar migraines
    – Complex migraines
  • CVA (TIA)
  • Autonomic disorders
  • Sleep disorders
    – narcolepsy/cataplexy
    – Paroxysmal nocturnal dyskinesias
    – REM disorders
  • Vestibular dysfunction
Physiological nonepileptic event
Example #1
Example #2
Diagnostic yield

• **Psychiatric events** that mimic epileptic seizures:
  - Psychogenic nonepileptic events (PNEE)
    - Conversion disorder
    - Somatoform disorder
  - Malingering
  - Catatonia
  - Panic attack
  - Hallucinations / psychosis
  - Episodic dyscontrol
  - Fugue states
  - Munchausen syndrome / Munchausen syndrome by proxy
Evidence of diagnostic accuracy - PNEE
EMU design and operations
EMU accreditation

- National Association of Epilepsy Centers (NAEC) defines 4 levels of epilepsy care and accredits epilepsy centers providing level 3 and 4 care.
  - Level 1 epilepsy evaluation in the ER or PCP office
  - Level 2 consultation with a general neurologist
  - Level 3 provide neurodiagnostic evaluation, some offer evaluation for straightforward resective epilepsy surgery
  - Level 4 intracranial evaluation, broad range of surgical procedures
Essential services, personnel, and facilities in specialized epilepsy centers—Revised 2010 guidelines

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Summary

This document was developed by the members of the Committee to Revise the Guidelines for Services, Personnel, and Facilities at Specialized Epilepsy Centers. After discussions with the general membership they were adopted by the Board of the National Association of Epilepsy Centers. The Guidelines will be reviewed and updated when considered necessary by the Board.

KEY WORDS: Guidelines, Epilepsy center, Epilepsy specialty care.
Safety in the EMU

- Ensuring electrical safety
- Availability of suction and an oxygen source present in the room
- Falls prevention
- Design - bed rails padded and elevated, location near central nursing area
- Video and EEG viewed simultaneously preferably by an EEG technologist or other trained health professional
- Alarms built into EEG software
- On-call staff available
EMU Caring is a free online continuing medical education series created by the American Epilepsy Society and NAEC. Even though the requirement is that only two providers complete EMU Caring, NAEC recommends the course for all members of the epilepsy center team.

• The program consists of 7 modules:

1. Introduction to Safety in the EMU
2. Enhancing Safety Prior to Admission
3. Seizure Observation
4. Environment and Activity
5. Seizure Provocation
6. Managing Seizures and Comorbidities
7. Preparing for Transition to Outpatient Care

Are all EMUs the same?

- EMUs from 25 countries
- Quality and safety data from the included studies reported on 181,823 patients admitted to an EMU between 1968 and 2016.
- The overall pooled adverse event proportion was 7% (95% confidence interval)
  - Overall 7.0%
  - Fall 1.3%
  - Seizure-related injury 0.5%
  - Status epilepticus 1.5%
  - Medication-related 5.5%
  - Seizure-clusters 18.4%
  - Postictal psychosis 1.8%
  - Cardiorespiratory complications 0.04%
- Authors quote “substantial heterogeneity in the quality and safety in EMUs and in the reporting of such data. The quality of included studies also varied considerably.”
Ochsner Epilepsy Program

• Level 4 Center - *Adult/Pediatric Epilepsy Center*

• **Highly Trained Specialists**
  - 5 adult and 1 pediatric board certified and experienced Epileptologists
  - Adult and pediatric functional neurosurgeon
  - 3 Neuropsychologists (PsychD)
  - A certified physician assistant
  - 3 board certified neuroradiologists
  - A certified (in EEG and long term monitoring) neuro-diagnostic lab manager
  - 3 Epilepsy nurse coordinators

• This team is committed to providing the most modern and innovative medical and surgical care for the treatment of epilepsy

• [https://www.ochsner.org/services/epilepsy-and-seizure-disorders](https://www.ochsner.org/services/epilepsy-and-seizure-disorders)
Clinical Research

Ochsner neurosciences institute hosts a dedicated research division which collaborates with Ochsner’s office of research to conducts several investigator initiated and national clinical trials. Our epileptologists are actively engaged in research and present their work at several national and international scientific meetings. Learn more about Clinical Research at Ochsner.

