The secrets of conventional EEG

- The spike/sharp wave activity
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Polymorphic delta activity...The EEG phenomenon characteristics of subcortical white matter destructive lesions
Electrical criteria of the Polymorphic slow wave activity.

- Quite variable in wave shape morphology, frequency and amplitude.
- Commonly lateralized over a wide area of the scalp, persistent in eye closed, eye open state, during all sleep stages, with no visual reactivity. Polymorphic Delta activity that fails to persist into sleep or attenuates significantly with arousal or eye opening is less indicative of structural pathology.
- Persistent polymorphic delta activity may not precisely match the true location of the lesion, particularly since it presumably arises from physiological deranged neurons often lying on the margin of the destructive lesion. Persistent polymorphic delta activity is aetiologically nonspecific and is seen in a variety of subcortical (while matter) destructive lesions including neoplasms, infarctions, abscesses, trauma, and haemorrhage. It can also be seen in reversible processes such as focal ischemia in transient ischemic attacks or focal depression from a recent seizure.
- Commonly due to a subcortical white matter lesion inducing deafferentation of the cerebral cortex.
- A purely cortical lesion does not induce polymorphic slow wave activity.

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INTERMIT DELTA ACTIVITY
Electrical criteria of The intermittent rhythmic delta activity

- Consists of sinusoidal waveforms of approximately 2.5 Hz that occur intermittently in the EEG recording. It is most often symmetric but can be lateralized.
- In adults, the delta activity has a frontal predominance (frontal intermittent rhythmic delta activity [FIRDA]). In children, it is maximal posteriorly (occipital intermittent rhythmic delta activity [OIRDA]).
- The intermittent rhythmic delta activity shows visual reactivity and is commonly suppressed in the eye open state unless the patient is comatose.
- Intermittent rhythmic delta activity is associated with structural lesions, most commonly diencephalic, infratentorial or intraventricular tumors, or with diffuse encephalopathies.
- FIRDA occurring in patients with a normal EEG background suggests that the pattern is due to a structural lesion; when associated with EEG background abnormalities, it is likely to be due to encephalopathy.
- OIRDA is associated with absence epilepsy in children aged 6-10 years.

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THE EEG SHARP ACTIVITY

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Electroclinical criteria of spike/sharp wave discharge

- A spike is a transient, clearly distinguished from the background activity, with pointed peak at conventional paper speeds and a duration from 20 to under 70 msec; the main component is generally negative. Amplitude is variable. Spikes represent the basic element of paroxysmal activity in the EEG.

- A sharp wave is a transient, clearly distinguished from background activity, with pointed peak at conventional paper speeds and duration of 70 to 200 msec. The main component is generally negative relative to other areas.

- Both spikes and sharp waves have multiphasic characters, being composed of a sequence of a minor positive, a major negative, and a second minor positive component is typical in most instances. The long duration of a sharp wave permits better insight into the multiphasic character of this potential.

- The spike/sharp wave potentials are reliable indicators of a potential seizure focus because they result from the characteristic neurophysiological event "the paroxysmal depolarization shift" (PDS). This phenomenon consists of thousands of neurons simultaneously undergoing large depolarization with superimposed action potentials. Both synaptic events and intrinsic cellular currents have been implicated in this process. EEG spikes/sharp waves are due to the slow depolarization currents in the PDS. Neurons surrounding the focus are inhibited during the paroxysmal depolarization shift, and within the focus the paroxysmal depolarization shift is followed by a hyperpolarization potential. Both an increase in depolarizing events and a loss of inhibitory mechanisms can lead to persistence and propagation of the discharge as a seizure.

- Spikes and sharp waves are neurophysiologically closely related phenomena; both of them are typical paroxysmal discharges and highly suggestive of an epileptic seizure disorder, although both phenomena may occur in patients without a history of seizure disorder.

- The largest and most pronounced spikes are not necessarily associated with more serious epileptic seizure disorders. On the contrary, Rolandic spikes in a child age 4 to 10 yr are very prominent; however, the seizure disorder is usually quite benign or there may be no clinical seizures at all. Low voltage spiking in the frontal or anterior temporal regions is highly epileptogenic even though its amplitude can be so low to the point that these spikes might be completely drowned within the background waves and subsequently can not be easily detected.

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THE 3 C/S SPIKE WAVE DISCHARGE

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Electroclinical criteria of the 3 c/s spike/wave discharge

- It is bilateral fairly symmetrical and synchronous.
- It has a frontal midline maximum.
- It has a sudden onset and sudden offset.
- Readily activated by hyperventilation.
- It might be proceeded by intermittent, rhythmic, bisynchronous monomorphic slow waves in the occipital regions (occipital intermittent rhythmic delta activity OIRDA).
- The 3 c/s SWD is usually associated with an ictal absence episode when it lasts over 5 seconds.
- The 3 c/s SWD is an age specific electrophysiological phenomenon. It usually start at the age of 3.5 years and disappear at the age of 16 years.
- This discharge pattern is markedly enhanced during nonREM sleep, usually during stage II. However the morphological features of this discharge pattern are altered during sleep with the discharge occurring in a more fragmented and atypical fashion, occurring in bursts of spikes, polyspikes and atypical spike/wave complexes. This discharge pattern usually occurs in conjunction with sleep spindles and has an invariable frontal midline maximum.
- Background activity is within normal before and after termination of the paroxysmal discharge.
The fast 4/6 C/S spike wave discharge of Juvenile myoclonic epilepsy (JME)
Electroclinical criteria of the fast 4-6 c/s spike/wave discharge

