AMERICAN EPILEPSY SOCIETY 2015

December 4 - 8 ■ Philadelphia, PA
69TH ANNUAL MEETING

Annual Fundamentals Symposium
Video-EEG Monitoring

Symposium Co-Chairs:

Elinor Ben-Menachem, M.D., Ph.D.

and

Michael Sperling, M.D.

Friday, December 4, 2015
Convention Center – Grand Ballroom AB

12:30 – 3:00 p.m.

Accreditation

The American Epilepsy Society is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

Credit Designation

Physicians

The American Epilepsy Society designates this live activity for a maximum of 30.75 *AMA PRA Category 1 Credits*™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Physician Assistant

AAPA accepts certificates of participation for educational activities certified for *AMA PRA Category 1 Credit*™ from organizations accredited by ACCME or a recognized state medical society. Physician assistants may receive a maximum of 30.75 hours of Category 1 credit for completing this program.

Jointly provided by AKH Inc., Advancing Knowledge in Healthcare and the American Epilepsy Society.

Nursing

AKH Inc., Advancing Knowledge in Healthcare is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is awarded 30.75 contact hours.

Nurse Practitioners

AKH Inc., Advancing Knowledge in Healthcare is accredited by the American Association of Nurse Practitioners as an approved provider of nurse practitioner continuing education. Provider Number: 030803. This program is accredited for 30.75 contact hours which includes 8 hours of pharmacology. Program ID #21547

This program was planned in accordance with AANP CE Standards and Policies and AANP Commercial Support Standards.

Pharmacy

AKH Inc., Advancing Knowledge in Healthcare is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education.

Select portions of this Annual Meeting are approved for pharmacy CE credit. Specific hours of credit for approved presentations and Universal Activity Numbers assigned to those presentations are found in the educational schedules. Criteria for success: nursing and pharmacy credit is based on program attendance and online completion of a program evaluation/assessment.

If you have any questions about this CE activity, please contact AKH Inc. at service@akhcme.com.

International Credits

The American Medical Association has determined that non-U.S. licensed physicians who participate in this CME activity are eligible for *AMA PRA Category 1 Credits*™.

CME/CE Certificates

For those attendees who wish to claim CME or CE, there is an additional fee. Registrants can pay this fee as part of the registration process. Those who do not pre-purchase the credit will also have the ability to pay this fee at the time they attempt to claim credit. Fees for CME increase after January 16 and are a one-time charge per annual meeting.

The evaluation system will remain open through Friday, February 26, 2016. Evaluations must be completed by this date in order to record and receive your CME/CE certificate.

Member Fees:	$50 through January 15, 2016 $75 January 16 – February 26, 2016
Non-member Fees:	$75 through January 15, 2016 $100 January 16 – February 26, 2016

Attendance Certificate/International Attendees

A meeting attendance certificate will be available at the registration desk for international meeting attendees on Tuesday, December 8.

Policy on Commercial Support and Conflict of Interest

The AES maintains a policy on the use of commercial support, which assures that all educational activities sponsored by the AES provide in-depth presentations that are fair, balanced, independent and scientifically rigorous. All faculty, planning committee members, moderators, panel members, editors, and other individuals who are in a position to control content are required to disclose relevant relationships with commercial interests whose products relate to the content of the educational activity. All educational materials are reviewed for fair balance, scientific objectivity and levels of evidence. Disclosure of these relationships to the learners will be made through syllabus materials and the meeting app.

Disclosure of Unlabeled/Unapproved Uses

This educational program may include references to the use of products for indications not approved by the FDA. Faculty have been instructed to disclose to the learners when discussing the off-label, experimental or investigational use of a product. Opinions expressed with regard to unapproved uses of products are solely those of the faculty and are not endorsed by the AES.

OVERVIEW
This program will provide education regarding design, implementation and use of video-EEG. It will review how to utilize modern technology, safety protocols and nursing and physician practice to provide optimal care for patients with uncontrolled seizures. Effective use of video, interictal EEG, ictal EEG and intracranial EEG will be reviewed, and participants will learn how to integrate data obtained using these modalities. Sample cases will be used to further illustrate use of this method.

LEARNING OBJECTIVES
Following participation in this symposium, learners should be able to:

- Design and implement installation of a video-EEG monitoring unit, while also implementing safety measures
- Recognize when to make timely referrals of uncontrolled patients for diagnostic study
- Provide better interpretation of video-EEG, providing more accurate diagnosis of non-epileptic events. Learner will more accurately identify surgical candidates with improved surgical outcome
- Counsel patients regarding the role of video-EEG and explain the process
- Use recognition of epileptic and non-epileptic behaviors, improve their ability to differentiate between seizures and psychogenic non-epileptic seizures and arrive at more accurate diagnoses

TARGET AUDIENCE
Basic: Those new to epilepsy treatment or whose background in the specialty is limited, e.g., students, residents, general physicians, general neurologists and neurosurgeons, other professionals in epilepsy care, administrators.

Intermediate: Epilepsy fellows, epileptologists, epilepsy neurosurgeons, and other providers with experience in epilepsy care (e.g., advanced practice nurses, nurses, physician assistants), neuropsychologists, psychiatrists, basic and translational researchers.

Agenda
Co-Chairs: Michael Sperling, M.D. and Elinor Ben-Menachem, M.D., Ph.D.

Introduction
Michael Sperling, M.D.

Creating an Epilepsy monitoring Unit
Joseph Sirven, M.D.

Effective Use of Video
Nancy Foldvary-Schaefer, D.O., M.S.

Use and Interpretation of Scalp EEG
Michael Sperling, M.D.

Optimizing Use of Intracranial EEG
Jean Gotman, Ph.D.

Case Studies
Nathalie Jette, M.D.

Conclusions
Elinor Ben-Menachem, M.D., Ph.D.

Education Credit
2.5 CME Credits

Nurses may claim up to 2.5 contact hours for this session.

Pharmacy Credit
AKH Inc., Advancing Knowledge in Healthcare approves this knowledge-based activity for 2.5 contact hours (0.25 CEUs). UAN 0077-9999-15-029-L01-P. Initial Release Date: 12/4/2015.

The American Board of Psychiatry and Neurology has reviewed the Video-EEG Monitoring Symposium and has approved this program as part of a comprehensive program, which is mandated by the ABMS as a necessary component of maintenance of certification.

Commercial Support Acknowledgement
Supported in part by an educational grant from LivaNova.

FACULTY/PLANNER DISCLOSURES
It is the policy of the AES to make disclosures of financial relationships of faculty, planners and staff involved in the development of educational content transparent to learners. All faculty participating in continuing medical education activities are expected to disclose to the program audience (1) any real or apparent conflict(s) of interest related to the content of their presentation and (2) discussions of unlabeled or unapproved uses of drugs or medical devices. AES carefully reviews reported conflicts of interest (COI) and resolves those conflicts by having an independent reviewer from the Council on Education validate the content of all presentations for fair balance, scientific objectivity, and the absence of commercial bias. The American Epilepsy Society adheres to the ACCME's Essential Areas and Elements regarding industry support of continuing medical education; disclosure by faculty of commercial relationships, if any, and discussions of unlabeled or unapproved uses will be made.

FACULTY / PLANNER BIO AND DISCLOSURES
Elinor Ben-Menachem, M.D., Ph.D. (Co-Chair)
Elinor Ben-Menachem, MD, PhD, is Professor of Neurology and Epilepsy at the Institute for Clinical Neurosciences and Physiology, Sahlgrenska Academy, University of Göteborg, Göteborg, Sweden. She is currently the Chairman of the Council on Education of the American Epilepsy Society (2015-2017) and serves as Chief Editor of Acta Neurological Scandinavia since 2001. She received the Ambassador for Epilepsy award from the International League Against Epilepsy (ILAE) 2005 and the American Epilepsy Society Service Award 2008. Her main area of expertise is on the development and understanding of new therapies for the treatment of refractory epilepsy when epilepsy surgery is not an option.

Dr. Ben-Menachem discloses receiving support for Consulting for UCB, Electrocore, Eisai; for Contract Research from UCB, Eisai, Bial, Astellas; Other Services as Chief Editor from Acta Neurologica Scandinavica; Chair of AES Council on Education.

Michael Sperling, M.D. (Co-Chair)
Dr. Sperling is Baldwin Keyes Professor of Neurology at Thomas Jefferson University in Philadelphia, where he is also Vice Chair for Clinical Affairs of the department of Neurology,
Director of the Jefferson Comprehensive Epilepsy Center and Clinical Neurophysiology Laboratory, and Director of Clinical Research. He has published nearly 300 peer reviewed articles, book chapters, and reviews and 2 textbooks related to epilepsy. He is actively engaged in epilepsy and cognitive neuroscience research, and lectures widely about these topics. He presently serves as an editor-in-chief of Epilepsia.

Dr. Sperling discloses receiving support as Contract Researech from NIH, DARPA, UCB Pharma, Eisai, Sunobion, SK Life Sciences, Glaxo, Upsher-Smith, Acorda, Medtronics, Marinus, Brain Sentinel, Pfizer (all payments to Thomas Jefferson University); Other Services member of Board of Directors of the Epilepsy Foundation of Eastern PA, Editor in Chief of Epilepsia, member of the ILAE Executive committee.

Nancy Foldvary-Schaefer, D.O., M.S.
Nancy Foldvary-Schaefer is an adult epileptologist at Cleveland Clinic. She serves as Director of the Sleep Disorders Center and Professor of Neurology at Cleveland Clinic Lerner College of Medicine of Case Western Reserve University. Dr. Foldvary-Schaefer is a clinical researcher with interest in sleep and epilepsy, semiology of complex nocturnal behaviors and women's health issues. Board certified by the American Board of Neurology and Psychiatry in Neurology, Clinical Neurophysiology, Sleep Medicine and Epilepsy Medicine, she has numerous publications to her credit involving epileptology and sleep medicine and has served as principal investigator and site PI of epilepsy clinical trials for over a decade.

Dr. Foldvary-Schaefer has indicated she has no financial relationships with commercial interests to disclose.

Jean Gotman, Ph.D.
Jean Gotman obtained a degree in Electrical Engineering from the University of Paris, a Master’s degree in Computer Science from Dartmouth College and a PhD in Neuroscience from McGill University. He joined the Montreal Neurological Institute of McGill in 1977 and has worked there since. His research interests center on analysis of the EEG, mechanisms of epileptogenesis and seizure spread in humans, and functional imaging in the diagnosis and study of epilepsy. His methods of automatic detection of spikes and seizures are used worldwide. He published over 250 peer-reviewed papers. In 1986, he created Stellate, a company that developed and sold equipment for EEG, long-term epilepsy monitoring and polysomnography.

Dr. Gotman has indicated he has no financial relationships with commercial interests to disclose.

Nathalie Jette, M.D., FRCPC
Nathalie Jette, MSc, MD, is a Professor in Neurology and Director of the Epilepsy Clinic and Seizure Monitoring Unit at the University of Calgary. She holds a Canada Research Chair in Neurological Health Services Research and leads the Hotchkiss Brain Institute Epilepsy NeuroTeam at her university. She is President of the Canadian League Against Epilepsy, Chair of the International League Against Epilepsy (ILAE) Task Force on Stigma in Epilepsy, Chair of the ILAETask Force on Epilepsy Guidelines, Secretary of the ILAE North American Regional Commissionand Chair of the American Epilepsy Society Epidemiology Special Interest Group. She is an Associate Editor of Epilepsia and sits on the editioral board of Neurology.

Dr. Jette discloses receiving support as Contract Research from Pfizer (co-funded by Mathison Health Centre/University of Calgary, all funds to the University of Calgary.)

Joseph Sirven, M.D.
Joseph Sirven is Professor and Chairman, Department of Neurology at Mayo Clinic in Arizona. Dr. Sirven also serves as Communications Council chair for the AES. He is also Editor-in- Chief of Epilepsy.com.

Dr. Sirven discloses receiving support for Royalties from UpTpo Dates; for Consulting from DMSB Acorda; for Contract Research from Neuropace, Upsher-Smith, GS; Other Services from Time Compensation as Editor in Chief of epilepsy.com, AAN Annual Meeting Education Chair and Vice President of the Epilepsy Section of the AAN.

CME Reviewers

Shahin Hakimian, M.D.

Shahin Hakimian is Associate Professor of Neurology at University of Washington/Regional Epilepsy Center at Harborview and Medical Director of Electroneurodiagnostic (EEG) laboratory at Harborview Medical Center.

Dr. Hakimian discloses receiving support for Consulting from OptumRx about inclusion of antiepileptic drugs on drug formularies.

