Common Pitfalls in EEG Interpretation & How to Write EEG Report

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Pitfalls in EEG Interpretation

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Pitfalls in EEG Interpretation

- **Important key issues**
  - Appreciation of normal & expected age-dependent characteristics, different findings between children and adult EEG
  - Awareness of the significance of both epileptiform & non-epileptiform activity,
  - Correlation of epileptiform abnormalities with clinical findings.

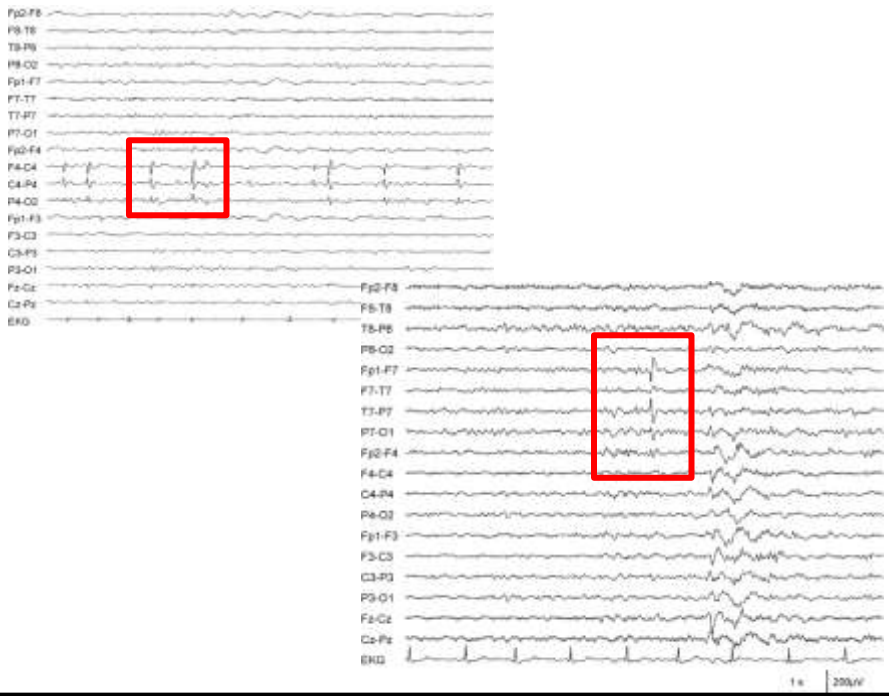
Pitfalls in EEG Interpretation

- **Avoid bias:**
  - Initial interpret without provided clinical information except patient's age, (patient's condition during recording)
  - Go through the recording one more time with the all provided information

Epileptiform

- In 1974 glossary of electroencephalographic (EEG) terms, Chatrian and colleagues described **"epileptiform"** as an interpretive term used in electroencephalography that applies to distinctive waves or complexes distinguishable from the background activity, and that resemble the waveforms recorded in a proportion of human subjects suffering from an epileptic disorder

G.E. Chatrian, L. Bergamini and M. Dondey, A glossary of terms most commonly used by clinical electroencephalographers, *EEG Clin Neurophysiol* 1974;**37:** 538–554.



Pitfalls in EEG Recording & Interpretation

- Insufficient recording
  - Recording technique
  - Duration / completeness
  - Patient's condition
- Interpretation: over-reading
  - Benign non-epileptiform discharges
  - Sleep patterns
  - Non-specific background activities

Recording Technique

- Electrode placement & impedance

  Impedance (contact resistance) less than 5 kΩ, to reduce the noise artefacts and other interference
- Sufficient duration
- Complete recording
  - Wakeful and sleep
  - Activation procedure

Recording Procedure: Infants and older children

- Adult electrode placement should be used as young as possible as more electrodes will enhance sensitivity
- Sleep recording
  - will increase the chance of recording epileptiform activity
  - usually reduce movement and muscle artefacts
  - spontaneous sleep are preferred to induced sleep in all children despite their age.

