

## NEONATAL EEG BACKGROUND

"NORMAL AND ABNORMAL PATTERNS AT TERM"

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## DISCLOSURES/CONFLICTS OF INTEREST

- No disclosures or conflicts of interest

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## OVERVIEW

- Basic principles and approach to the term EEG
- Normal and abnormal patterns
  - Discontinuous patterns at term
    - Sharp waves
    - Graphoelements
- Common artifacts

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## BASIC APPROACH TO NEONATAL EEG

- Continuity vs. discontinuity
  - Function of behavioral state and postmenstrual age
- State change/sleep wake cycling/variability
- Symmetry
- Synchrony
- Reactivity
- Sharp waves (normal transients vs. abnormal spikes/sharp waves)
- Graphoelements

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## CONTINUITY AND DISCONTINUITY

- Continuity
  - Uninterrupted, non-stop electrical activity
    - Normal continuous patterns
      - Activité moyenne
      - Low voltage irregular
- Discontinuity
  - Higher voltage bursts of electrical activity interrupted by lower voltage inter bursts intervals (IBI)
  - IBI- Intervening periods of attenuation in which activity is attenuated <25 to 50  $\mu$ V for 2 seconds or more
    - Normal discontinuous pattern
      - Tracé alternant (quiet sleep)
    - Abnormal discontinuous pattern
      - Excess discontinuity
      - Burst suppression



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## DISCONTINUITY BY PMA

Weeks	26	27	28	<30	31-33	34-36	37-40
Interval (secs) - Longest acceptable	46	36	27	35	20	10	6

Hrachovy and Mizrahi Atlas of Neonatal Encephalography 2015

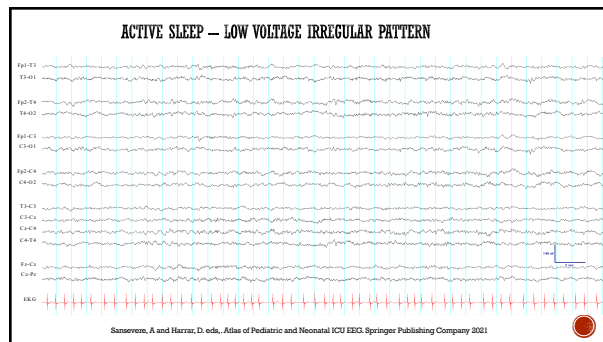
PMA (Weeks)	Maximum Interburst Interval (Seconds)	Voltage of Interburst ( $\mu$ V)
<30	35	<25
30-33	20	<25
34-36	10	~25
37-40	6	>25

Values for IBI duration and amplitude vary with PMA.

Tsuchida et al 2013, ACNS Standardized EEG Terminology

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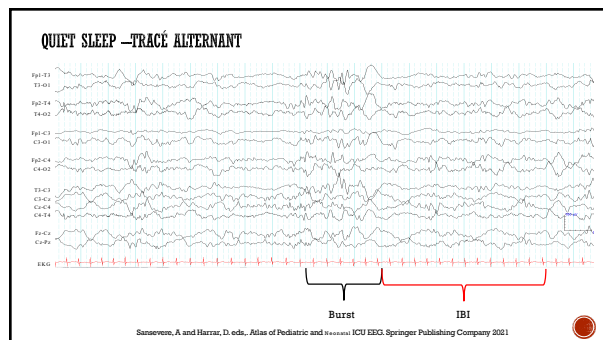


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**NORMAL DISCONTINUOUS PATTERNS**

- Quiet sleep
- Tracé alternant pattern
  - Bursts of 1-6 Hz, 50-200 uV with admixed sharp components up to 4 to 6 s
  - IBI – voltage > 25 uV, duration up to 6 seconds

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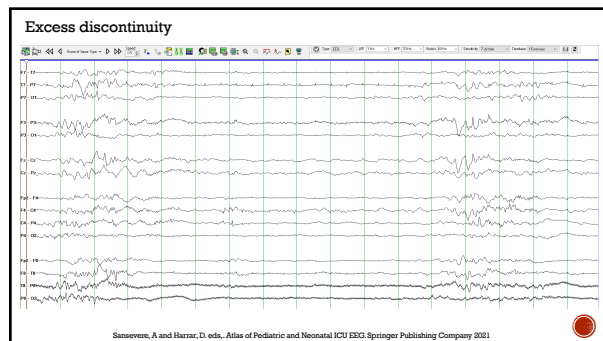


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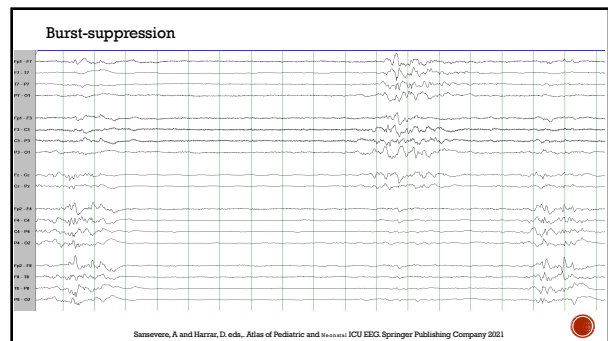
**ABNORMAL DISCONTINUOUS PATTERNS**