John Pollard, M.D.

Dr. Pollard is an adult epileptologist who focusses on clinical care, fellowship education, clinical trials, and clinical research at the University of Pennsvlvania. As a member of the exectutive committee of the Epilepsy Study Consortium, he is interested in helping to design and execute early stage clinical trials. In order to help improve the quality of subjects enrolled in clinical trials he has been conducting research using biospecimen biomarkers to aid in seizure diagnosis.

Dr. Pollard discloses receiving support for Consulting from Brain Sentinel; for Contracted Research from Clinical trials grants paid to the University of Pennsylvania: H. Lundbeck, Glaxo-SmithKline, Brain Sentinel, SK pharmaceuticals, Upsher-Smith Laboratories, Alexza and Eisai.; for Ownership (i.e. stocks, stock options or other ownership) from part owner of a company Cognizance Biomarkers, LLC that has no current value. It exists on a NIH SBIR grant.

Paul Levisohn, M.D. (Medical Content Specialist, AES)

Dr. Levisohn is a member of the faculty of the section of Pediatric Neurology at The University of Colorado School of Medicine and Children's Hospital Colorado Neuroscience Institute, having joined the faculty over 15 years ago following a similar period of time in the private practice of pediatric neurology. His academic career has focused on clinical care for children with epilepsy with particular interest in clinical trials and on the psychosocial impact of epilepsy. Dr. Levisohn is currently a consultant on medical content for CME activities to staff of AES. He is a member of the national Advisory Board of EF and has been chair of the advisory committee for the National Center of Project Access through EF.

Dr. Levisohn has indicated he has no financial relationships with commercial interests to disclose.

AKH STAFF / REVIEWERS

Dorothy Caputo, MA, BSN, RN (Lead Nurse Planner) has indicated she has no financial relationships with commercial interests to disclose.

Bernadette Marie Makar, MSN, NP-C, APRN-C (Nurse Planner) has indicated she has no financial relationships with commercial interests to disclose.

John P. Duffy, RPh, B.S. Pharmacy (Pharmacy Reviewer) has indicated he has no financial relationships with commercial interests to disclose.

AKH staff and planners have nothing to disclose.

CLAIMING CREDIT:

PHYSICIANS

Physicians can claim CME credit online at **https://cme.experientevent.com/AES151/**

This Link is <u>NOT</u> Mobile-friendly! You must access it from a laptop, desktop or tablet.

How to Claim CME Credit
To claim CME credits online, please follow the on-screen instructions at the above url. Log in using your last name and zip code, OR your last name and country if you're not from the United States. All CME credits must be claimed **by February 26, 2106**.

Questions?
Contact Experient Customer Service at: 800-974-9769 or **AES@experient-inc.com**

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Nursing and Pharmacy credit (per session) is based on attendance as well as completion of an online evaluation form available at:

WWW.AKHCME.COM/2015AES

THIS MUST BE DONE BY JANUARY 15, 2016 TO RECEIVE YOUR CE CREDIT.
We cannot submit credit to NABP after this date.
If you have any questions, please contact AKH at service@akhcme.com.

DISCLAIMER
Opinions expressed with regard to unapproved uses of products are solely those of the faculty and are not endorsed by the American Epilepsy Society or any manufacturers of pharmaceuticals.

Video-EEG Monitoring Introduction

Michael R. Sperling, M.D.
Thomas Jefferson University
Philadelphia, PA

December 5, 2015

1

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69TH ANNUAL MEETING DECEMBER 4 - 8, 2015 PHILADELPHIA, PA

Disclosure

Industry research grants to Thomas Jefferson University: SK Life Sciences, Eisai, Marinus, Upsher Smith, Accorda, Pfizer, GSK, Brain Sentinel, Medtronics, Sunovion, Lundbeck
Federal grants: NIH, DARPA
None relevant to current presentation

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING

Main Learning Objectives for this course

How to utilize modern technology, safety protocols and nursing and physician practice to provide optimal care and diagnosis for patients with uncontrolled seizures

How to establish an EMU and the safety issues involved

3

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING

Learning Objectives

To learn the practical aspects of video recordings that enhance quality of the Video-EEG evaluation

To demonstrate a spectrum of epileptic and nonepileptic semiology and how Video-EEG can help differentiate non-epileptic from epileptic events

To illustrate the role of semiology in the implication of functional network activation in focal epilepsies

To review practical aspects of video recordings that enhance quality of the VEEG evaluation

4

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING

Learning Objectives

To understand situations in which intracranial electrodes may be useful

To understand the fundamental limitations of intracranial electrodes

To become familiar with some of the difficulties of interpreting intracranial EEG

To understand the importance of Video-EEG in the pre-surgical evaluation

5

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING

#AESmtg15

AMERICAN EPILEPSY SOCIETY
69TH ANNUAL MEETING DECEMBER 4 - 8, 2015 PHILADELPHIA, PA

Creating an epilepsy monitoring unit

Joseph I. Sirven, MD
Professor and Chair
Department of Neurology
Phoenix, Arizona USA

December, 2015

American Epilepsy Society
69th Annual Meeting December 4 - 8, 2015 Philadelphia, PA

Disclosure

Name of
Commercial Interest

Grant Support-
Neuropace,
GW Pharma

Consulting-
Acorda
Upsher- Smith
GW Pharma
UCB

American Epilepsy Society 69th Annual Meeting

Learning Objectives

- To describe the important components in creating a high quality epilepsy monitoring unit: staffing, safety, data management informed by the IOM, NAEC and AES
- Describe and stress the importance of safety considerations prior, during and after admissions to the Epilepsy Monitoring Unit (EMU)
- Delineate measures that will ensure quality in the Epilepsy Monitoring Unit (EMU)

American Epilepsy Society 69th Annual Meeting

Creating an EMU

- Purpose of an EMU
- Safety Considerations
- Nuts and Bolts- Components
- Phase II Evaluation
- Certification

Purpose of EMU

- Diagnosis of Spells
- Characterization of seizures
- Therapeutic interventions
- Surgical Evaluation

- 80% of EMU admissions- influences treatment
  - Chen et al Ped Neurol 1995; 12:220-224

Why have an EMU?

- Quality Measures by AAN/ IOM
- Necessary as a Neuroscience Center
- US News World Report metrics
- New Age of Devices
- Making a diagnosis and reducing unnecessary resource utilization (i.e. ER visits and admissions)

EMU is **most helpful** for:

- Patient with spells- Diagnostic
- Patient needing classification of seizures for therapy selection
- Patient requiring medication change for seizures
- Patient with seizures- Not controlled
- Drug resistant epilepsy- Presurgical evaluation

EMU is not appropriate for:

- ER admissions
- Primary psychiatric diagnosis
- Medically unstable patients

EMU Admission Goal:

- Record all typical events if admitted for a diagnosis
- If presurgical at least 1 seizures

- Accomplished by:
  - Hyperventilation
  - Photic stimulation
  - Exercise
  - Sleep deprivation
  - Medication reduction

Typical EMU Admission

- Admit in early weekday
- Neuropsychological Evaluation
- Occasional Psychiatric Evaluation
- Activating Procedures
- Discharge back on meds typically by friday

EMU requires a Team

- Epileptologists
- Nursing
- EEG Technicians
- Neuropsychologists
- Neuroradiologists
- Neurosurgeons

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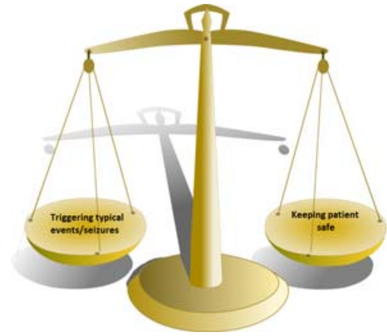
Basically, during an EMU admission…

"We are artificially creating an emergency to help prevent a future emergency"

"The Delicate Balance"



Why is safety imperative in the EMU?

- Inducing spells/seizures – "ticking time bombs"
- Immobility - DVT's, skin breakdown, deconditioning, pressure ulcers
- Falls
- Risk of medication errors
- Fractures
- Unrecognized seizures
- Prolonged post-ictal confusion that could potentially lead to self harm or harm to others
- Status Epilepticus/seizure clusters
- Cardiac arrhythmias/Ictal Asystole
- Fatality (uncommon)

Safety in the EMU

- 149 consecutive patients over 1 year
  - The mean time to first seizure was 2 days, with a mean length of stay of 5 days.
  - » Adverse event requiring intervention --in 21% of these patients.
  - » Seizure clusters occurred in 35 (23%)
    - » 1 episode of status epilepticus,
    - » 3 potentially serious electrocardiographic abnormalities,
    - » 2 cases of postictal psychosis, and
    - » 4 vertebral compression fractures during a generalized convulsion, representing 11% of patients with a recorded generalized tonic-clonic seizure.
    - » No deaths, transfers to the intensive care unit, falls, dental injuries, or pulmonary complications were recorded.

Mayo Clin Proc. 2009 Jun;84(6):495-500. doi: 10.1016/S0025-6196(11)60580-6.

National and International surveys of hospital EMUs…

- Found a wide variability of EMU practices among different institutions
- Found **safety** challenges
- Inconsistent use of protocols or policies
- **Emphasized the importance of multidisciplinary care in the EMU**
- **Emphasized the need for safety practices**

Article – "*A consensus-based approach to patient safety in epilepsy monitoring units: Recommendations for preferred practices*"

- 30 recommendations on 4 main areas:
  - Seizure observation
  - Seizure provocation
  - Management of acute seizures
  - Activity and environment
- Provided the first step in establishing EMU safety practices
- First published list of consensus items devoted solely to patient safety in epilepsy

Shafer 2012 Epilepsy & Behavior 449-456

NAEC/AES Collaboration

- Work in progress
- Free online continuing education medical education series - “Safety in the Epilepsy Monitoring Unit”
- 7 modules
- In an effort to improve safety and best practices in EMU

General Safety Considerations

- Multidisciplinary **Teamwork** Approach – Communication, education, hand off
- Immediate nursing/staff support
- Continuous observation of VEEG (similar to cardiac monitoring) by medical personnel
- Safety measures in unit/patient rooms

General Safety Measures in the Unit

- Code cart – maintenance
- Rapid response available
- Security (“panic button”)
- All patients are considered “fall risk”
- Voluntary Safety Belt (could be waived)
- Rescue medications readily available
- Eye wash station – collodion accident
- Safe for flammables for collodion and acetone
- EMU staff like “firefighters” waiting for the fire (seizure) to occur.

Creating an EMU

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EMU configuration - Diverse

Dedicated Unit

- Staff with expertise and special interest on epilepsy population
- Core staff– specific mandatory education, and competencies
- Continuous observation
- Admission rate needs to be constant and at a target capacity

Non-Dedicated Unit/other configurations

- Multi-use (hybrid use)
- more cost - effective
- Requires prioritizing and coordination of EMU patients for the use of beds
- May not provide continuous observation

Sirven, Joseph, and John Stern. *Atlas of Video EEG Monitoring: Chapter 5 Establishing a Video-EEG Monitoring Unit*, 2010

EMU Patient Room

- Bed height in lowest position, and wheels locked at all times.
- All 4 bed rails should be raised and padded to prevent limb entanglement during a seizure.
- Oral suction should be available and ready to use. **Tubing long enough to reach bathroom.**
- Oxygen should be available as well as a nasal cannula or mask. **Tubing long enough to reach bathroom.**
- Portable vital signs equipment has to be available.
- Free of clutter
- IV access for immediate control of prolonged events, or status epilepticus (SE).

Assisting patients out of bed

- Know seizure presentation (watch for "drop attacks")
- 2 person assistance if necessary
- Seizure helmets
- Floor mats
- Gait belts
- Avoid distractions while patient in bathroom; pay attention to noises
- Consider bedside commode
- No lock on bathroom door. Staff outside the door. Prefer curtain instead of doors in the bathroom

Triggering Patient's Events

- Medication manipulation
- Activation procedures – HV, Photic, sleep deprivation, exercise
- Patient specific triggers
- Staff vigilance and readiness!

