EEG at a Glance

A nurse's guide to understanding the basics

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The History Behind the Electroencephalogram

- In the year 1870, some of the worlds leading doctors began experimenting with animals, in order to learn how to record the electrical activity of the brains of rabbits, monkeys, and dogs.
- This included finding a way to record and publish the first animal EEG.
- Research in the field of medicine has come a long way since the 1870's, but today the use of animals is highly scrutinized and regulated.
- There are still many areas where animal testing is necessary and non-animal testing is not yet a scientifically valid and available option. However, FDA has supported efforts to reduce animal testing and to work towards replacement of animal testing.

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The First EEG Performed

- EEG was first performed on humans by a German psychiatrist named Hans Berger in 1924.
- During a training exercise in the military, he was thrown from his horse directly in front of a horse drawn cannon. At this time, his sister was worried about him, and sent him a telegraph asking how he was doing.
- The incident made him wonder how it was that in a time of severe danger, he was able to telepathically transport his feelings of immense danger to his sister (the receiver).
- He became obsessed with the idea of inventing a method to record brainwaves.

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History Continued

- Franklin Offner (1911–1999), professor of biophysics at Northwestern University developed a prototype of the EEG that incorporated a piezoelectric inkwriter called a Crystograph (the whole device was typically known as the Offner Dynograph).
- EEG is considered to be one of the main diagnostic tests for diagnosing Epilepsy.

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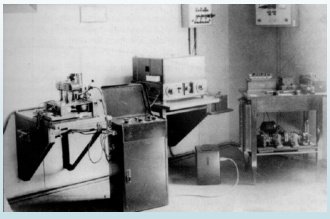
The First Electroencephalogram



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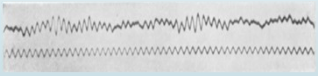
History Continued

- By 1938, EEG had gained widespread recognition by important researchers in the field, leading to its practical use in diagnosis in the United States, England, and France.
- Today EEG is used as a graphic representation of the difference in voltage between two different scalp locations plotted over time.

The upper is EEG signal, and the lower is a 10Hz timing signal



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So What is EEG Exactly?

- An EEG is used to evaluate the electrical activity in the brain. Brain cells communicate with each other through electrical impulses. That activity can be monitored to help detect potential problems associated with this activity.
- An EEG tracks and records brain wave patterns. Small flat disc electrodes are attached to the scalp. These electrodes record the impulses in the brain, and send the signals to a computer that records the results.
- An electroencephalogram (EEG) is a noninvasive test which is used to help diagnose conditions such as seizures, epilepsy, head injuries, dizziness, headaches, brain tumors, and sleeping problems. It can also be used to confirm brain death

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EEG Electrode Placement

- The correct placement of electrodes for EEG is critical for accurate interpretation of EEG, otherwise there is room for error.
- An internationally utilized system (The 10-20 system of Electrode placement) was developed to create a standard format and common terminology to describe the locations.
- The system is based on the relationship between the location of the electrode, and the underlying area of cerebral cortex.
- The numbers 10 and 20 refer to the fact that distances between electrodes are either 10% or 20% of the total front to back or right to left distance of the skull.
- Each site has a number or letter. The number refers to what hemisphere location, and the letter to which lobe it covers. Odd numbers left, Even numbers Right
- F=Frontal, T=Temporal, P=Parietal, O=Occipital

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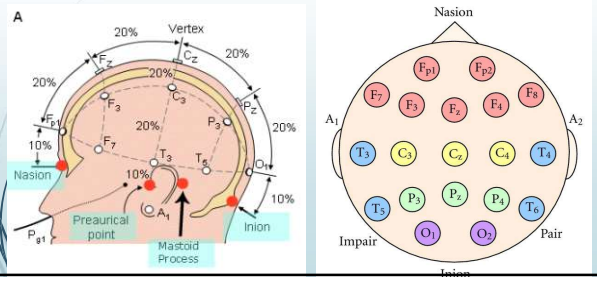
On the Left: Example of how we utilize skull landmarks and percentages of the total scalp measurement, in order to figure specific electrode placement.

