

EEG RECORDING HELP IN DIAGNOSIS OF NOCTURNAL FRONTAL LOBE EPILEPSY (NFLE)

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ABSTRACT

Nocturnal Frontal Lobe Epilepsy is the most distinct syndrome in the sleep related disturbances. NFLE seizures are more dominant in males rather than females (7:3). This paper contains an overview of NFLE, which is a sleeping disorder and the diagnosis of NFLE through Electroencephalography (EEG) in which electrical activity of the brain is recorded. These recordings are done using EEG machine. In this we have discussed about sleep and its types e.g. bruxism, insomnia, NFLE, narcolepsy. This can be caused by abnormalities such as tumours, stroke, infection etc.

Key words: EEG Signals, Stages of Sleep, Sleep Disorders, Causes of Nocturnal Seizures, Diagnosis of NFLE.

I. INTRODUCTION

Sleep is a naturally recurring state characterized by altered consciousness, relatively restrictive to action and prohibiting of nearly all voluntary muscles. It is distinguished from wakefulness by a decreased ability to react to stimuli. Sleeping is associated with a state of muscle relaxation and limited perception of environmental stimuli.

During sleep, most systems are in a heightened anabolic state, giving special significance to the growth and rejuvenation of the immune, nervous, skeletal and muscular systems. Sleep in non-human animals is observed in mammals, birds, reptiles, amphibians, and fish, and in some form in insects.

Sleep is sometimes thought to help conserve energy, though this theory is not fully adequate as it only decreases metabolism by about 5–10%.

II. EEG SIGNALS

Electroencephalography (EEG) is the recording of electrical activity along the scalp. EEG measures voltage fluctuations resulting from ionic current flows within the neurons of the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20–40 minutes, as recorded from multiple electrodes placed on the scalp.

EEG is most often used to diagnose epilepsy, which causes abnormalities in EEG readings. It is also used to diagnose sleep disorders, coma and brain death etc. It may be noted that awake and alert signal frequency is very high as compared to deep sleep EEG frequency. Rhythmical potentials are generated by brain. These potentials originate from individual neurons of the brain. The neuron has potential of -70mV with respect to the exterior. The waveform pattern is complex and is termed as electro-encephalogram (EEG).

An electroencephalogram (EEG) is a test that records electrical activity in the brain. Brain cells create tiny electrical impulses for communicating with each other. The EEG picks up these impulses through tiny wires (electrodes) placed on your scalp. The impulses are amplified and digitally recorded by a computer. The recordings look like wavy lines (sometimes called brain waves). An EEG may be done when you are awake, asleep, or both.

The signal of EEG are taken from electrodes either from scalp or directly from cerebral cortex. The frequency varies from 0.5Hz-50Hz.

The basic frequency of EEG is classified into 5 bands for analysis purpose:

- 1) Delta- 0.1Hz-4Hz
- 2) Theta- 4Hz-8Hz
- 3) Alpha- 8Hz-13Hz
- 4) Beta- 13Hz-22Hz
- 5) Gamma- 25Hz-100Hz

Table-1 Classification of EEG waves and their Frequencies

Waveform	Frequency	Occurrence
Delta	0.1Hz-4Hz	Premature babies, sleeping adults
Theta	4Hz-8Hz	Children and sleeping adults
Alpha	8Hz-13Hz	Normal
Beta	13Hz-22Hz	Normal
Gamma	25Hz-100Hz	Abnormal

EEG is used for examination of epilepsy, brain damage, brain tumors and other organic brain injuries. There is occasional use of EEG for determination of level of consciousness i.e. depth of anaesthesia.

III. STAGES OF SLEEP

NREM Stage 1

This is a stage of sleep that usually occurs between sleep and wakefulness, and sometimes occurs between periods of deeper sleep and periods of REM. The muscles are active, and the eyes roll slowly, opening and closing moderately.

NREM Stage 2

In this stage, theta activity is observed and sleepers become gradually harder to awaken; the alpha waves of the previous stage are interrupted by abrupt activity called sleep spindles.

NREM Stage 3

Formerly divided into stages 3 and 4, this stage is called slow-wave sleep (SWS). SWS consists of delta activity, high amplitude waves at less than 3.5 Hz. The sleeper is less responsive to the environment.

3.1 Rem

The sleeper now enters Rapid Eye Movement (REM) where most muscles are paralyzed. REM sleep is turned on by acetylcholine secretion and is inhibited by neurons. This level is also referred to as paradoxical sleep

because the sleeper, although exhibiting EEG waves similar to a waking state, is harder to arouse than at any other sleep stage.

An adult reaches REM approximately every 90 minutes, with the latter half of sleep being more dominated by this stage. REM sleep occurs as a person returns to stage 1 from a deep sleep.

During periods of REM the EEG pattern returns to high-frequency waves that look similar to the waves produced while the person is awake.

IV. SLEEP DISORDERS

A sleep disorder is a medical disorder of the sleep patterns of a person or animal. Some sleep disorders are serious enough to interfere with normal physical, mental, social and emotional functioning.

Table 2- Normal Sleeping Hours Required by Age

Age and condition	Sleep Needs
Newborns (0–3 months)	14 to 17 hours
Infants (4–11 months)	12 to 15 hours
Toddlers (1–2 years)	11 to 14 hours
Preschoolers (3–5 years)	10 to 13 hours
School-age children (6–13 years)	9 to 11 hours
Teenagers (14–17 years)	8 to 10 hours
Adults	7 to 9 hours

Disruptions in sleep can be caused by a variety of issues, from teeth grinding (bruxism) to night terrors. When a person suffers from difficulty falling asleep and/or staying asleep with no obvious cause, it is referred to as insomnia.