Nursing Intervention/Documentation Quality

- History Intake/Medications
  Be aware of seizure semiology
  - Is the patient able to push alarm button with seizure?
  - Does the patient have a history of status?
  - Does the patient become combative post-ictally?
- Be aware of other medical conditions such as DM, heart conditions, pain.
- Seizure Assessment and documentation
- Consider Hourly Rounding

Nursing Intervention/Documentation Quality

- Make sure call light and seizure button are both within patient's reach
- Case discussions during weekly multidisciplinary epilepsy case conference - **teamwork**
- Educate patient and family of new diagnosis, providing community resources information
- Follow up call after discharge – understanding of discharge instructions, readmissions, ED visits
- Utilize hospital resources such as pet therapy, music therapy, chaplain services, aromatherapy, social work, case management if needed

Video-EEG Recording - Quality

- LTM Technologists – competencies, credentials, continuing education
- Monitoring Techs – competencies, education
- LTM set up – Impedances, head measurement accuracy, tap test to avoid misplacement of electrodes – follow ACNS guidelines
- VEEG system should be connected to battery back ups
- VEEG data – Acquisition/Post acquisition integrity – established guidelines for clipping/editing (physician's recommendations)
- Maintenance of Database/server space

Video-EEG Recording - Quality

- Activation Procedures – done per physician's order
- Critical Values reporting – seizure reporting
- Skin integrity checks/documentation – listen to patient complaints of itch/burn. Monitoring techs notices
- Test event button on every file change
- Bio Med – Regular checks for equipment maintenance
- Schedule that provides LTM technologist coverage available 24-7
- Remote access to VEEG data is optimal (technologists as well as physicians)
- Infection Control – review periodically/update

Patient Label

LTM
LOG SHEET

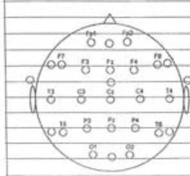
Page # __________
Room # __________

Attending Neurologist: ____________________

Date / Time	Description of Activity/ Event	Tech's Initials
	Sample	

Initial check LTM Checklist **Sample**

Notes	X	First Day Check List
		Check Scalp Integrity
		Check Impedances
		Tap Test Electrodes
		EKG Polarity
		Check Event Alarm
		Inform Family of
		Safety Belt key
		Calibration
		Bio Calibration
		LFF/ HFF/ SENS.
		Blink Artifact
		Lateral Eye Artifact
		Glossokinetic Artifact
		Background



EEG Critical value – Reporting documentation **Sample**

DATE:	PT. NAME & FIN#	ORDERING PROVIDER	NAME OF REPORTER	DATE/TIME IDENTIFIED	DATE/TIME REPORTED	RESULT/FINDING	NAME OF LICENSED CAREGIVER NOTIFIED (M.D. OR R.N.)	<60 MINS (Y or N)

Epilepsy Monitoring Unit
RISKS ASSESSMENTS LOG **SAMPLE**

DATE	INCIDENT DESCRIPTION	ACTION/ CHANGES MADE

VEEG AUDIT

Plan: LTM technologist completes 1 VEEG Audit per month. Choose a random admission. Review all items below.

Purpose: The purpose of this audit tool is to evaluate how patients receive VEEG services in compliance with our policies, procedures, standards, and protocols by reviewing the documentation and quality of the VEEG recordings.

Process: Complete VEEG audit on 1 admission by the 5th of each month.

Account #	Digital Calibration at start of each file	Impedance checks on each file at least twice a day	Tap test on set up day	Event button check on every file change	All events, samples, activation procedures, clipped/edited per policy	Activation procedures performed as ordered	Timely response to events/seizures Who responded?	Appropriate Ictal Cognitive Assessment done	Overall quality of tracing (Poor, Good, Excellent)	Charged correctly
					SAMPLE					

Data Storage

- Requires storage of audio/video and EEG data for years
  - Longer for kids
- Creating a network with a dedicated server for storage
- Backup systems and servers in case of system failure
- Dedicated IT resources for emergencies

Focusing on Safety and Quality

- Is the proper hand off done during lunch coverage?
- Event response time/ who responded?
- Ictal Cognitive assessment (ICA)– appropriate for type of event/spell, and patient population – Spanish assessment tools. Would baseline cognitive assessment be helpful on pediatrics or mentally challenged patients?
- Falls / Near misses – Incident reporting for risk assessment/process improvement
- Research/ pilot programs – best practices, staff engagement
- Anticipate needs rather than reacting to unexpected events

Creating an EMU

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Indications for EMU Phase II Admission Intracranial EEG Monitoring

- Localization of seizure onset when non-invasive testing is inadequate/limited
- Tailoring of cortical resection
- Mapping cortical function

EMU Phase II – Intracranial EEG Monitoring

- Implantation of the brain with foreign material is associated with an increase level of risks
- Prolonged bed rest increases the risk
- First 48 hours should be in Neuro-ICU setting for careful observation or similar settings
- Careful pre-, intra- and post-implant care can alleviate some of the risks
- Information should be gathered in the shortest possible time and the electrodes removed immediately thereafter.

Safety Considerations during EMU Phase II Intracranial EEG Monitoring

- CSF leakage – check dressing
- Infections – PPE when working on dressing
- Bleeding
- Cerebral edema
- Educate family – do not touch patients head
- Bedside commode only – The patient must be within arms reach at all times.
- The patient may not sit out in the chair.
- Electrode pouch must not be underneath lap belt.
- During a seizure (and at any other time) ensure the patient does not pull on the leads.

Intracranial EEG Monitoring - Quality

- EEG Set-up

  It is imperative that the electrodes are plugged in correctly
  - Recommend that 2 techs be present

    - One to plug in electrodes in head box, one to verify
  - Diagram of grid/depth electrode placement (map)
  - Clear interaction with epilepsy group (neurosurgeon, epileptologists to clarify any concerns

Focusing on Safety and Quality

- Patient pre-admission education
- Who is watching the patient?- failure to recognize subtle changes in behavior/EEG that could represent a seizure. Direct observation is optimal.
- Daily huddles to discuss progress of each admission
- Everything is videotaped
- Random EMR and VEEG audits – peer audits by individual disciplines
- Patient feedback of their admission experience

Creating an EMU

- Purpose of an EMU
- Safety Considerations
- Nuts and Bolts- Components
- Phase II Evaluation
- Certification

Administrative Quality in EMU

- Established Policies and Procedures – Periodically revised (Recommend ASET P&P manual)
- Established workflows and protocols – uniformity
- MSDS update periodically
- Monitor and audit charges
- Maintenance of procedures log
- Consent for EMU admission and/or waiver of safety belt signed/scanned in EMR
- Scanned outside records in Electronic Medical Record (EMR)
- Ref Physician order in EMR
- Dictations in EMR prior to deleting any raw VEEG data ("mother file")
- Admission notes sent to referring physician for re-establishment of care after discharge

"Return on the Investment"

- Value-based service
- What is patient's perception of an extraordinary experience that was worth the expense and uncomfortable admission?
- "Did I receive a diagnosis?" If not, where do we go from here?"; If yes, do I understand it?
- Patient feedback is valuable
- Positive feedback – Celebrate with team!
- Negative feedback – opportunity for improvement…What could we have done better? Brainstorm on how? Staff participation

EPILEPSY MONITORING UNIT (EMU) ****Sample****
PATIENT FEEDBACK

In an attempt to improve the quality of our service and create an extraordinary patient experience, we would like for you to take a moment and fill out this service feedback. Please, feel free to make any comments that you understand would guide us on striving for service excellence. We truly value your opinion and comments!

My registration process was done in a **timely** manner YES NO
The EMU staff **explained** procedures, and **clarified** all my questions YES NO

The Epileptologist made daily visits and kept me **informed** of my progress YES NO

The EMU staff was diligent and quick in **responding** to my needs YES NO
My room was kept **clean** daily YES NO

The environment was **quiet** and conducive to healing YES NO

I felt comfortable and **safe** during my entire admission YES NO

My Neuropsychological Evaluation (if applicable) was **explained** and completed during my stay in a smooth fashion YES NO

Comments / Suggestions:
____
____
____
____
____

On behalf of the EMU Unit staff, we would like to extend our most sincere gratitude for choosing ***************************** for you medical needs! We look forward to caring for you in the future!

Sincerely,

EMU Unit Staff

Levels of Epilepsy Care

- Level 1- Primary care or ER- seizures well controlled- First AED is prescribed
- Level 2- General Neurologist or Epilepsy Center if sezures not controlled within 3 months
- Level 3 & 4 Epilepsy Centers- Seizures are not well controlled and other options like surgery need to be considered
  - http://www.naec-epilepsy.org/spec_care/guidelines.htm

Impact on Clinical Care and Practice

Safety in EMU and High Quality standards will be ensured by…

➢ Establishing a cohesive and strong EMU team
➢ Designing EMU specific education ("EMU Boot-camp" series)and mandatory competencies
➢Creating a continuous learning environment; one that provides and fosters risk assessments, and process improvements in a "no blame" culture
➢Creating a sense of ownership and accountability among the team
➢Communicating effectively!

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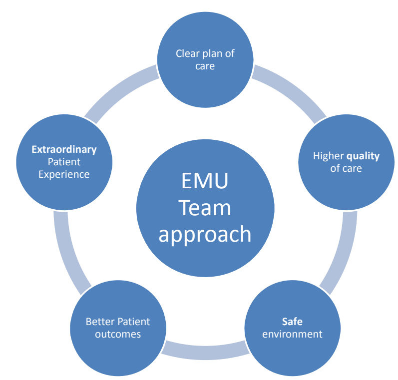
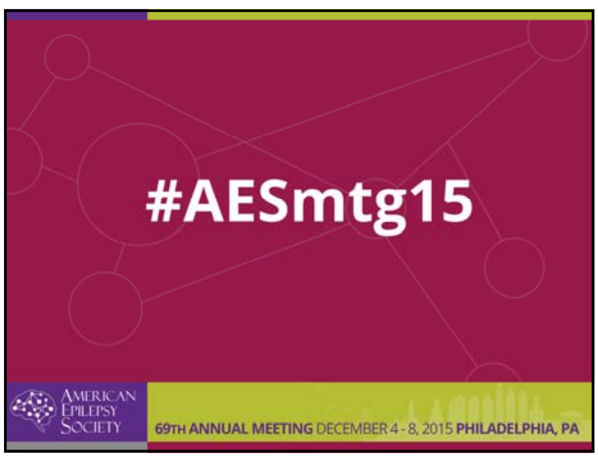


Recommended Website Resources

- http://www.aset.org
- http://abret.org
- http://www.acns.org
- http://naec-epilepsy.org
- http://www.aesnet.org
- http://iom.edu



Effective Use of Video

Nancy Foldvary-Schaefer, DO, MS

Cleveland Clinic

December 4, 2015

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Disclosures

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ResMED: Research funding
Jazz Pharma: Speaker's bureau, Research funding

Learning Objectives

- To demonstrate a spectrum of epileptic and nonepileptic semiology and key differentiating factors
- To illustrate the role of semiology in the implication of functional network activation in focal epilepsies
- To review practical aspects of video recordings that enhance quality of the VEEG evaluation

Impact on Clinical Care and Practice

- Semiological analysis and electroclinical correlation are key to generating surgical hypotheses in the evaluation of drug-resistant epilepsy
- Video evaluation of semiology (character of motor/behavior, stereotypy, tempo of evolution and nature of onset/offset) allows for clear differentiation of epilepsy and nonepileptic events
- High quality video and educated examiners are key to optimizing semiology interpretations

ILAE Revised Terminology and Concepts

- "Generalized" and "Focal" abandoned as overarching categories of classification–replaced by network concept
  - Focal seizures originate within networks limited to 1 hemisphere
  - Generalized seizures originate within & rapidly engaging bilateral networks
- Etiological terms changed
  - Idiopathic → **Genetic**
  - Symptomatic → **Structural/Metabolic**
  - Cryptogenic → **Unknown**
- "Complex partial", "Simple partial" abandoned in favor of describing semiology with mention of awareness
  - "**Dyscognitive**" describes alteration/loss of awareness

Berg AT. *Epilepsia* 2010;51:676-685.

Seizure Classification

- **Generalized**
  - Tonic-clonic
  - Absence
  - Myoclonic
  - Clonic
  - Tonic
  - Atonic
  - Astatic
  - Versive
- **Unknown**
  - Epileptic spasm
- **Focal**
  - Without LOA
  - Motor components
  - Autonomic components
  - Subjective phenomena
    - Sensory
    - Psychic
  - With LOA – "dyscognitive"
  - Evolving to bilateral convulsive seizure

Berg AT. *Epilepsia* 2010;51:676-685; Blume W. *Epilepsia* 2001; 42:1212-1218.

Semiology: Basic Concepts

- Dependent upon electrical activity produced by seizures, organized within neural networks (epileptogenic zone [EZ] and early spread)
- Signs evolve as ictal discharge spreads in time and space
- Semiology production occurs with variable time lag after seizure onset
- Speed of semiology emergence varies (frontal faster than temporal)
- Level of complexity varies with degree of involvement of primary or associative cortices; the latter involving more widely distributed networks

Chauvel P. *Epilepsy & Behav* 2014;38:94-103.

