EPILEPSY SURGERY EVALUATION IN ADULTS WITH SCALP VIDEO-EEG MONITORING

Meriem Bensalem-Owen, MD
University of Kentucky
DISCLOSURES

Received grants for sponsored research as investigator from:

- UCB
- Eisai
- Upsher-Smith Laboratories

Speaker bureau:

- Sunovion
OBJECTIVES

• To review the principles of video-EEG monitoring in the pre-surgical evaluation of drug resistant epilepsy patients.

• To outline the limitations of non-invasive video-EEG monitoring.

• To discuss the importance of safety during monitoring.
INTRODUCTION

• VEM is the most indispensable initial step in the evaluation and identification of the epileptogenic zone in order to determine candidacy for surgical treatment.

• The epileptogenic zone being defined as the area generating seizures, and whose removal/disconnection is necessary for seizure freedom.

Lüders HO. Epilepsy Surgery 3rd Ed. 2009
HISTORICAL PERSPECTIVE

• In 1935, about a year after Berger’s findings on interictal EEG activity, Penfield recognized the great potential of the EEG to define better the epileptogenic zone.

• In the 1970s, Dreifus, Penry and Porter aided in the development of the video-EEG system.

BASIC PRINCIPLES OF VEM

• Valuable tool for the diagnosis, localization and lateralization of seizures.
• In the surgical evaluation, it helps correlate ictal EEG with seizure semiology.
• Activation techniques:
  1. AED withdrawal
  2. Sleep deprivation
• Special strategies: additional electrodes and tailored seizure examination.
• Creation of an environment where seizures can be safely captured.
CHALLENGES & LIMITATIONS OF VEM

• The EEG can only support a diagnosis of epilepsy that is clinically based.
• Temporal relationship between the clinical and EEG findings may vary.
• Time constraint (cost, patient comfort...)
• How many seizures are necessary for localization of the epileptogenic zone?
• Co-existent epileptic and non-epileptic events in pre-surgical candidates.
• Effects of anticonvulsant withdrawal on seizure semiology and EEG.
• Safety issues.
TEMPORAL RELATIONSHIP BETWEEN CLINICAL & EEG FINDINGS

- In temporal lobe seizures the clinical onset almost always precedes the EEG, often by several seconds.
- Auras will often not show up in the scalp-sphenoidal EEG.
- In approximately 30% of cases auras may be reflected by suppression of ongoing activity, changes in the heart rate, or, occasionally, some rhythmic or semi-rhythmic periodic activity on the sphenoidal and anterotemporal electrodes.


AURAS: FREQUENTLY CONSIDERED AS THE BEST INDICATOR OF THE EPILPTOGENIC ZONE

- The symptomatology of the aura usually correlates with seizure onset.

- Up to 90% of patients with temporal lobe epilepsy report experiencing auras, however, auras are frequently lacking during monitoring or are not remembered.

- Seizures arising from silent cortex produce auras at a distance from the epileptogenic zone.
VISUAL AURA IN A PRE-SURGICAL PATIENT
PSYCHIC AURA- INVASIVE RECORDING
CONT.
VISUAL AURA IN A DIFFERENT PATIENT—NO CLEAR EEG CHANGE BUT TACHYCARDIA
FIRST SEIZURE RECORDED DURING PRE-SURGICAL EVALUATION ASSOCIATED WITH ASYSTOLE
HOW MANY SEIZURES ARE NECESSARY FOR LOCALIZATION OF THE EPILEPTOGENIC ZONE?

• There is no consensus.
• Mathematical models suggest the need for at least 5 concordant seizures to achieve a 95% level of confidence of unilaterally or at least 4 such seizures in patients with strictly unilateral interictal spikes.
• The first seizure, usually captured within 2 days of recording and especially when well localized, has proven to be a good predictor of the final outcome of the study.
• The total duration of noninvasive VEM and the number of seizures to be captured should depend on the individual patient history.
• Patient comfort, cost of the procedure and the use of available resources should be considered.

CO-EXISTENCE OF EPILEPTIC AND NON-EPILEPTIC SEIZURES IN A PRE-SURGICAL CANDIDATE

• Video
SAME PATIENT

• Video
ATYPICAL EVENT (DE NOVO NES) DURING THE PRE-SURGICAL EVALUATION

• Video
ANTICONVULSANT WITHDRAWAL

• Antiepileptic drugs (AEDs) are often withdrawn in order to record several seizures over a short time that a patient is typically kept in the unit (2-7 days).