- This discharge occurs in patients older than 16 years.
- It is bilateral but less symmetrical and synchronous compared with the 3 c/s SWD and usually takes the morphological feature of polyspike wave discharge.
- It has a frontal midline maximum
- It has a sudden onset and sudden offset and lasts for a very short periods (usually less than 3 seconds)
- This discharge pattern is not activated hyperventilation, however phobic stimulation is a potent activator of this discharge pattern.
- The clinical correlate of this discharge pattern is myoclonus and grand mal fits (juvenile myoclonic epilepsy).
- Studies using video monitoring combined with EEG recording revealed that the spike components of this discharge coincide with the myoclonic jerks and the slow waves coincide with periods of relaxation between the myoclonic fits, accordingly the number of spikes in this polyspike/wave complexes were found to be proportional to the severity of the myoclonic fits.
- The fast spike/wave complexes of juvenile myoclonic epilepsy has a strong genetic background. The gene locus was mapped on the short arm of chromosome 6.
SLOW 1-2.5 C/S SPIKE WAVE DISCHARGE

The slow spike/wave discharge of Lennox-Gastaut syndrome

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This EEG pattern is bilateral but asymmetrical and asynchronous with frequent lateralization and focalization.

- It has a frontal midline maximum.
- It is frequently continuous without any definite onset or offset and might extend through the whole record and is not associated with any clinical accompaniment.
- The discharge is not activated by hyperventilation
- The 1-2.5 c/s SWD is an age specific electrophysiological phenomenon. It usually start at the age of 6 months (earlier than the 3 c/s SWD) and disappear at the age of 16 years and is replaced by anterior temporal sharp activity and the clinical seizure manifestations merge into the main stream of temporal lobe epilepsies
- Background activity is often disorganized with frequent slow wave activity.
- The clinical correlate of this discharge is Lennox-Gastaut syndrome with multiseizure clinical presentation (grand mal fits, atonic fits, akinetic fits, atypical absence attacks, absence status). The occurrence of two or more than two types of seizures is almost the rule, mental retardation is very common.
- This discharge pattern could be idiopathic of genetic origin, cryptogenic with no overt cause, or symptomatic to a variety of brain diseases that include CNS infection, birth trauma, lipidosis, tuberous sclerosis, etc.
THE HYPSARRHYTHMIA PATTERN

Hypsarrhythmia pattern.

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Electroclinical criteria of Hypsarrhythmia discharge

- The word Hypsarrhythmia is originally derived from the Greek word hypsolos which means high and it refers to high voltage arrhythmia with a disorganized EEG pattern that consists of chaotic admixture of continuous, multifocal, high amplitude spikes, polyspikes, sharp waves and arrhythmic slow waves. This EEG pattern is dynamic and highly variable from one patient to another and between one study and another study for a single patient. Background activity is often disorganized with frequent slow wave activity.
- Marked change in the Hypsarrhythmia pattern also occurs during sleep. In REM sleep there is marked reduction to total disappearance of this EEG pattern. There is also normalization of this discharge pattern immediately following awakening from sleep.
- This discharge pattern is seen in children between the age of 4 months to 4 years and after the age of 4 years this pattern of discharge usually merges into the slow spike/slow wave complexes.
- Hypsarrhythmia pattern is frequently equated with infantile spasm (West syndrome), (characterized by massive flexion myoclonus of the head and neck called jack-knifing or Salaam attacks), however this pattern is not specific to any disease entity and is seen in response to any severe cerebral insult or severe multifocal disease process that occurs below the age of 1 year.
- Five different types of Hypsarrhythmia are present:
  - Hypsarrhythmia with increased interhemispheric synchronization.
  - Asymmetrical Hypsarrhythmia.
  - Hypsarrhythmia with a constant focus.
  - Hypsarrhythmia with episodes of voltage attenuation.
  - Hypsarrhythmia composed only of high voltage slow waves without spikes or sharp waves.
HEPATIC TRIPHASIC WAVES

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Electrical characteristics of triphasic waves

- Triphasic waves (TWs) are a distinctive but nonspecific electroencephalographic (EEG) pattern originally described in a stuporous patient in 1950 by Foley as "blunted spike and wave." In 1955, Bickford and Butt coined the term "triphasic wave." Since their findings were limited to patients with hepatic failure, triphasic wave encephalopathy (TWE) became synonymous with hepatic encephalopathy. More recently, TWE has been associated with a wide range of toxic, metabolic, and structural abnormalities.

- TWs are large-amplitude, generalized waves of 1.5-3.0 Hz. They are bilaterally synchronous and bifrontally predominant periodic waves with a characteristic morphology. Classic TWs have an initial small-amplitude, sharp-negative component followed by a large-amplitude, sharp-positive wave; they end with a slow negative wave.