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Temporal Lobe Examples

- Déjà vu -> automatisms with preserved awareness, tachycardia (nondominant hippocampal/PHG)
- Grimace/pain/fear/distress/ictal speech (nondominant amygdala)
- Prominent tongue/mouth movements (hippocampus/amydala->frontal operculum)
- Gustatory/olfactory/CL sensory/pain/ grimace/ autonomic -> epigastric/minor mouth movements (hippocampus/amygdala -> parietal operculum/insula)
- Auditory aura -> version -> GTC (planum temporale/Heschl's/inferior parietal lobule)

Foldvary-Schaefer, N. *Epi Behav* 2011; 20:160-166.

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Lateralizing Signs

- Contralateral to EZ
  - Dystonic posturing
  - Unilateral ictal/postictal immobile limb
  - Focal clonic/version/figure "4" before generalization
- Ipsilateral to EZ
  - Unilateral eye blinking
  - Nosewiping (temporal)
  - Last clonic jerk of GTC seizure
- Inconsistent lateralization
  - Unilateral tonic
  - Non-versive head turning
  - Nosewiping (frontal)
  - Postictal cough

Kotagal P. *Epilepsy Res* 1995;20:49-67; Benbadis SR. *Neurology* 1996;46:45-48; Geyer JD. *Neurology* 1999;52:743-745; Chee MWL. *Neurology* 1993;43:2519-2525; Wyllie E. *Neurology* 1986;36:606-611. Kotagal P. *Epilepsia* 2000;41:457-462; Bonelli SB. *Epilepsia* 2007;48:517-523.

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Lateralizing Temporal Lobe Signs

Nondominant

- Automatisms with preserved awareness
- Ictal speech
- Ictal vomiting/spitting
- Urinary urge
- Peri-ictal water drinking

Dominant

- Postictal dysphasia

Ebner A. *Neurology* 1995;45:61-64; Baumgartner C. *Neurology* 2000;55:432-434; Ramirez MJ. *Epilepsia* 2008;49:22-32; Kramer RE. *Neurology* 1988;38:1048-1052; Kellinghaus C. *Epilepsia* 2003;44:1064-1069; Gabr M. *Ann Neurol* 1989;25:82-87.

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Temporal Epilepsy Language Disturbances Examples

- Nondominant temporal
  - Ictal speech
- Dominant temporal
  - Postictal aphasia: receptive, expressive
  - Electrical stimulation induced

Chang EF. *J Neurosurg* 2015;22:250–261.

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Seizure Interview

1. Remember color (blue, green, etc.)
2. Stick your tongue out.
3. Raise your right arm.
4. Point to the door.
5. Say the word "house".
6. What is this object? (show pen, cup, etc.)
7. What do you do with it?
8. What is your name?
9. How are you feeling?
10. Describe what you see.
11. Continue until the patient responds.

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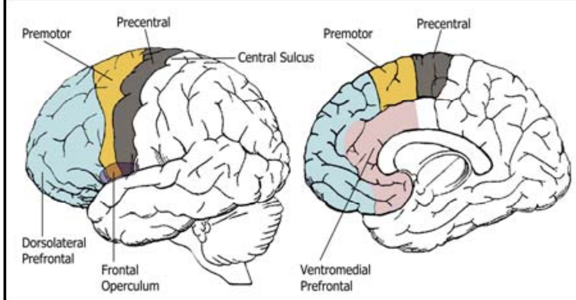
Postictal Interview

1. When was your last seizure?
2. What just happened? "I had a seizure."
3. What makes you think you had a seizure?
4. Did you feel anything before your seizure?
5. Do you remember the color? If no: choices.
6. Name and describe function of an object.
7. Ask patient: "Is the seizure over?"
8. Are you OK?
9. Where are you?
10. What day is it?
11. Test for Todd's paresis.

Symptomatogenic Areas in the Frontal Lobe



Foldvary-Schaefer N. *Continuum* (Minneap Minn) 2013;19:104-141.

Frontal Lobe Seizure Semiology and Localization:
SEEG Analysis of 374 seizures in 54 patients

Elementary motor
- Precentral and premotor

Fearful behavior
- Paralimbic system: Ventromedial frontal and anterior temporal structures

Elementary motor , non-integrated gestural motor
- Premotor and prefrontal

Integrated gestural motor, distal stereotypies
- Anterior lateral and medial prefrontal

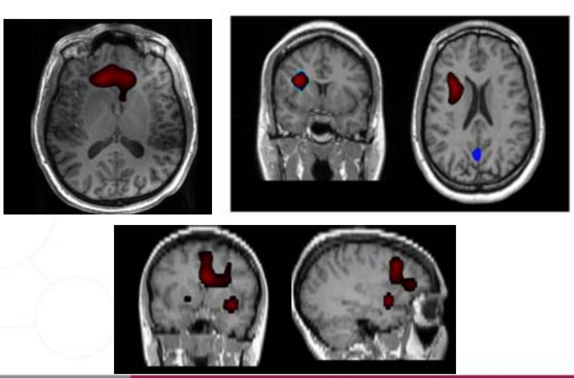
Bonini F. *Epilepsia* 2014;55:264-277.

Frontal Lobe Examples

- Vocalization- > Dialepsis -> oral automatisms-> version -> GTC
- Hypermotor/Autonomic variants
  - Cingulate
  - Superior frontal sulcus
  - Insula
  - Orbitofrontal-Insular-Anterior cingulate network
  - PNES variant – side to side head movements
- Asymmetric tonic variants

Bonini F. Epilepsia 2014;55:264-277.

Hypermotor Variants: Ictal SPECT



Rudimentary Motor Activity due to Brainstem Common Pattern Generator Activation

Extra-Frontal Epilepsies Presenting with Nocturnal Seizures Mimicking Frontal Lobe

- Constitute 30% of cases
- Temporal lobe
  - Epigastric, fear, déjà vu -> behavioral arrest, staring, automatisms
  - Restricted to sleep in 9%
  - Infrequent seizures, rare family history, low prevalence of febrile convulsions[1]
- Insula
  - Autonomic, laryngeal discomfort, retrosternal/epigastric heaviness, perioral/contralateral somatosensory, dysphonia, dysarthria-> contralateral face/arm tonic[2]
- Posterior cortex
  - Visual or somatosensory auras

[1]Bernasconi A. *Neurology* 1998;50:1772-1777; [2]Isnard J. *Epilepsia* 2004;45:1079-1090.

Posterior Cortex Epilepsy Examples

- Subtle manifestations
  - Ipsilateral downward head turn
  - Eye movement abnormalities
- Dialepsis/surprised facial expression -> version-> GTC: Parieto-frontal network
- Photic induced occipital semiology

Ristic AJ. *Epileptic Disord* 2012; 14 (1): 22-31.

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Differential Diagnosis of Epilepsy

- Psychiatric disorders
  - Psychogenic nonepileptic seizures (PNES)
  - Panic attacks
  - Anxiety
- Neurologic disorders
  - Syncope
  - Attention disorders
  - Benign myoclonus/Startle
  - Breath-holding spells
  - Vertigo
  - Tremor
  - Headache
  - Cerebrovascular disease
  - Nocturnal wandering (dementia)
- Medical disorders
  - Cardiac arrhythmia
  - GERD
  - Metabolic derangements
  - Drug intoxication
- Sleep disorders
  - NREM disorders of arousal
  - REM behavior disorder
  - Rhythmic movement disorder
  - Hypnic jerks
  - Periodic limb movements
  - Cataplexy
  - Apnea
- Munchausen by proxy

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Psychogenic Nonepileptic Seizures (PNES)

- Paroxysmal events c/b alterations in consciousness, motor activity, sensation, cognition with psychosocial underpinnings
- 20-40% of EMU admits, peak in 2^{nd} -3^{rd} decade, F:M 3:1
- Risk factors: young age, poor SES, stressors (sexual abuse), psychiatric comorbidity
- Clinical features: forced eye closure, crying, pelvic thrusting, preserved awareness, asynchronous/side-to-side head mvts, prolonged duration, fluctuating symptoms
- Misleading features: sleep onset, incontinence, prodromal symptoms, LOC during attack, tongue biting, postictal confusion
- Observer descriptions unreliable

Duncan R. *Epilepsy Behav* 2011;20:308-311; Salinsky M. *Neurology* 2011;77:945-950.

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PNES Examples

- Variants
  - Dialeptic
  - Hypermotor
  - Convulsive
- PNES vs. Epilepsy (or both?)

Duncan R. Epilepsy Behav 2011;20:308-311; Salinsky M. Neurology 2011;77:945-950.

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NREM Disorders of Arousal

- Arise from SWS, first 1/3 of sleep period, min to hrs
- Childhood onset, diminishing w/age, but adult onset
- High lifetime prevalence: SW 22.4%, CA 18.5%, ST 10.4%
- Three subtypes with overlapping features
  - Confusional arousals: Confusion during/following arousal, slow mentation, amnesia, inappropriate behavior
  - Sleepwalking: Series of complex behaviors resulting in walking, unresponsiveness + eating, driving, sexual activities
  - Sleep Terrors: Arousal with piercing vocalization accompanied by autonomic/behavioral manifestations of intense fear, unresponsiveness

Ohayon MM. *J Clin Psychiatry* 1999;60:268-76; Bjorvatn B. *Sleep Med* 2010;11:1031-40.

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REM Behavior Disorder

- 90% of affected are elderly males
- Majority evolve to α-synucleopathies
- Arise from REM ($\geq$90 min after SO, last 1/3 sleep period)
- Clinical features:
  - Talking, laughing, shouting, swearing, gesturing, arm flailing, slapping, punching, kicking, sitting up, leaping from bed, crawling, running
  - Violent, confrontational, action-packed dreams w/theme of being attacked/chased
  - If awoken, patient is alert, recalls negative dream content
- Diagnostic criteria
  - Repeated episodes of sleep-related vocalization, complex motor behaviors
  - Behaviors during REM documented by PSG or, based on clinical history of dream enactment, presumed to occur during REM
  - PSG demonstrates REM sleep without atonia

International Classification of Sleep Disorder 3rd ed.

REM Behavior Disorder Example

Feature	Epilepsy	PNES	NREM DOA	RBD
Age of onset	Variable	2nd -4th decade	1st decade	>50
Gender	M=F	F>M	M=F	M>F
State	Wake, NREM	Wake	NREM 3	REM
Timing	Anytime	Anytime	1st 1/3 of sleep	Last 1/3 of sleep
Duration	5 60 sec	Sec min	2 30 min	Sec 2 min
Frequency	Variable	Variable	Sporadic	Sporadic
Onset/offset	Sudden	Variable	Gradual	Sudden
Stereotyped	Highly	Not	Not	Not
Consciousness	Variable	Variable	Variable	Impaired
Post confusion	Variable	Variable	Present	Absent
Risk of injury	Low	Low	High	Moderate

Beyond the Seizure Examples

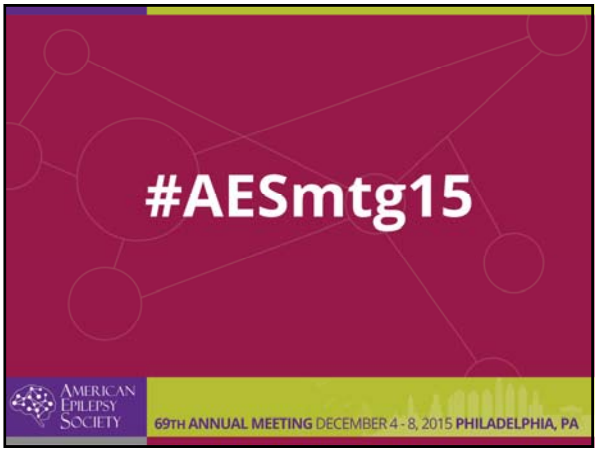
- Interpersonal interactions
- Drug seeking, addictive behaviors

Optimizing Video

- Technical
  - Continuous live review
  - Seizure recognition
  - Seizure interviews
- Camera Specifications
  - Low light recording capabilities
  - Autofocus functionality
  - Remote control for angle and zoom

Summary

- Detailed semiological analysis provides key information in the generation of surgical hypotheses in the evaluation of epilepsy surgical candidates
  - Seizures generally involve widespread networks and semiology evolves as ictal discharge spreads in time and space
  - Useful signs can be subtle and easily overlooked
  - Speed of clinical expression is useful in differentiating seizures involving temporal and frontal networks
- Nonepileptic events are usually readily differentiated from epilepsy by the degree of stereotypy, character of motor/behavioral activity, tempo of evolution and nature of onset/offset
- High quality video and educated examiners are key to optimizing semiology interpretations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American Epilepsy Society
69th ANNUAL MEETING DECEMBER 4 - 8, 2015 PHILADELPHIA, PA

Video-EEG: Use and Interpretation of Scalp EEG

Michael R. Sperling, MD
Sidney Kimmel Medical college
Thomas Jefferson university
Philadelphia, PA, USA

December 4, 2015

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Disclosure

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Federal grants: NIH, DARPA
None relevant to current presentation

Learning Objectives

- Learn purpose of video-EEG
- Learn limitations of video-EEG
- Learn effective use of video-EEG

Impact on Clinical Care and Practice

- Improve accuracy of interpretation of data for localization of seizures
- Avoid over-interpretation of video-EEG data
  - Awareness of potential for false localization and lateralization
  - Awareness of limits of seizure detection

Discussion Topics

- Role of video-EEG using scalp electrodes
- Interictal EEG
- Ictal EEG
- Integration of video
- Cautions/limitations

Why Perform Video-EEG?