On the Right: Image of the electrode names, and where on the scalp each is located.



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Types of Electrodes

- There are a variety of different electrode types on the market currently
- Some examples include disposable electrodes, reusable electrodes and MRI compatible electrodes.
- MR Compatible electrodes that we use come in a harness, and connect with long braided cables that plug into a jack box.

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Lets Take a Moment to Discuss This Question in Smaller Groups

- Case Study: A 26 year old male is admitted to the intensive care unit, after having his first generalized tonic clonic seizure, which was witnessed by his parents. The young man has no other medical history, but his parents report sleep deprivation and stress may have preceded this event. He also has a maternal uncle with a history of Epilepsy. The Neurology team orders a 24 hour Video EEG for the patient.
- What would you say to your patient and his family in order to prep them for the upcoming procedure?
- We will now split up into break out rooms and discuss this topic briefly

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What Happens to the Brain During a Seizure?

- Brain cells either excite or inhibit (stop) other brain cells from sending messages. Usually there is a balance of cells that excite and those that can stop these messages. However, when a seizure occurs, there may be too much or too little activity, causing an imbalance between exciting and stopping activity. The chemical changes can lead to surges of electrical activity that cause seizures.
- Seizures sometimes are not controlled with seizure medications. A number of different terms may be used to describe these including: "uncontrolled," "intractable," "refractory," or "drug resistant."
- EEG is used to diagnose a person with Epilepsy by recording the electrical discharge of the brain.

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Routine EEG Versus Video EEG, What is the Difference?

- A **routine EEG** typically lasts 25-30 minutes, and is mostly done in the outpatient lab, but can also be performed at the patient's bedside.
- Routine EEG consists of using a conductive paste, and placement of between 19-24 electrodes.
- In a routine EEG, it is important to record the patient's awake, drowsy and asleep stages. (Sleep is the most important type of physiologic activation method to observe EEG abnormalities).
- Other activation methods such as ***hyperventilation*** can induce focal EEG abnormalities. ***Photic Stimulation*** can be used to provoke generalized abnormalities. Both are considered reasonably safe.

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Long Term Video EEG Monitoring

- **Video EEG Monitoring** is utilized, when it is important to characterize a patient's clinical behaviors, while simultaneously recording EEG.
- It helps clinicians to better characterize a patient's seizure type.
- Recordings of longer duration, help to capture physiologic and behavioral changes.

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Common Indications for Video EEG Monitoring

- The two most common indications for Video EEG are:
  1.) a diagnostic evaluation to determine the nature of a seizure or seizure-like event
  2.) Pre-surgical Evaluation for medically refractory Epilepsy (or seizures that are difficult to control).

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Physiologic Non-Epileptic Events that Mimic Epileptic Seizures

- Cardiac Events: Syncope, arrhythmias, orthostatic hypotension
- Toxic/Metabolic: Hypo or hyperglycemia, drug intoxication
- Pulmonary: Hyperventilation or sleep apnea
- Movement disorders
- Migraines
- Transient ischemic attacks
- Sleep disorders
- Transient global amnesia

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Psychiatric Events that May Mimic Seizures

- Psychogenic non-epileptic seizures (PNES)
- Malingering
- Catatonia
- Panic Attacks
- Hallucinations/psychosis
- Munchausen syndrome/munchausen by proxy

Prolonged Video EEG is the gold standard for diagnoses of psychogenic non-epileptic seizures. PNES are thought to be highly under diagnosed. As many as up to 20% of cases that are referred to Epilepsy units for monitoring have psychogenic seizures.

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What is Collodion?

- Collodion is a flammable, syrupy solution of nitrocellulose in ether and alcohol. There are two basic types: flexible and non-flexible. The flexible type is often used as a surgical dressing or to hold dressings in place. When painted on the skin, collodion dries to form a flexible film. Non-flexible collodion is often used in theatrical make-up.
- Collodion is what is used to adhere the electrodes to the scalp in Video EEG hookups.