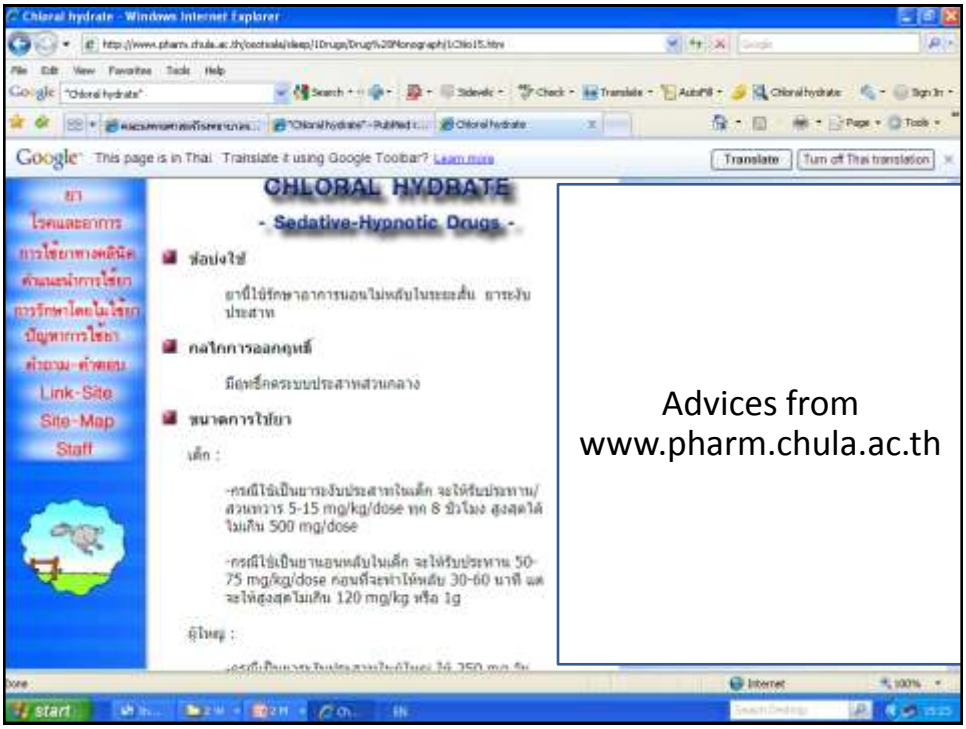
Recording Technique

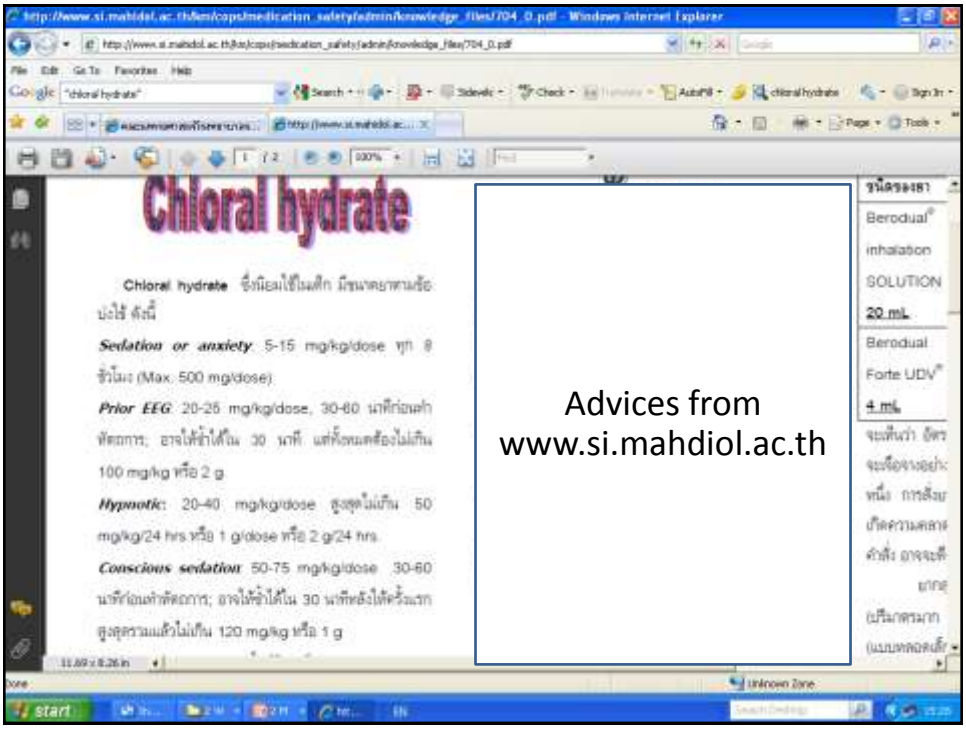
- Electrode placement & impedance

  Impedance (contact resistance) less than 5 kΩ, to reduce the noise artefacts and other interference
- Sufficient duration:
  - 30 – 60 minutes
- Complete recording
  - Wakeful and sleep
  - Activation procedure

EEG-Sedation

- Chloral hydrate (CH) is used to sedate children unable to cooperate during investigations
- Dosage: 25 – 75 mg/kg/dose, maximum 1000 mg
- Chloral hydrate: increase in beta activities
- CH or its metabolites modify the EEG: unknown
- Adverse effect: unlikely





EEG-Sedation: Chloral hydrate

- At sedative doses,
  - CH can generally be used before an EEG recording without loss of information
  - There were evidence that it could alter interpretation.

    Thoresen M, et al. Electroencephalogr Clin Neurophysiol. 1997;102(2):152-7.

- CH for children undergoing EEG examinations is effective and safe. Complications are infrequent.
  Need for sedation can be decreased greatly by adequate preparation and by creating a less-threatening, child-friendly environment in which to perform the study

  Olson DM, et al. Pediatrics. 2001;108:163-5.