- Must have focused question that can be answered by the technique – both video and EEG
  - Define nature of events of interest – seizure, postictal state, syncope, sleep disorder, psychogenic disorder, migraine, TIA
  - If seizure, classify type – focal vs. generalized, SPS vs. CPS, CPS vs. absence,
  - If seizure, putative localization of area of origin
  - If seizure, assess frequency (EEG alone may be sufficient)
  - Management of status epilepticus
  - Assess response to therapy

Why Perform Video-EEG?

- Use of polygraphic variables helpful – EKG, EMG, O_2 saturation, respiration, etc.
  - Muscle artifact is diagnostic for tonic-clonic seizure
  - Eye movements and muscle help diagnose CPS and psychogenic seizures
- Video data
  - Specific movements useful for diagnosis (stereotypy eye open or closed, arched back) and lateralization (versive eye/head deviation, focal clonic movements or tonic posture, sign of 4, postictal nose wipe)

7

Limitations

- EEG does not detect all seizures
  - Most SPS do not appear in the scalp EEG, many could be missed by intracranial EEG
  - Signals from buried cortex, e.g., interhemispheric, basal, deep nuclei may not propagate to surface
  - Artifact can obscure some seizures
- Artifact, electrode malfunction may prevent identification of seizures
  - Rhythmic artifact can be mistaken for ictal activity
  - Look for double and triple phase reversals on bipolar runs
- Video improperly aimed or blurred (ICU problem)
- Can have data overload – mainly intracranial EEG
- Not a substitute for tilt table, cardiac electrophysiology assessment

8

Analysis

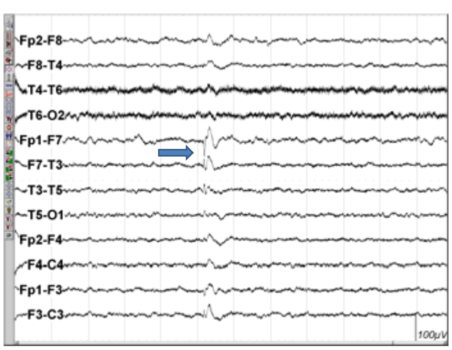
- Visual inspection remains the gold standard for interpretation of EEG
  - Perhaps excessive reliance on ictal EEG
- Computer aided analysis
  - Spike and seizure detection: poor specificity, reasonable sensitivity
  - Interictal signal analysis: variety of methods looking at many parameters – HFOs are fashionable at present, other non-linear methods may have value; seizure prediction?
  - Ictal signal analysis: can use linear and non-linear methods to characterize relationships between cortical regions, spread patterns
  - Methods rely on preliminary human screening to eliminate artifact contaminated channels or segments

9

Interictal Recording

- Adequate sampling of relevant regions
  - Location of electrodes determined by clinical hypothesis for intracranial EEG
  - No fishing expeditions
- Recording in wakefulness and sleep
- Attend to effects of postictal state, changes in medication
- Evaluate for synchrony, interictal spikes, background rhythms (also important)

10



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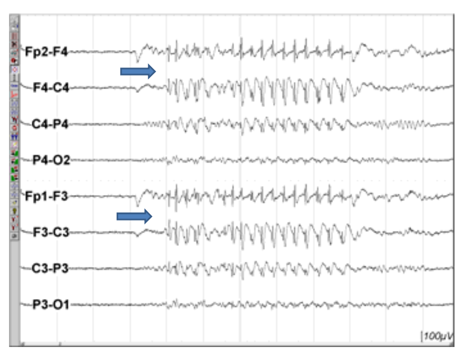

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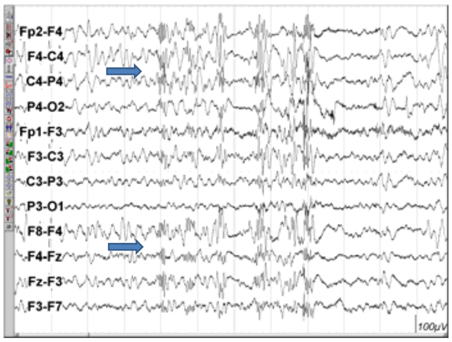


14

Ictal Recording

- Look to see if EEG changes and for the earliest change
- May not be obviously ictal
  - Beware of enhancement of normal background rhythmicity
- Seizures can begin with
  - Loss of usual background activity – focal or widespread
  - increased interictal spiking which transforms to rhythmic spiking
  - Fast activity (beta, gamma)
  - Theta or delta frequencies

15

Ictal Recording

- Focal seizures may appear non-lateralized or falsely localize or not be seen
  - Prognosis after surgery similar in TLE whether lateralized or non-lateralized seizure onset is seen (Monnerat et al. Seizure 22:287,2013)
- Important to correlate ictal behaviors in video with EEG
- Timing less useful with scalp EEG than intracranial
  - Even so, relate time of lateralizing/localizing findings in video with EEG discharges
- Lack of ictal EEG activity does not necessarily exclude seizure as a diagnosis
  - Simple partial seziures appear in perhaps 25% of scalp EEG
  - Rarely, CPS may not be apparent (espec frontal lobe)

16

Video

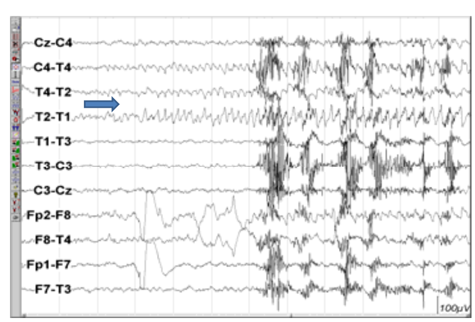
17

ARS Question

- 1. Focal epileptic seizure
- 2. Generalized epileptic seizure
- 3. Psychogenic non-epileptic seizure
- 4. Paroxysmal dyskinesia
- 5. Odd behavior, none of the above

18

Focal Seizure Onset: Right Temporal



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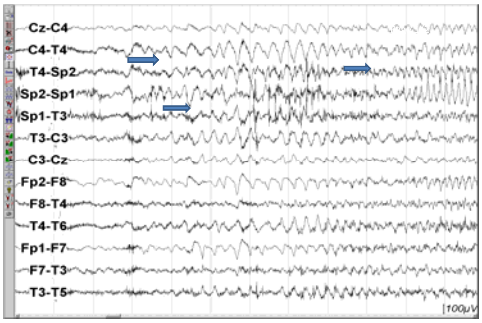
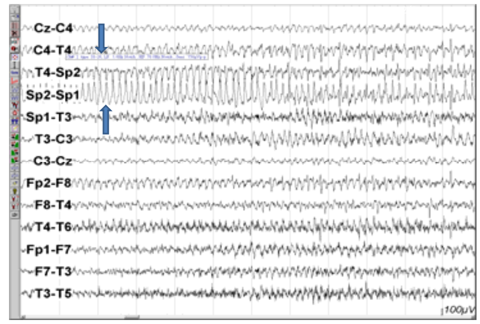
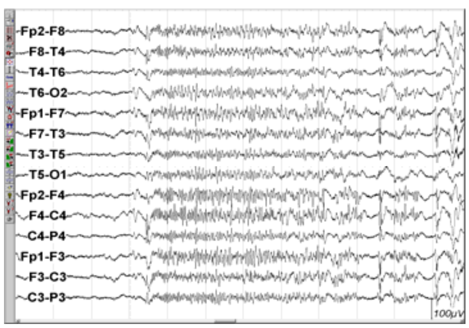
Focal Seizure Onset: Alternate



Focal Seizure Onset: continuation



Generalized Seizure Onset

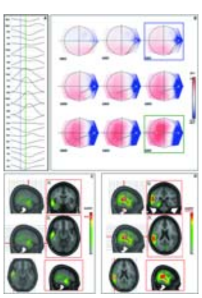


Seizure Localization and Imaging

Discharges	Wake	Sleep	p value
Concordant with imaging, all seizures	2188 (67.8%)	157 (54.8%)	0.03
Concordant with imaging, patients with seizures awake and asleep	93 (56%)	80 (70.7%)	0.007
Focal ictal EEG onset	139 (53%)	65 (32%)	0.001
Interictal EEG concordant with imaging	45 (64.2%)	25 (35.7%)	0.002

Singh et al. Clin Neurophys 125:2337, 2014

Source Localization of Seizures

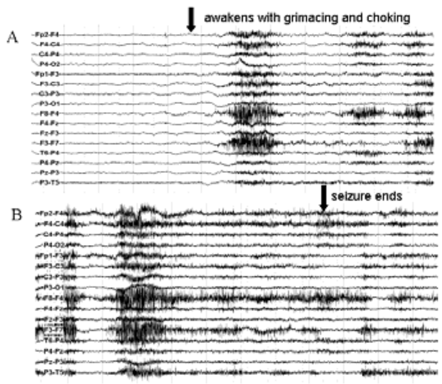


(A)The averaged waveform.
(B) Sequential voltage maps on the ascending slope of the averaged waveform (timeframes: 18–26; duration of a timeframe: 4 msec). A change in the voltage distribution along the ascending slope is observed. Source localization is performed at timeframe 20 (blue box) and at timeframe 26 (green box).
(C) The source localization corresponding to the initial voltage distribution (timeframe 20) shows activation at the anterior part of the right temporal lobe/pole.
(D) At the peak of the averaged waveform (timeframe 26) the activation propagates to the posterior-lateral part of the temporal lobe and to the parietal lobe.

S Beniczky. Epilepsia 54:1743, 2013

Case

- 32 year old man with 8 year history of "attacks" who came for second opinion after being referred to a Movement Disorder specialist
- Episodes begin with regular, fast jerking of right eye for several seconds, then tonic contraction of right lower face, pulling in throat, inability to speak, sense of choking, lasts 20-30 seconds
- Occur 5-10 times per week, awake and asleep
- Modest response to carbamazepine 200 mg daily
- Video-EEG normal during 6 episodes
- Diagnosis?