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Some of the tools that are utilized to place electrodes on a patient for video EEG are:
Collodion, calipers (a type of measuring tool), tape measure and a marker or pencil and an air jet.

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- Try to imagine yourself attempting to carefully glue 24 tiny electrodes to your irritable cat who is trying to escape you. Then add some post ictal psychosis or delirium to the picture.
- Now you understand our process. The nurse is a technologist's best friend. You can help us calm the person, move or hold the person still. Sometimes getting the patient's family involved is helpful, other times not.
- In the critical care setting, sometimes by just contacting the MD for an order for restraints is all that we need to complete the setup.

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Seizure Precautions and First Aid: What to Do if You Witness a Seizure?

- Respond to changes in consciousness or behavior promptly.
- Monitor vitals during seizures, and after administration of antiepileptic medications.
- Turn patients on their side as soon as possible after a convulsion.
- Ensure that suction and O2 are available at all times.
- Provide padded side rails.
- Assess patients frequently until return to baseline.
- Record length of event, and document observations ie., eye rolling, facial twitching, or unilateral weakness.

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Invasive EEG Monitoring, When is it Indicated?

- Invasive EEG Monitoring with intracranial electrodes is indicated when the non invasive evaluation is not able to assist in localizing the seizure onset.
- Or, when it is necessary to carefully map out the cortical function in an area of planned surgical resection.
- Compared to scalp recordings, implanted electrodes have the advantage of improved signal quality, increased sensitivity, and improved spatial resolution.
- Invasive electrodes can also be used for stimulation studies in mapping cortical function.

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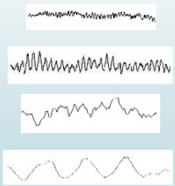
What Are We Actually Looking at on the EEG? What is Normal EEG?

EEG activity can be broken down into 4 distinct frequency bands:

- Beta activity > 13 Hz
- Alpha activity 8 Hz-12 Hz
- Theta activity 4 Hz-7 Hz
- Delta activity < 4 Hz



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What are Considered Normal EEG Findings?

- An awake posterior dominant rhythm is seen in the parietal/occipital regions and consists of an alpha frequency.
- Eye blinks
- Some beta maximal bi-frontal regions
- Normal Stage II Sleep structures including: Spindles, Vertex Waves, and Posts

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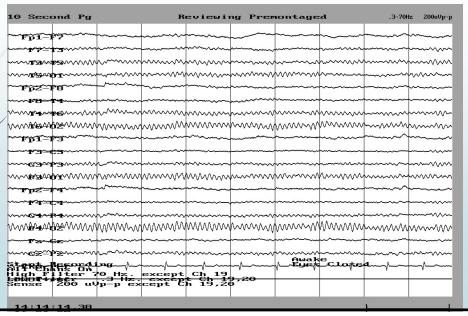
Normal Awake Background (PDR)=Posterior Dominant Rhythm



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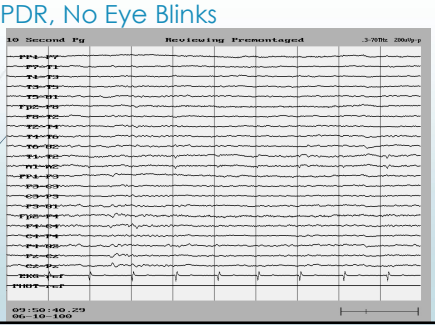
Sleep=Loss of Fast Frequencies, Loss of PDR, No Eye Blinks



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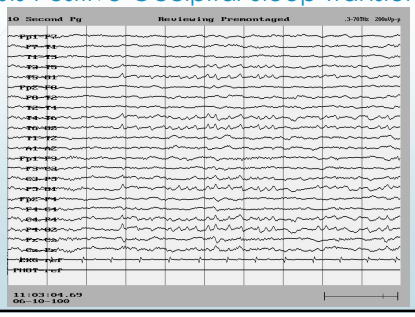
Sleep also includes Vertex Waves, and Posts Positive Occipital Sleep Transients