<table>
<thead>
<tr>
<th>Conditions Treated</th>
<th>Treatment Options</th>
<th>EMU</th>
<th>For Referring Physicians</th>
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</thead>
</table>

Epilepsy Monitoring Unit (EMU)

Ochsner is the only institution in Louisiana that operates an epilepsy monitoring unit (EMU) where patients with complex seizure disorders and other repetitive neurological events can be diagnosed and managed. A monitoring study in the EMU provides a detailed analysis of brain activity over a prolonged period of time.

The EMU at Ochsner has 6 dedicated adult beds with capacity to expand services to other telemetry beds in the hospital for adult and pediatric patients. Our team of epileptologists, nurses, intensivists, and EEG technologists track and record brain activity 24 hours a day. Patients are closely monitored to ensure safety during their stay in the hospital.

At Ochsner we use the latest in technology to perform detailed diagnostic evaluations in the EMU:

- Video EEG (Electroencephalogram) Monitoring
- Pharmacological and non-Pharmacological activation procedures to provoke seizures and seizure like events
- Transcranial Doppler
- Tilt-table study

For Patients

Download the information regarding your diagnostic study in the EMU.
Ochsner Epilepsy Program

Long-term monitoring is continuous, combined EEG and video recording of patients for hours to days.

Epilepsy Surgical Volume
Ochsner Medical Center, 2014–2015

Epilepsy Growth in Monitoring Unit Admissions
Ochsner Medical Center, 2013–2015
201 admissions studied

Our study provides valuable information on safe discharge practices from the EMU.

Of the patients who did experience seizures post discharge, none experienced seizures greater than their pre-admission baseline frequency in the first week of discharge.

37% of all patients had treatment resistant epilepsy.
**EMU and tilt**

**VALUE OF EEG IN TILT-TABLE TESTING**

Uma Menon, MD, MBA, Anil Chimakurthy, MD, Fawad Khan, MD, Neil Billeaud, MD, Freddy Abi-Samra, MD, R. Eugene Ramsay, MD.

**Introduction**

Simultaneous EEG monitoring with Head Up Tilt-Table (HUT) testing can assist to identify causes of syncopal and pre-syncopal events.

Well-defined EEG abnormalities have been described with tilt-induced events.

**Methods**

After baseline tilting, immediate follow up re-testing was performed as needed with Isuprel, nitroglycerin and/or edrophonium stimulation, or with ACE wrapping to mid thighs.

EEG was monitored with video throughout the procedure.

**Results**

Thirty seven patients underwent HUT with EEG monitoring during the period of review.

Demographics were 22 female and 15 male patients aged 12-95 years.

No hemodynamic or EEG abnormalities were found in 21 patients.

Abnormal results were noted in 14 patients with hemodynamic abnormalities identified in 14 patients as underlying to the events.

One patient had normal hemodynamic findings but had generalized slowing and suppression of EEG activity correlating with complaints of dizziness and confusion, despite normal blood pressure.

Another patient had a syncopal spell associated with slowing of EEG activity while the SEPs remained >85 with palpable radial pulses.

**Conclusions**

EEG changes during positive HUT reflect cerebral hypo-perfusion related to abnormal peripheral hemodynamics.

However, EEG changes of hypo-perfusion can also be seen in the absence of associated hypotension, suggesting that the observed cerebral hypo-perfusion may be related to anomalies in intra-cerebral vascular auto-regulation.

This may be of clinical significance in patients who develop apparent spells despite negative HUT findings and who would otherwise be (incorrectly) suspected of having conversion reactions.

**References**

Thank you

For a Fast Track Clinic Appointment, Clinic Concierge Line: 1.855.312.4190

To Initiate a Hospital Transfer for EMU study:
Regional Referral Center: 1.855.OHS.LINK