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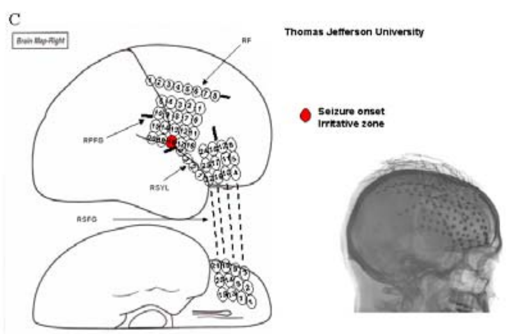
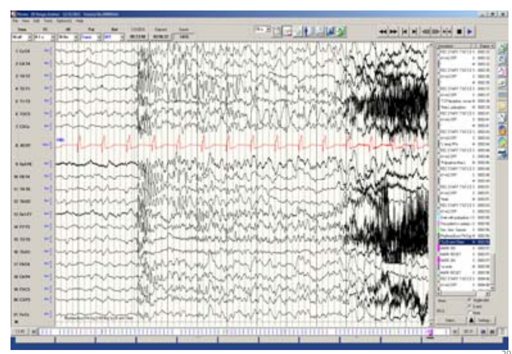


28

Muscle Pattern is Distinctive in Seizures



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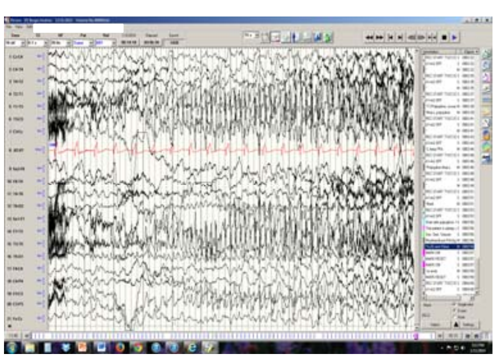

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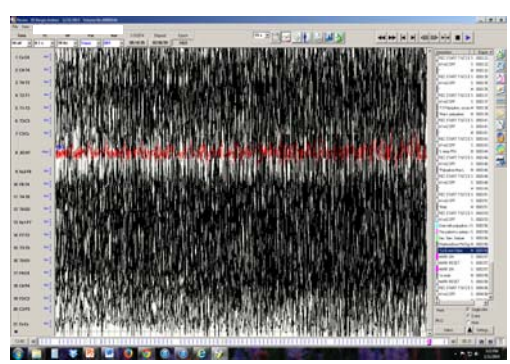

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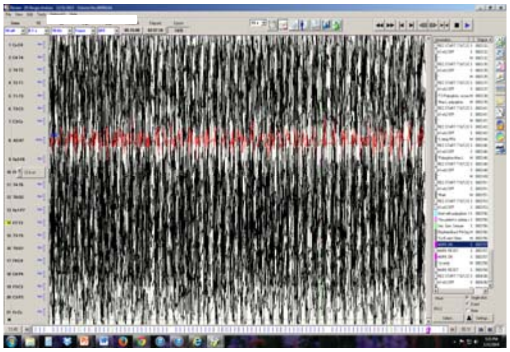

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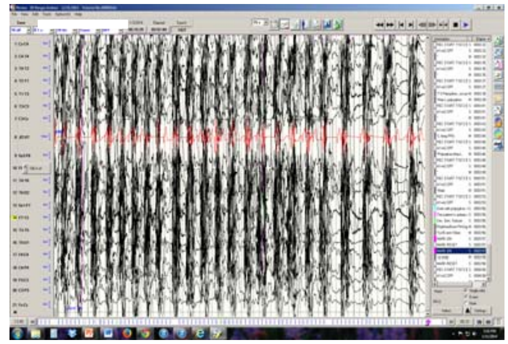

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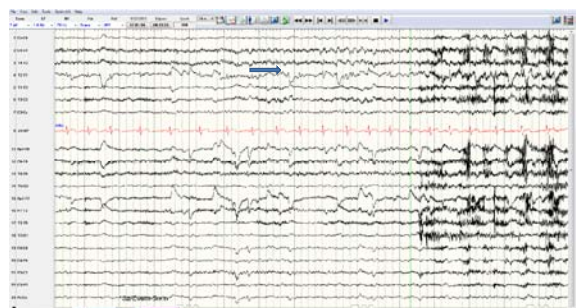
ARS Question

- Was this a seizure?
- 1. Yes
- 2. No
- 3. Unsure

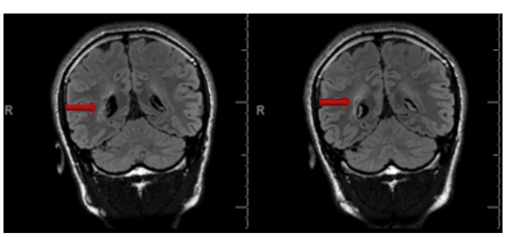
34

Complex Partial Seizure Onset: Eye Movement Effects



35

MRI Shows Subcortical Pathology



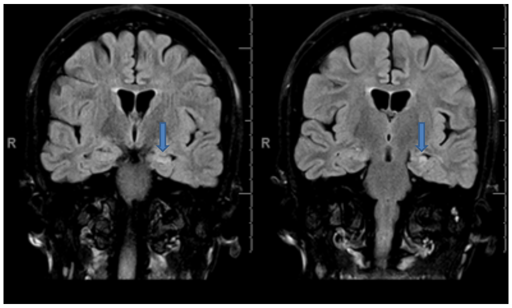
36

Case

- 51 year old right handed woman with complex partial seizures starting at age 38 without antecedent risk factors other than special education in school
- No aura, sudden loss of awareness, oral automatisms, occur in clustersof 2-4 seizures every 2 months
  - Failed 4 drugs
- Neurological exam normal except impaired memory and naming
- Neuropsychology: IQ low average, BNT 26, impaired fluency, poor verbal memory, visuospatial memory normal
- PET: left temporal lobe hypometabolism
- Interictal EEG: left and right anterior temporal sharp waves

37

Case: MRI



38

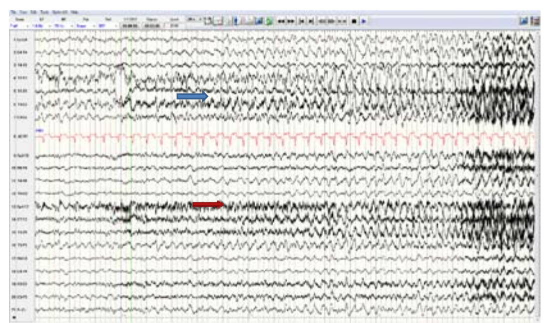
Case: Preictal EEG

39

Case: Ictal EEG (page 1)

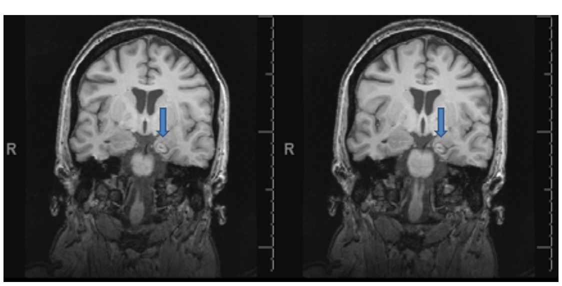
40

Case: Ictal EEG (page 2)



41

MRI After Thermal Ablation



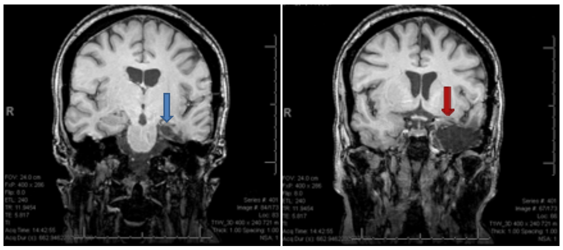
42

Case: Course after Thermal Ablation

- CPS persist without change in character or frequency
- Several months later, she had a left anterior temporal lobectomy

43

Case: MRI after ATL



44

Case

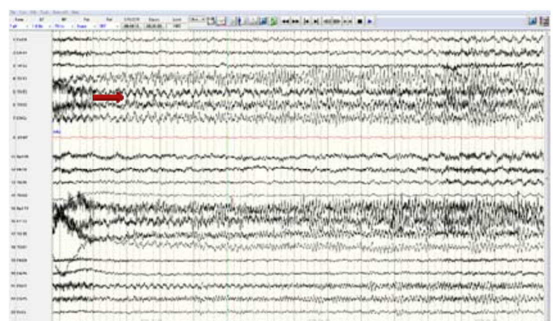
- CPS persist without change in character or frequency
- Post-ATL EEG follows

45

Case: Postop Seizure

46

Case: Postop Seizure (cont)



47

Video-EEG: Lessons

- Video-EEG is a valuable tool
  - Aids in diagnosis and management of epilepsy
- It has limits like every other diagnostic technique
  - Sensitivity
  - Specificity
  - PPV, NPV
- Results must be considered in light of all data – history remains the most important aspect of the epilepsy evaluation, followed by MRI

48

Annual Fundamentals of Epilepsy Symposium: Video-EEG Monitoring

Optimizing Use of Intracranial EEG

Jean Gotman, PhD
Montreal Neurological Institute
McGill University

No Disclosure

2

Learning Objectives

- To understand situations in which intracranial electrodes may be useful.
- To understand the fundamental limitations of intracranial electrodes.
- To become familiar with some of the difficulties of interpreting intracranial EEG.

3

Outline

- Cases of intracerebral electrodes (stereotactic)
- Cases with subdural electrodes, combined with a few depth electrodes (free hand)
- Why do we still need intracranial electrodes today?
- Strengths and weaknesses of intracranial electrodes
- Pitfalls in the interpretation of intracranial EEG.

4

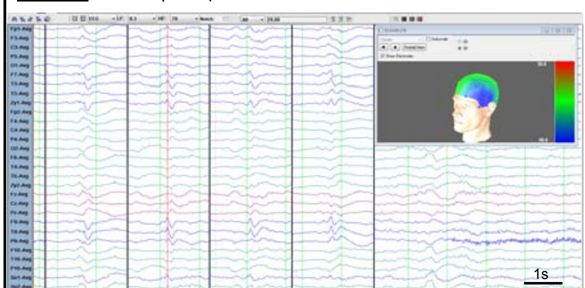
Frontal vs. Temporal

- 36-year old right-handed man
- Seizures since age 5 (mostly sleep)
- Semiology: heart racing; feeling "embarrassed"; hypermotor seizure with screams, intense agitation, fear; unusually long duration, post-ictal amnesia, slow recovery
- FDG-PET: prefrontal hypometabolism left
- Neuropsychology: frontocentral dysfunction, not lateralized

5

Scalp EEG

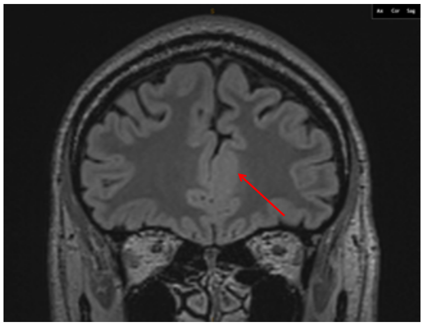
Interictal: left temporal (F7-T3-F9-T9



Ictal: artifact at onset, later rhythmic delta over anterior head regions

6

MRI: FCD left anterior cingulate



Hypothesis and Implantation

- left anterior cingulate generator?
  (seizure semiology and concordant lesion)

But: - strong temporal involvement in IEDs
- long seizure duration, postictal amnesia, and slow recovery (temporal spread?)

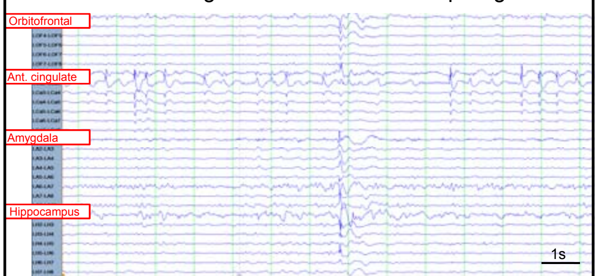
➡ Depth electrodes to exclude temporal or widespread onset
<u>Left:</u>
- orbitofrontal, anterior and superior cingulate, amygdala,hippocampus

<u>Right:</u>
- anterior cingulate, hippocampus

8

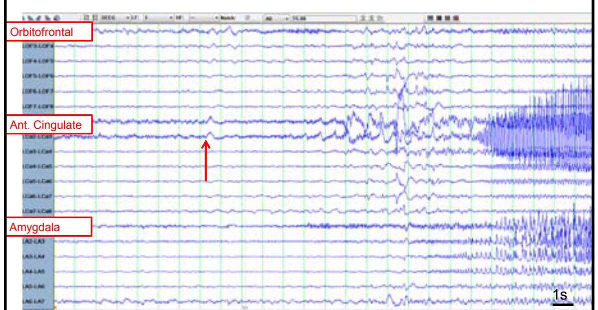
Interictal SEEG

Anterior cingulate semi-continuous spiking



9

Ictal SEEG

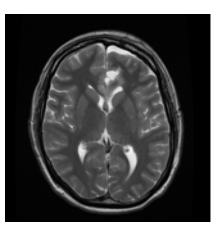


<u>Stimulation</u>: Habitual seizure evoked in Ant Cingulate (50Hz, 1.6mA)

10

SEEG outcome

- Hypothesis confirmed
  - Resection of FCD
  - Histology: FCD type 2b
  - 2-year follow-up: Engel 1a



11

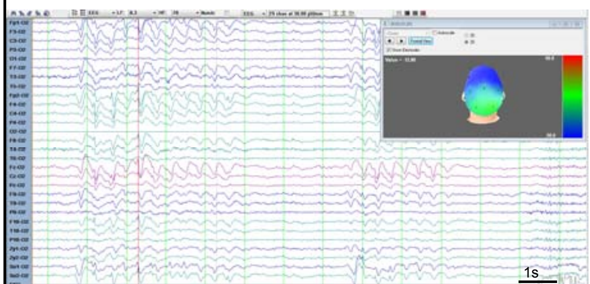
Focal frontal generator?