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Focal Abnormality-Periodic Discharges that are Maximal in the Right Parietal Region

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Generalized Inter-Ictal Discharge

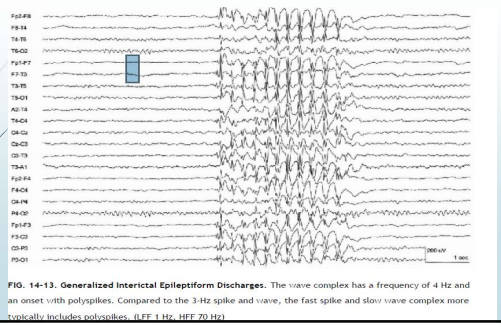

FIG. 14-13. Generalized Interictal Epileptiform Discharges. The wave complex has a frequency of 4 Hz and an onset with polyspikes. Compared to the 3-Hz spike and wave, the fast spike and slow wave complex more typically includes polyspikes. (LFF 1 Hz, HFF 70 Hz)

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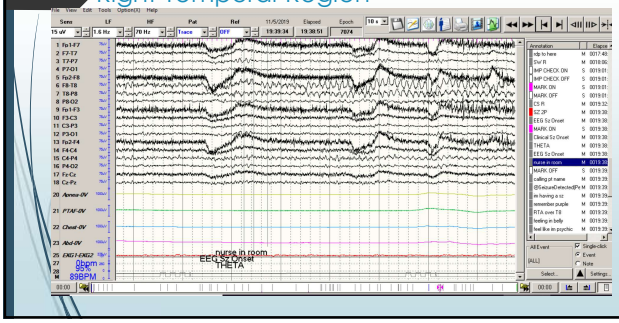
Electrographic Seizure Progressing over the Right Temporal Region



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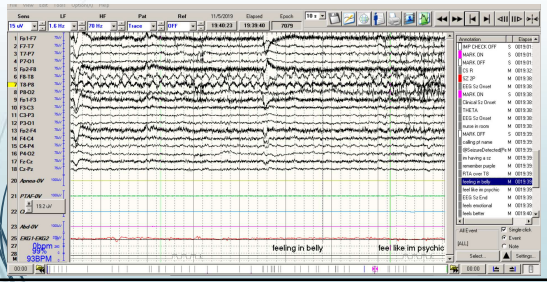
The Patient Reports Feeling an Unusual Sensation in Her Belly, She Feels a Sensation of Déjà vu, and Overly Emotional.



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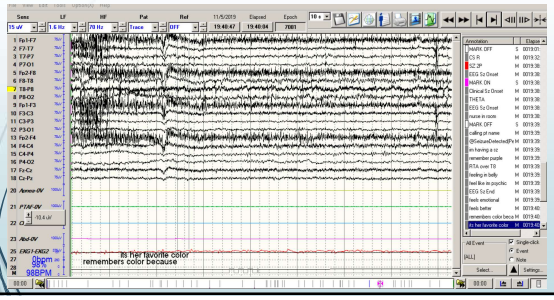
End of Seizure Pattern, and Clinical Symptoms



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Lets pause here to stop the recording for a moment.
I would like to show some video clips of some interesting seizure types.
There will be 4 videos: One out of the four is a non-epileptic seizure.

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- Seizure #1: woman in chair?
- Seizure #2: Screaming man?
- Seizure #3: Laughing man?
- Seizure #4: Woman on her side in bed?

Which of these videos was a non epileptic seizure?

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Volunteer Time: Lets Try to Answer a Few Questions!

Question 1: Briefly explain how an EEG works

Question 2: What are some reasons that Video EEG monitoring is helpful to physicians?

Question 3: As an RN, what are your main priorities for a patient who is possibly having seizures.

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Thank You!!

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