- Excess discontinuity
  - IBI are too long, voltage too depressed
- Burst suppression
  - Invariant, IBI < 5uV, non-reactive, no normal features in the bursts
  - Sparse IBI activity up to 15 uV in 1 electrode or < 2 seconds of transient activity up to 15 uV

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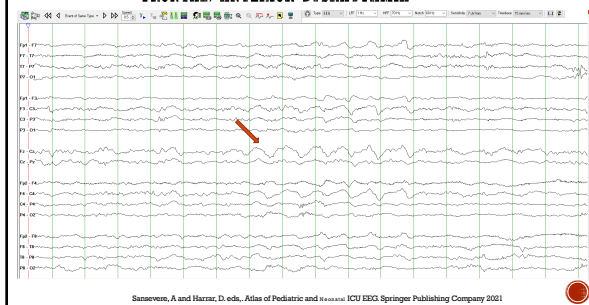


## FRONTAL/ANTERIOR DYSRHYTHMIA

- Frontal delta (1.5-4 Hz)
- < 4-6 seconds
- 50-150  $\mu$ volts
- Polymorphic or monomorphic
- Associated w/frontal sharp transients
- Transitional and QS

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## FRONTAL/ANTERIOR DYSRHYTHMIA

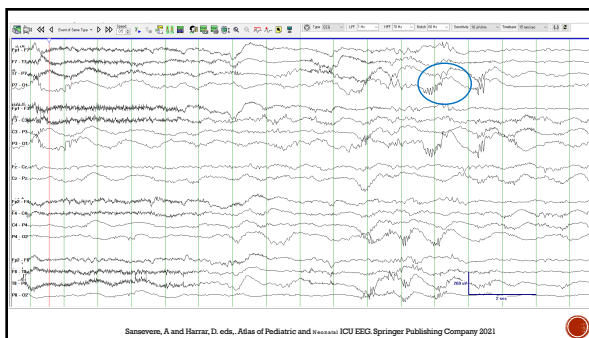


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## DELTA BRUSH (AKA BETA-DELTA COMPLEXES, RIPPLES OF PREMATURITY)

- Marker of prematurity
- First seen at 26 weeks
- Peak at 32-34 wks
- Associated with quiet sleep after 33 weeks
- 0.3-1.5 Hz delta wave of 50-250  $\mu$ volts
- Superimposed fast activity (18-22 most common, 8-12 also common), voltage up to 75  $\mu$ V
- Migrate centrally (< 32 weeks) to temporo-occipital

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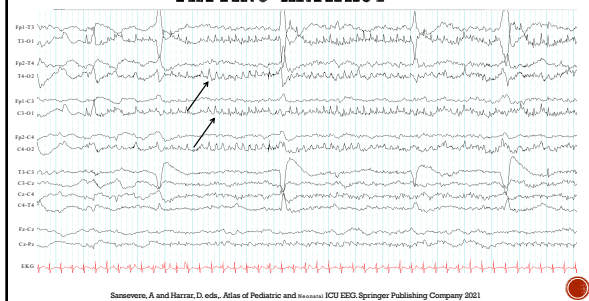
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## COMMON ARTIFACTS

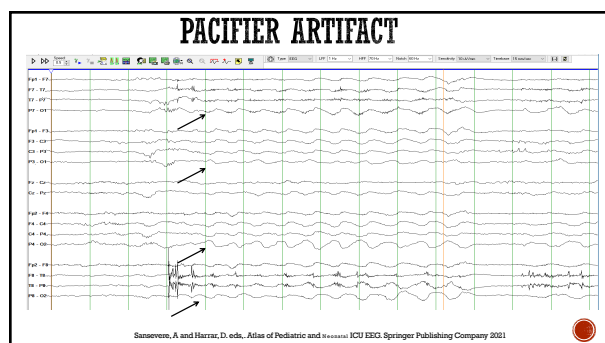
- Non-physiologic
  - Electrode artifact
  - Bedside provider
    - Patting
    - Rocking
- Physiologic
  - Muscle artifact
  - EKG artifact

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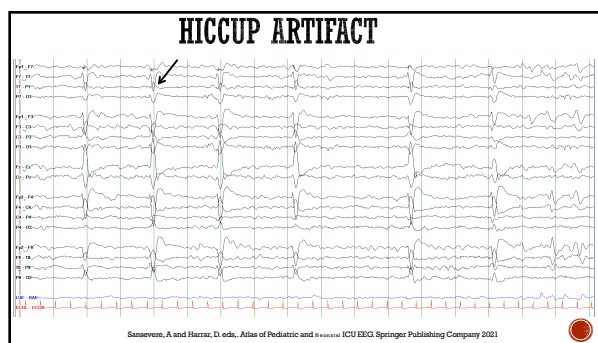
## PATting ARTIFACT