• No universal standard AED withdraw protocol.

• AEDs levels?

• Knowledge of the pharmacology of AEDs can help maximize the information in the least possible time.

• Several assumptions underlie this approach:
  1. Acute withdrawal reliably leads to increased seizure frequency occurring within a short time after discontinuation
  2. Seizures recorded are clinically similar to a patient’s habitual seizures
  3. Withdrawal is safe for the patient
CHALLENGES OF AEDS WITHDRAWAL

- The risk of increased seizures is not the same for all AEDs.
- Risk of bilateral convulsive seizures at times in patients who never had them or haven’t had them for years.
- Atypical seizures can be recorded.
- Effects of AED withdrawal on EEG characteristics?
- Complications such as status epilepticus and behavioral changes, even though rare, can occur.

FIRST SECONDARILY GTC SEIZURE EXPERIENCED DURING VEM ASSOCIATED WITH COMPRESSIVE FRACTURE

• VIDEO
SLOW VS. RAPID AED WITHDRAWAL?

• Di Gennaro et al. study in 54 patients undergoing pre-surgical VEM (total of 190 seizures recorded):

  ➢ 11% patients had 4-h clusters
  ➢ 39% patients had 24-h clusters
  ➢ 26% sGTCS
  ➢ No status epilepticus
  ➢ 3 patients had epileptic falls with no significant injuries
  ➢ Mean time to first seizure was 3.3 days
  ➢ Time to conclude video-EEG monitoring averaged 6 days.

SLOW VS. RAPID AED WITHDRAWAL?

- The complication rate in one study including 158 patients who had rapid withdrawal of AEDs over 24hr was of 5.06%.
- Complications were characterized largely by musculoskeletal pain secondary to clinical seizures.
- No mortality observed.
- 2.5% of patients received emergency-room admission for seizure clustering in the first month following VEM.

LIMITATIONS OF NONINVASIVE VEM EVALUATION

• The electrical signals generated by the brain:
  1. are small
  2. their recording is subject to numerous distorting factors
  3. they must compete for recognition with larger electrical potentials in the same environment

• Artifact (muscle and movement) can occur at the most critical points of the recording, i.e. seizure onset.

• Blume and Lemieux found scalp potentials to be 1/5 to 1/6 that recorded on the cortex.

• Both ictal and interictal recordings may yield ambiguous data when epiletogenesis arises from “occult” surfaces (mesial or inferior surfaces).

WHEN EEG, CLINICAL SEMIOLOGY AND IMAGING ARE DISCORDANT

• Video
SAME PATIENT
FRONTAL LOBE SEIZURE, NON-LESIONAL MRI AND INCONCLUSIVE EEG
SAME PATIENT - SAFETY ISSUES!

• Video
SAFETY DURING VEM

- Admissions for VEM result in the induction of seizures rather than minimizing and/or treating symptoms which can lead to an increased risk to patient safety.
- Report of serious adverse events (SAEs) vary.
- SAEs affect about 10% of patients.
- SUDEP and near-SUDEP, were encountered by more than 10% of European and Australian EMUs.
- In US-based EMUs 3% of patients suffer a death within a 1-year duration census.

SAFETY DURING VEM

- In a recent study, Sauro et al. found that the number of adverse events was low at 4.9%.

- In the study Dobesberger et al. 9% of 507 consecutive patients had adverse events:
  - 5% have psychiatric complications (postictal psychosis, aggression, panic attacks)
  - 4% injuries (fractures, ecchymosis…)
  - 3% status epilepticus


SAFETY- POSTICTAL AGITATION DURING PRESURGICAL VEM

• Video
STRATEGIES TO PROMOTE SAFETY

• Staff education
• Safe environment (patient room and bathroom)
• Preadmission screening (history!)
• Development of appropriate guidelines
  ➢ Seizure provocation techniques
  ➢ Seizure precautions
  ➢ AED withdraw protocols/tailoring to patient’s history
  ➢ Seizure response protocols and rescue medications
  ➢ Postictal aggression and psychosis
  ➢ Safe discharge practices
CONCLUSIONS

• VEM is the most indispensable initial step in the evaluation and identification of the epileptogenic zone.

• There are several challenges and limitations encountered during pre-surgical scalp video-EEG evaluation.

• Maintaining a safe environment during VEM is essential to delivering the best possible care and to mitigating undesirable outcomes.