- 33-year old right-handed woman
- Seizures started at age 14
- TBI at age 7
- Semiology: No aura. Loss of awareness, hesitates, grimacing, sometimes giggles, eyelids fluttering, head turn to L, some restlessness and pedaling and hand automatisms with chewing. Post-ictal amnesia and slow recovery
- Neuropsychology: diffuse interference, mostly frontal

12

Scalp EEG

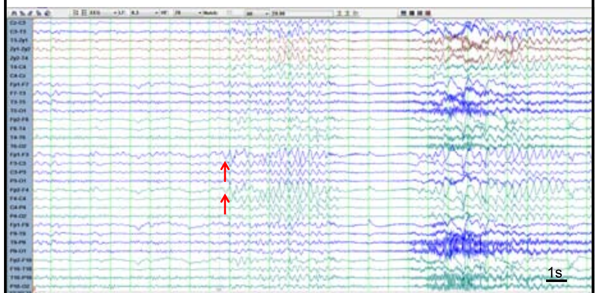
Interictal: Fronto-temporal slow sharp waves, bilateral symmetrical



13

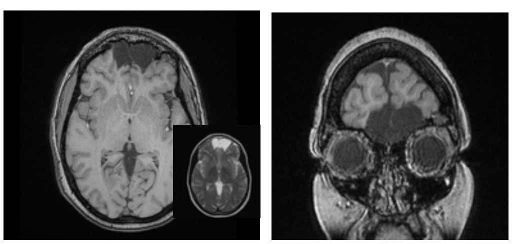
Scalp EEG

Ictal: diffuse bursts of slow spike-and-wave and attenuation, symmetrical



14

MRI: anterior frontal bilateral encephalomalacia



15

Hypothesis

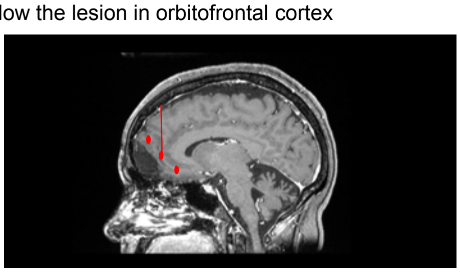
- Most likely a frontal generator close to lesion. Lateralization not visible from scalp EEG but is it possible with intracranial electrodes?

Implantation in the frontal lobes to lateralize the generator

16

SEEG Implantation

- 3 depth electrodes in each hemisphere:
  - superior to lesion in first frontal gyrus
  - behind the lesion (parasaggital insertion)
  - below the lesion in orbitofrontal cortex

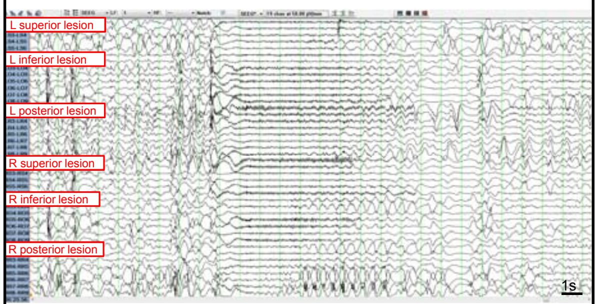


17

SEEG interictal: widespread symmetrical

18

SEEG ictal: widespread symmetrical



19

SEEG outcome

- SEEG:
  - Epileptogenic area in both frontal lobes
  - Hypothesis of a lateralized generator could not be confirmed

➡ No surgery

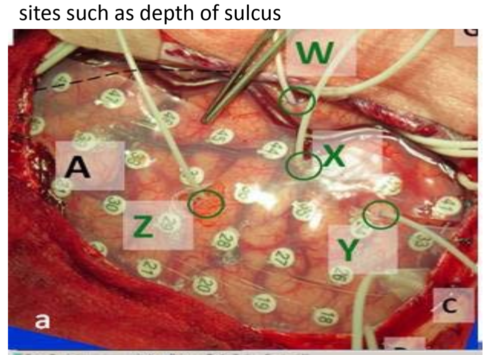
20

Depth vs. Grids

- Depth electrodes can reach almost any region of the brain, including the cortical surface but their coverage of the cortical surface cannot be extensive.
- Subdural grids provide a better coverage of the cortical surface but they do not see deep generators, including the typical "depth of the sulcus" FCDs.
- Combination of subdural grid and a few depth electrodes can partially address this weakness.

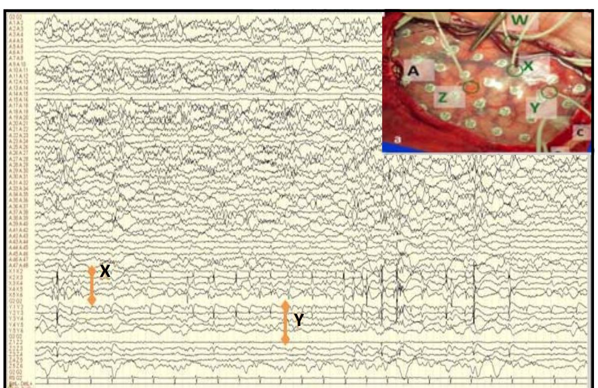
21

Combination of subdural and depth allows coverage of wide cortical surface + specific deep sites such as depth of sulcus



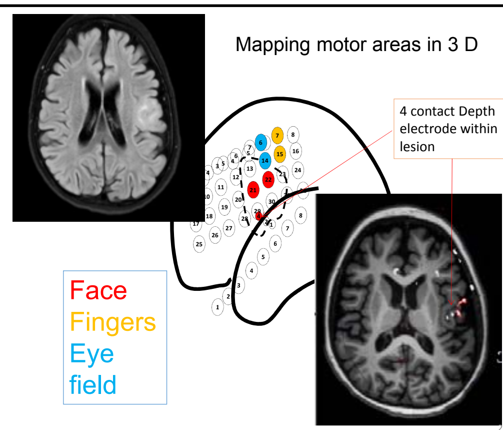
Courtesy of P. Jayakar

22



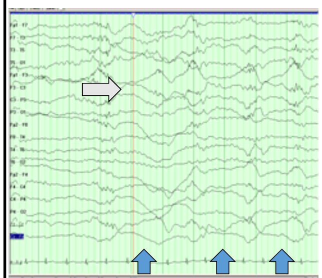
Spikes seen in depth and not subdural

Mapping motor areas in 3 D



Courtesy of P. Jayakar

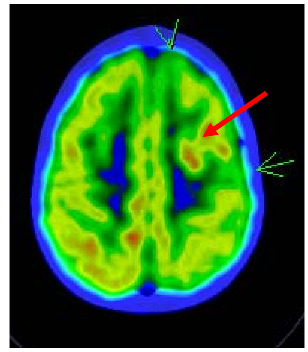
24

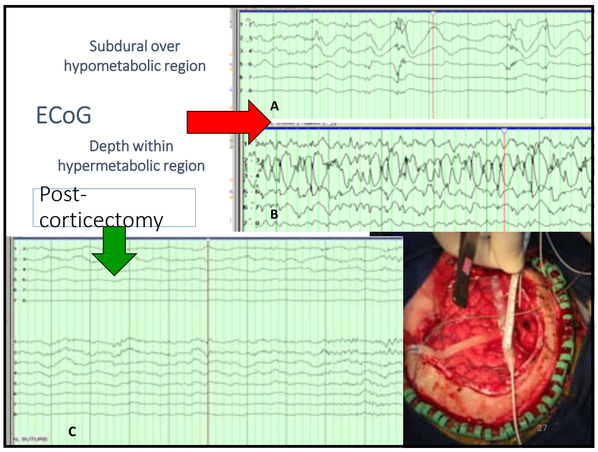


Case :
MRI negative
10 yr old with aphasia
Encephalopathic EEG with semi-periodic discharges

Courtesy of P. Jayakar

PET hypermetabolism with surround hypometabolism





Outline

- Cases of intracerebral electrodes (stereotactic)
- Cases with subdural electrodes, combined with a few depth electrodes (free hand)
- Why do we still need intracranial electrodes today?
- Strengths and weaknesses of intracranial electrodes
- Pitfalls in the interpretation of intracranial EEG.

Why do we still need Intracranial Electrodes Today?

- If one places a large number of electrodes on the scalp, and one used source models, can we not « see » what happens in the depth of the brain?
- Can magnetoencephalography (MEG), with its hundreds of sensors and sophisticated analysis methods, not « see » sources deep in the brain?

The Fundamental Problem : Amplitude

Amplitude of the deep generator and of the corresponding scalp potential

- Within the brain, the potential decreases with the square of the distance between the generator and the recording point.
- The skull attenuates the signal considerably (approx factor 5).
- Example:
  - Generator in the hippocampus
  - Potential of 500μV, 0.5cm from the generator
  - 4cm from the generator (8 times further), on the temporal neocortex, the potential is 64 times smaller (8μV)
  - On the scalp, the potential is reduced by a factor of 5: **1.6μV**

The hippocampal signal is lost in the larger amplitude EEG generated in the temporal neocortex

Outline

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31

Advantages of Intracranial Electrodes

- They can be placed almost anywhere with a relatively low risk, thanks to modern image-guided neurosurgical techniques.
- The EEG is of very high quality, without the main artefacts visible on the scalp (movement, eye movements). This is particularly important during epileptic seizures.
- EMG contaminates the signal minimally.
- The electrodes can be very close to neuronal generators.
- The electrodes can be used for stimulation, to trigger seizures or for functional mapping.

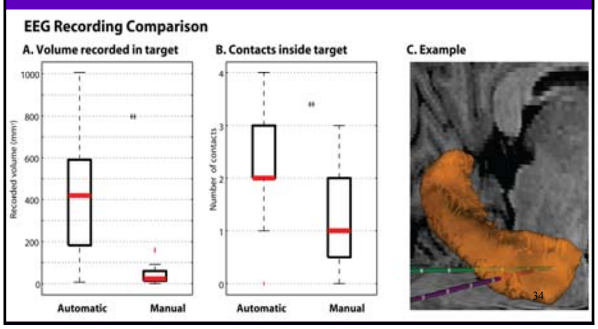
32

But intracerebral electrodes explore a small brain volume…

- **Depth electrodes**
  - 1 multi-contact electrode « captures » a cylinder of ~ 1cm in diameter and 6cm in length = 5cm^3
  - 10 electrodes (100 contacts) = 50cm^3
  - 1 brain ~ 1300cm^3
  - **10 electrodes = 4% of one brain, 8% of one hemisphere**
- **Subdural grids**
  - 1 grid contact is sensitive to a disk of ~ 2cm in diameter (3cm^2)
  - 1 8x8 grid explores 64x3 ~ 200 cm^2
  - One hemisphere ~ 5,000 cm^2
  - **One 8x8 grid covers about 4% of the cortical surface of one hemisphere**

33

Automatic selection of electrode path to maximize grey matter and target coverage, and minimize risk (Zelmann et al, 2015)



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It is critical to have a small number of specific hypotheses that can be elucidated by implantation since intracranial electrodes explore only a small fraction of the brain volume or surface.

35

Outline

- Cases of intracerebral electrodes (stereotactic)
- Cases with subdural electrodes, combined with a few depth electrodes (free hand)
- Why do we still need intracranial electrodes today?
- Strengths and weaknesses of intracranial electrodes
- Pitfalls in the interpretation of intracranial EEG.

36

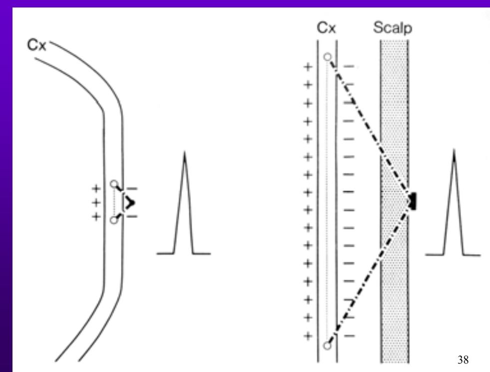
Interpretation of the Intracranial EEG Signal

- The close proximity between an electrode and a generator results in a signal of very large amplitude, even if the generator has a small spatial extent.
- The amplitude may therefore be very misleading because it can vary considerably within a few mm.
- For a generator to have an important volume, it must be visible on several contacts, not necessarily with large amplitude.
- The precise knowledge of the relationship between the position of an electrode and the cortex is helpful in unraveling the complexity of intracerebral recordings.