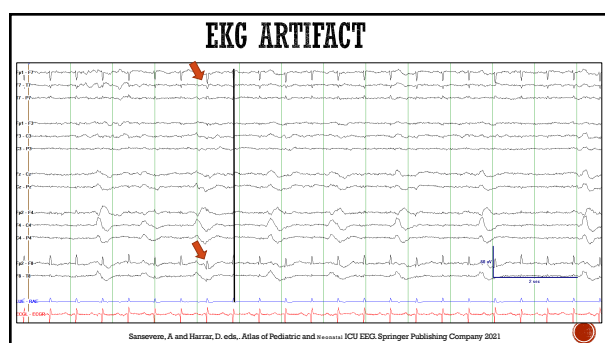
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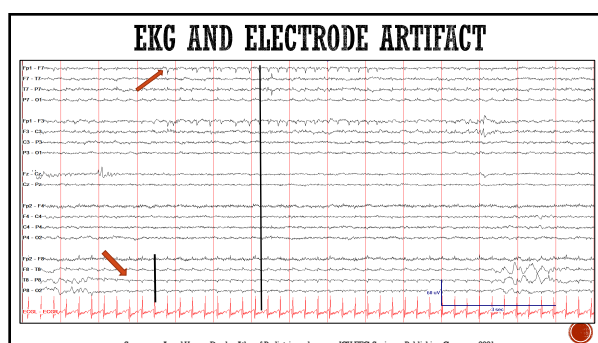
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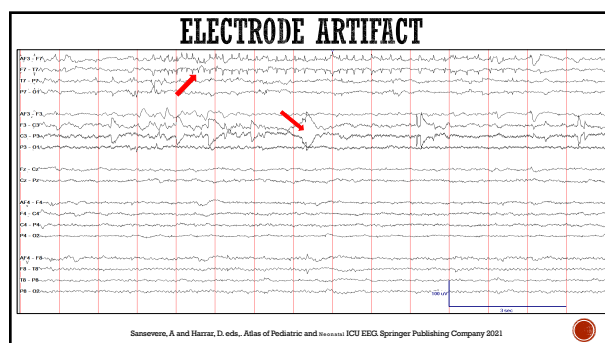
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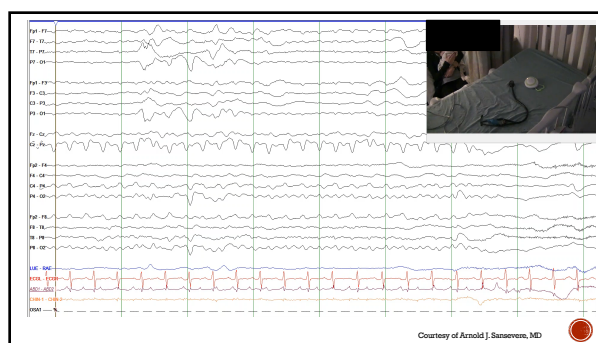
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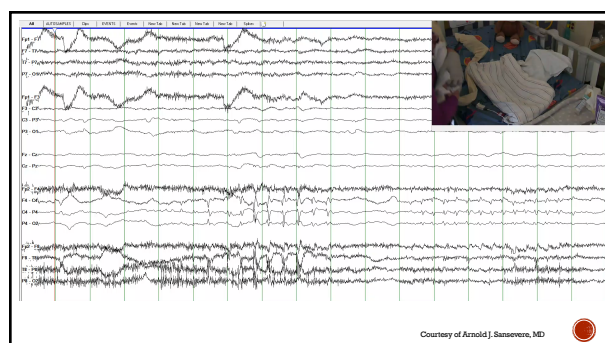
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## REFERENCES

- Blum, A. & Rutkove, S. (Ed.) (2010). *The Clinical Neurophysiology Primer*. Totowa New Jersey: Humana Press
- Hrachovy, R.A. and Mizrahi, E.M. *Atlas of Neonatal Encephalography*. Springer Publishing Company 2015
- Libenson, M. (2010). *Practical Approach to Electroencephalography*. Philadelphia, PA: Saunders/Elsevier
- Sansever, A. and Harrar, D. eds., *Atlas of Pediatric and Neonatal ICU EEG*. Springer Publishing Company 2021
- Tsuchida, T., Wusthoff, C.J., Shellhaas, R.A., Abend, N.S., Hahn, C.D., Sullivan, J.E., Nguyen, S., Weinstein, S., Scher, M.S., Riviello, J.J. and Clancy, R.R., 2013. *ACNS standardized EEG terminology and categorization for the description of continuous EEG monitoring in neonates*. *J. Clin.*

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## THANK YOU



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