Sleep disorders are broadly classified into dyssomnias, parasomnias, circadian rhythm sleep disorders involving the timing of sleep, and other disorders including ones caused by medical or psychological conditions and sleeping sickness. Epilepsy is a disorder that is characterized by uncontrolled and disorganized communication between nerve cells in the brain. When this occurs, seizures can occur. Seizures can come on at any age, in any ethnic group.

Some common sleep disorders include:

1. Sleep apnea (stops in breathing during sleep)
2. Narcolepsy and hypersomnia (excessive sleepiness at inappropriate times)
3. Ctaplexy (sudden and transient loss of muscle tone while awake)
4. Sleeping sickness (disruption of sleep cycle due to infection)
5. Other disorders include sleepwalking, night terrors and bed wetting.
6. Bruxism (Involuntarily grinding or clenching of the teeth while sleeping).
7. Delayed sleep phase disorder (DSPD): (inability to awaken and fall asleep at socially acceptable times but no problem with sleep maintenance, a disorder of circadian rhythms)
8. Hypopnea syndrome (Abnormally shallow breathing or slow respiratory rate while sleeping).
9. Insomnia disorder(Chronic difficulty in falling asleep)
10. Narcolepsy (Excessive daytime sleepiness).

11. Night terror (sleep terror disorder, an abrupt awakening from sleep)
12. Parasomnias (Disruptive sleep-related events involving inappropriate actions during sleep; sleep walking and night-terrors).
13. Periodic limb movement disorder (PLMD) (Sudden involuntary movement of arms and/or legs during sleep)
14. Rapid eye movement sleep behavior disorder (RBD) (Acting out violent or dramatic dreams while in REM sleep, sometimes injuring bed partner or self).
15. Restless legs syndrome (RLS):(An irresistible urge to move legs)
16. Sleep paralysis (temporary paralysis of the body shortly before or after sleep).
17. Sleep talking.
18. Exploding head syndrome (Waking up in the night hearing loud noises).
19. Nocturnal frontal lobe epilepsy.

V. NOCTURNAL FRONTAL LOBE EPILEPSY

Nocturnal frontal lobe epilepsy (NFLE) is syndrome in the heterogeneous group of sleep disorders. The variable duration and intensity of the seizures distinguish three non-rapid eye movement-related subtypes:

1. Paroxysmal arousals: characterized by brief and sudden recurrent motor paroxysmal behaviour (sudden uncontrollable attack).
2. Nocturnal paroxysmal dystonia: motor attacks with complex dystonic–dyskinetic features (abnormality in performing voluntary muscle movement).
3. Episodic nocturnal wanderings.

NFLE seizures predominate in males (7:3). Age at onset of the nocturnal seizures varies, but centers during infancy and adolescence.

1. (13%) have personal antecedents (such as birth anoxia, febrile convulsions).
2. (14%). brain CT or MRI abnormalities.
3. (44%) ictal.
4. (51%) interictal (51%) EEGs are uninformative.
5. (25%) of the cases recurrence of the epileptic attacks.
6. (39%) of the patients present a family history.

NFLE does not show a tendency to spontaneous remission. Carbamazepine completely abolishes the seizures in ~20% of the cases and gives remarkable relief (reduction of the seizures by at least 50%) in another 48%.

5.1 Causes of Nocturnal Seizures

Nocturnal seizures are sleep-related seizures that occur at night. A person with this condition has a burst of movement that jerks the body awake. These types of seizures can happen several times a night, or they may be limited to rare occurrences.

Some other causes of these kind of seizures are:

- 1) **Injuries:** The damage to the skull or the brain can lead to swelling and ultimately seizures. Nocturnal seizures may happen several years after the trauma incident.
- 2) **Alcohol and drugs:** Alcohol and drugs can also lead to seizures. The first nocturnal seizure can occur from several hours to two days after cessation from alcohol and some drugs.

VI. DIAGNOSIS OF NFLE

People who have nocturnal seizures may notice unusual conditions upon awakening in the morning, such as a headache, having wet the bed, having bitten the tongue, a bone or joint injury, or light-headedness.

It is often also very difficult to know how long the seizure has been going. Diagnosis of NFLE was straightforward when patients displayed one or more episodes associated with clear-cut ictal epileptic frontal activity.

Patients often complained of nocturnal sleep discontinuity, with sleep disrupted by repeated arousals. A remarkable number (72%). Those attacks occurring during sleep triggered by arousals and also during wakefulness after protracted exercise. These attacks were observed in two children and lasted 3–5 min.

It can be diagnosed by three methods-

1. Brain Scan-Frontal lobe seizures can be caused by tumors, abnormal blood vessels or injuries.
2. Electroencephalogram(EEG)-An EEG shows the electrical activity in our brain by putting a series of electrodes attached to our scalp.
3. Video EEG-Video EEG is usually performed during an overnight stay. Both a video camera and an EEG monitor works together all night.

VII. CONCLUSION

EEG helps determine seizure type and epilepsy syndrome in patients with epilepsy, and thereby choice of antiepileptic medication and prediction of the course of a disease. In practice, the clinician will be reasonably certain about seizure type based on the account provided by the patient and witness. Carbamazepine completely abolishes the seizures in ~20% of the cases and gives remarkable relief in another 48%.

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