37

Very different generator size, same spike amplitude

Gloor 1985



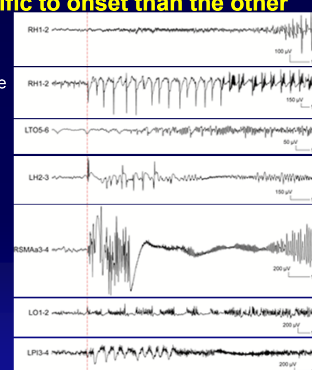
38

Very localized large spike: present in one electrode, absent from the neighbor Electrodes are 5mm apart

39

Different seizure onset patterns: None is more specific to onset than the other

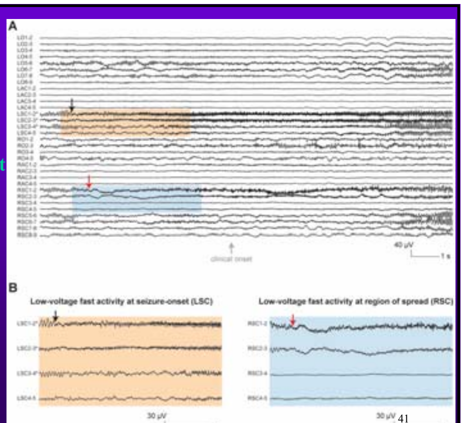
1) Low-voltage fast activity
2) Low-frequency high-amplitude periodic spikes
3) Sharp activity at ≤13Hz
4) Spike-and-wave activity
5) Burst of high-amplitude polyspikes
6) Burst suppression
7) Delta brush



Perucca P et al., *Brain* 2014;137:183-96

The same seizure onset pattern can represent **onset and spread**

Perucca et al, *Brain*, 2014



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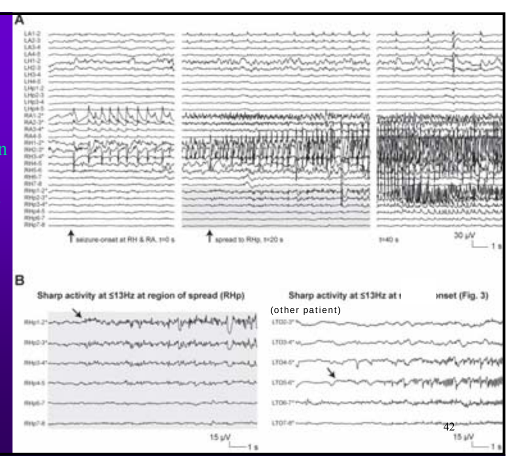
The same seizure onset pattern can represent **onset and spread**



42

If you are curious and if your equipment allows you, look at High Frequency Oscillations by using a high-pass filter at 80 or 200Hz, increasing the gain and stretching the time scale.
Several studies demonstrated that the removal of regions generating ripples or fast ripples is a better predictor of seizure outcome than the removal of seizure onset regions.

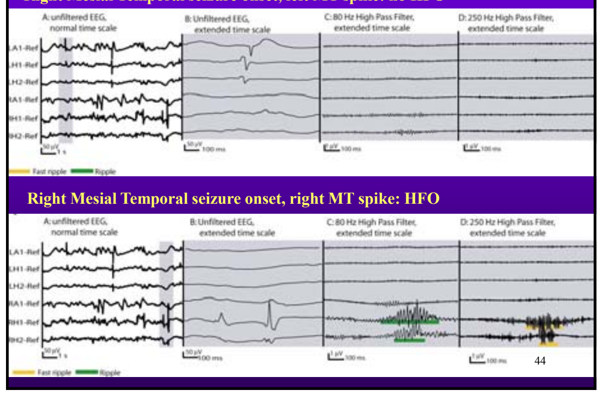
Jacobs et al, *Ann Neurol,* 2010
Wu et al, *Neurology,* 2010
Cho et al, *Epilepsia,* 2014
Okanishi et al, *Epilepsia,* 2014
van 't Klooster et al, *Neurology,* 2015

43

Interictal HFOs

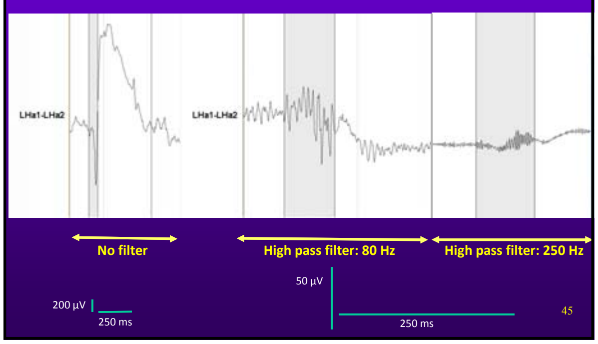
Right Mesial Temporal seizure onset, left MT spike: no HFO

Right Mesial Temporal seizure onset, right MT spike: HFO



44

Ripple and fast ripple at the time of a hippocampal spike



45

Optimizing the Use of Intracranial EEG
Conclusions

- Define clearly the hypothesis that the electrode implantation will support or destroy.
- Place electrodes according to this hypothesis
- When planning the implantation, remember that each contact can only see a very small brain volume
- When interpreting the EEG, remember that amplitude can be misleading and that very few patterns are specific to seizure onset.

46

The End

47

Case Studies

Nathalie Jette MD, MSc, FRCPC
Professor Neurology
University of Calgary
President Canadian League Against Epilepsy

UNIVERSITY OF CALGARY O'Brien Institute for Public Health | CALGARY EPILEPSY programme | HOTCHKISS BRAIN INSTITUTE

December 4, 2015

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING DECEMBER 4 - 8, 2015 PHILADELPHIA, PA

Disclosure

Co-Investigator on a University of Calgary (Hotchkiss Brain Institute)/Pfizer Canada co-funded grant not related to this presentation.

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING

Learning Objectives

- Through the use of video-EEG (vEEG) recordings:
  - Understand how vEEG can be used to characterize events and optimize care
  - Recognize how vEEG can be helpful at differentiating non epileptic from epileptic events
  - Understand the importance of vEEG in the pre-surgical evaluation

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING

Case #1

- 75 y.o. right handed female, retired occupational therapist
- Well until May 2015 when acutely developed new spells:
  - **Type 1** – déjà vu lasting seconds, followed by significant fatigue occurring daily; tired after event
  - **Type 2** – "clenching of the left hand and left face, sometimes the right hand and face"
    - May be associated with drooling and nausea (only if involving right side)
    - Last 5-10 seconds and occur >30 times daily; tired after event

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING

Case #1 – History (continued

No epilepsy risk factors

Review of systems
- Progressive dysarthria
- Low mood, low appetite, low energy

Meds
- Clopidogrel
- Gabapentin (for pain)

Past Medical History
- Atrial fibrillation
- Degenerative disc disease

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING

Case #1 – History (continued)

Family History
- Non contributory

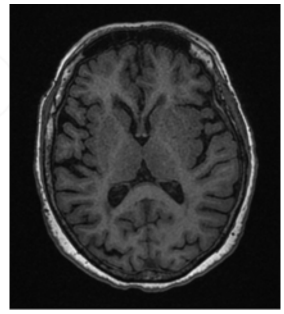
Social History
- Retired occupational therapist
- Non smoker, rare alcohol
- Divorced
- Has a son & daughter (both health)

Neurological exam
- Mild dysarthria but otherwise normal

AMERICAN EPILEPSY SOCIETY 69TH ANNUAL MEETING

Case #1 – Video-EEG

MRI Brain



Case #1 - Diagnosis

Will be discussed

Case #2

- 54 y.o. right handed male, maintenance worker, with onset of spells at ~age 31
- **Type 1**
  - Burning smell lasting seconds (1/month)
- **Type 2**
  - Blank staring, “lip movements”, +/- humming lasting 5-30 seconds (1/month)
- **Type 3**
  - Onset never witnessed – but had 4 and essentially had bilateral convulsive activity

Case #2 History (continued)

Medications
- Valproic acid 250 mg am, 500 mg pm

Prior AED Trials
- Lamotrigine → rash
- Carbamazepine → severe diarrhea

Past Medical History
- MI with quadruple bypass (2006)
- Dyslipidemia

Case #2 History (continued)

Family History
- Maternal cousin with epilepsy (?type)

Social History
- Grade 12 education
- Maintenance worker
- Occasional alcohol
- Marijuana (2 x per week)
- Not driving

Physical Exam → normal

Case #2 – Video-EEG

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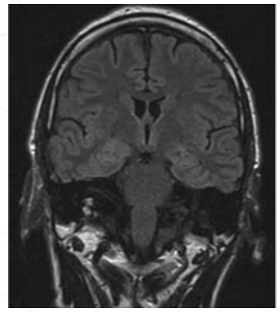
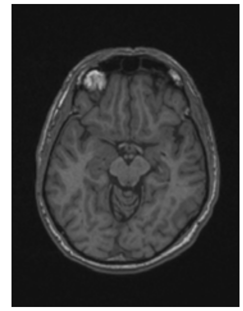
Case #2 – History continued





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Case #2 - Discussion

Will be discussed

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Case #2 – Video-EEG

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Case #2 - Discussion

Will be discussed

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Case #3

- 24 y.o. right handed female with onset of spells at age 13
- **Type 1**
  - Out of body experience → bilateral convulsive activity lasting 30-60 secs, occurring about 1-2/year
- **Type 2**
  - Indescribable feeling → may repeat words over and over, and speaks in a “child-like” manner lasting up to 15 mins, occurring daily

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Case #3 – History (continued)

- **Epilepsy Risk Factors**
  - None
- **Review of Systems**
  - Visual and auditory hallucinations starting in childhood → has been treated by youth psychosis team for years
- **Past Medical History**
  - Presyncope/syncope (rare)
  - Necrotizing enterocolitis at 6 months of age

Case #3 – History (continued)

- **Social History**
  - Engaged
  - No children
  - Finished grade 12
  - On social assistance
  - Smokes 5-6 cigs/day
  - Illicit substances – used to ingest cocaine, crystal methamphetamine, marijuana but none x 2 yrs
  - Has never driven
  - Born to drug addicted mother and father with alcoholism; raised in foster homes; significant emotional, physical and sexual abuse

Case #3 – Video-EEG

Case #3 - Diagnosis

Will be discussed

Impact on Clinical Care and Practice

- vEEG monitoring can be helpful to:
  - Characterize spells → seizure vs. non-epileptic
  - Quantify seizures → optimize management
  - Localize seizures → presurgical evaluation
- Can also be helpful if patient is not responding to treatment
  - Is poor adherence an issue?
  - Is the diagnosis wrong?
  - Is surgery an option?

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Video-EEG Monitoring Conclusion

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1

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Disclosure

Name of Commercial Interest	Type of Financial Relationship
UCB	Research Grant, Consult
Eisai	Research Grant, Consult
Bial	Research Grant
Astellas	Research Grant
Janssen-Cilag	Consult
Electrocore	Consult
Acta Neurologica Scnadinavica	Chief Editor

2

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Main Learning Objectives for this course

How to utilize modern technology, safety protocols and nursing and physician practice to provide optimal care and diagnosis for patients with uncontrolled seizures

How to establish an EMU and the safety issues involved

3

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Learnings Objectives

To learn the practical aspects of video recordings that enhance quality of the VEEG evaluation

To demonstrate a spectrum of epileptic and nonepileptic semiology and how VEEG can help differentiate non epileptic from epileptic events

To illustrate the role of semiology in the implication of functional network activation in focal epilepsies

To review practical aspects of video recordings that enhance quality of the VEEG evaluation

4

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Learning Objectives

To understand situations in which intracranial electrodes may be useful

To understand the fundamental limitations of intracranial electrodes

To become familiar with some of the difficulties of interpreting intracranial EEG

To understand the importance of VEEG in the pre-surgical evaluation

5

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Did we succeed with our learning objectives? Answers with a range from 1-4

1. Agree
2. Mostly agree
3. Somewhat agree
4. Not at all

6

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Impact on Clinical Care and Practice-ARS question

How will you change your practice after taking this course-one choice- the most important or immediate change

- 1. Do more diagnostic EEG monitoring
- 2. Consider options of epilepsy surgery in more of my refractory patients
- 3. Begin to set up a high quality video-EEG monitoring unit
- 4. Try to form a functioning epilepsy team
- 5. Not necessary to change or implement video-EEG registration
- 6. I already have access to video-EEG monitoring and use it

7

What are the barriers for you to implement Video-EEG monitoring techniques in your practice

1. None

2- Financial

3. Practical problems such as space, priorities, finding appropriate and educated team members

4. Already have Video-EEG monitoring capabilities and use them

8

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