- Compared to non-CH-EEGs, CH-EEGs were no more likely to show sleep specific epileptiform activities, prolonged the acquisition time, and were associated with changes in clinical care in <3%.

  Britton JW, Kosa SC. Epilepsy Res. 2010;88:215-20.

Interpretation of EEG Recordings in Infants and Children Sedated with Chloral Hydrate

- 84 infants and children from 1 month – 69 months (mean 30 mo.)
- Chloral hydrate 27.8- 94 mg/kg (mean 45 mg/kg)
- Results:
  - No adverse effects
  - Excessive bata-range wave 5/84
  - Yield of abnormal EEG result which confirmed the diagnosis of epilepsy in epileptic children: 23.6 %

Visudtibhan A, et al. Epilepsia 2005;46 (suppl. 6):236 Abstract

Recording Technique

- Electrode placement & impedance

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- Sufficient duration:
  - 30 – 60 minutes
- Complete recording
  - Wakeful and sleep
  - Activation procedure

Recording Technique

- Electrode placement & impedance
  Impedance (contact resistance) less than 5 kΩ, to reduce the noise artefacts and other interference
- Sufficient duration
- Complete recording
  - Wakeful and sleep: use sedation if it is needed
  - Activation procedure
    - Sleep deprivation
    - Wakeful & sleep recording
    - Hyperventilation
    - Photic stimulation

Does sleep or sleep deprivation increase epileptiform discharges in pediatric electroencephalograms?

- Sleep deprivation before obtaining an electroencephalogram (EEG) is suggested
  - to increase the likelihood of sleep during an EEG
  - to increase the detection of interictal epileptiform discharges.
- Debate by Gilbert DL
  - Neither the presence of sleep nor the use of partial sleep deprivation protocols increased the odds of epileptiform EEGs.
  - Sleep deprivation should not be used routinely to increase the yield of pediatric EEGs.

Gilbert DL. Pediatrics 2004; 114:658-62.

Activation Procedures

- Wakeful & sleep recording
  - EEG Recording should include wakeful and sleep especially in children who have seizure during sleep
  - ESES: Stage IV sleep
  - Sleep disorders: EEG not enough for exclusion, need PSG

Erwin CW. J Clin Neurophysiology 1984;1:253-74
Fisher RS. EEG for Beginners. John Hopkins Atlas of Digital EEG 2006:11-74

Activation Procedures

- Hyperventilation
  - Focal slowing or ictal
  - 3 -4 minutes of full-effort hyperventilation
  - Transient diffuse slowing, return to baseline within 4 minutes
  - Omit in patients with ischemic stroke
  - Is it necessary or should it routinely be included?

Activation Procedures

Photic stimulation

- Normal
  - Photomyogenic response
  - Photochemical reaction
- Abnormal:
  - Asymmetrical driving/response
  - Appearance of epileptiform discharges
  - Photoconvulsive repsonse
    - ??? Should it be documented by repeat stimulation
    - Repeat stimulation with precaution

Interpretation: Avoiding of over-reading

- Recognition of normal EEG features in wakefulness:
  - posterior slow waves of youth
  - mu rhythm
  - lambda waves
- Understanding of age-dependent characteristics of EEG state-changes is essential, such as:
  - monorhythmic &paroxysmal hypnagogic hypersynchrony,
  - vertex transients and sleep spindles,
  - positive occipital sharp transients,
  - initial arousal responses
  - post-arousal hypersynchrony.

Video EEG Demo

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Interpretation: Avoiding of over-reading

- Patterns of uncertain diagnostic significance also may be present in children,
  - 14- and 6-Hz bursts
  - rhythmic temporal theta bursts of drowsiness (psychomotor variant)
- Some nonepileptiform EEG abnormalities may also be misinterpreted as epileptiform
- Effects of drugs to EEG

Prevalence of benign epileptiform variants

- Age-specific variation in the prevalence of BEVs:
  - 14 and 6 Hz positive spike pattern occurred in teenagers (Lombroso et al., 1966)
  - 6 Hz spike-and-waves and RTTD in adolescents and young adults (Gibbs et al., 1963, Hughes, 1980)
  - BSSS and wicket waves occurred in the adults (Reiher & Lebel, 1977, White et al., 1977)
  - SREDA in middle-aged and elderly subjects (Miller et al., 1985,Westmoreland & Klass, 1997)
  - A significant gender related variation for 6Hz spike-and-waves (Hughes 1980, Santoshhumar 2009)

A Practical Guide for Routine EEG Studies in Epilepsy

- Know what is not epilepsy!
- An electroencephalographer can do much more damage by overinterpreting than by underinterpreting an EEG tracing.
- Epilepsy is a clinical, not an EEG, diagnosis, but the EEG, when used appropriately, can greatly aid the diagnostic process.

Engel J Jr.J Clin Neurophysiol. 1984;1(2):109-42