

## Practical EEG monitoring in PICU & NICU

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### EEG Monitoring in ICU

- Routine EEG
- continuous EEG (cEEG)

### Routine EEG in ICU

- better localization
- better Sz detection
- Extra cautions with artifacts (lots more in ICU)
- Duration limit
- Requiring high time & expertise

### continuous EEG Monitoring

- Give out a trend
- Able to review raw EEG
- Less time-consuming
- Easily reviewed by ICU team
- sensitivity & specificity depend on number of electrodes

### continuous EEG Monitoring

- Neonates
  - Cerebral function monitoring (CFM)
- Pediatric & adult
  - continuous EEG (cEEG)
  - quantitative EEG analysis

### Why cEEG in NICU?

- Background
  - low amplitude
  - continuity
  - asymmetry
  - maturity
  - sleep wake cycle
- encephalopathy
- Seizure
  - electroclinical Sz (confirm Sz)
  - electrographic Sz (subclinical Sz)

## Uses of cEEG in NICU

- Early indicator - for therapeutic hypothermia
- Confirm the nature of “clinical Sz”
- Detect subclinical Sz / NCSE
- Assess “Cooling” & AED effect
- Predict outcome

## Indications in neonates

- Birth asphyxia: mod -severe
- At risk of seizure (esp. subclinical)
- Sz requiring AED IV loading

## Neonates: CFM

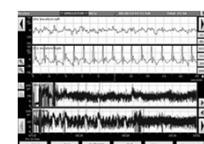
- portable machine, limited leads
  - 3 leads = whole brain
  - 4 leads = left & right
- easy to do: hydrogel electrodes
- easy to interpret → NICU staff
- amplitude integrated EEG (aEEG)
- immediate bedside assessment



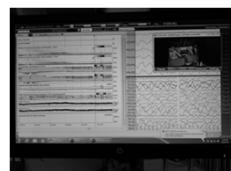
3 leads (1 channel)



4 leads (2 channel)



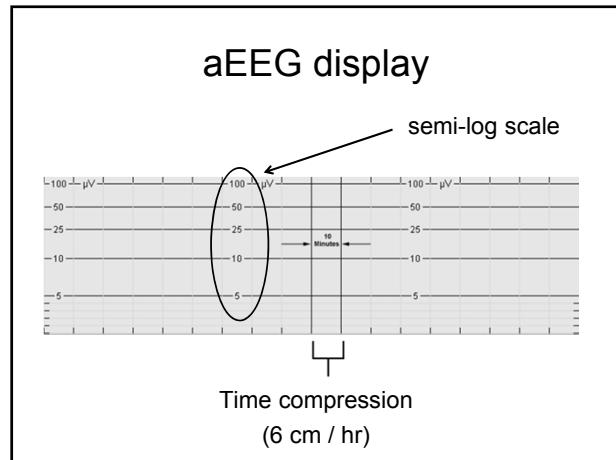
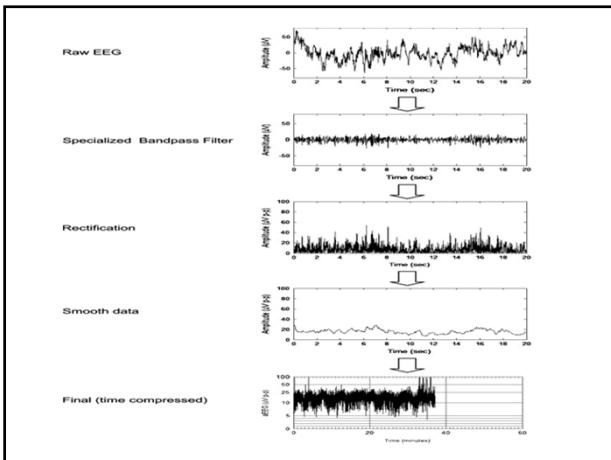
## Standard cEEG



Quantitative analysis

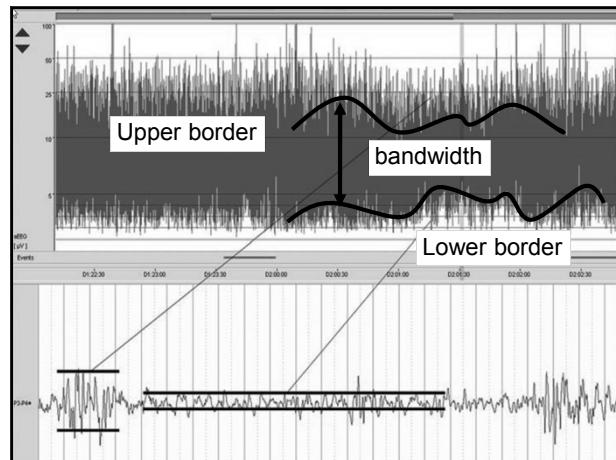
## What is aEEG ?

- Raw EEG from selected leads
- Filter & rectify EEG amplitude
- Displays data in semi-log scale
- Compressed time interval
- Shows “trend” not “localization”
- Good correlation with EEG



### aEEG: Limitation

- Not for localization
- Focal, low amplitude seizure - lower sensitivity
- Never replace standard EEG**

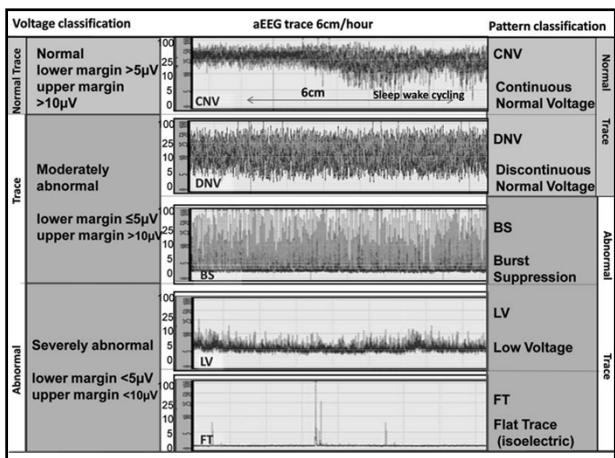


### Background Abnormality

	Lower	Upper	SWC
Normal	>5	>10	Yes
Moderate*	<5	>10	No
Severe	<5	<10	No

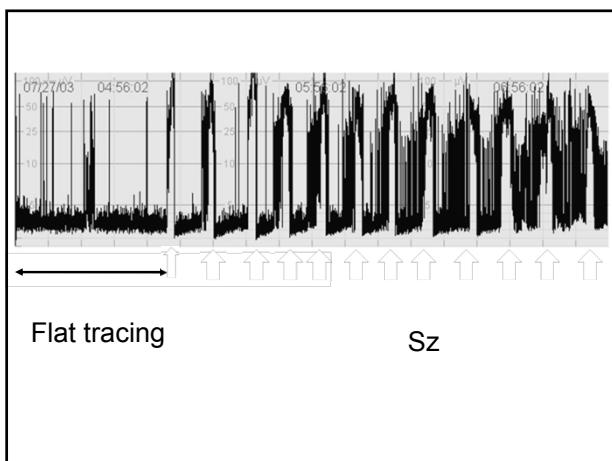
\* Also seen in AED effect or prematurity

- ### Background patterns
- CNV** Continuous normal voltage
  - DNV** Discontinuous normal voltage (Min < 5, Max > 10)
  - CLV** Continuous low voltage (Min < 5, Max < 10)
  - BS** Burst-suppression Min < 5 no variability, Max >10 hi-voltage bursts)
  - FT** Flat Tracing (Min and Max < 5)



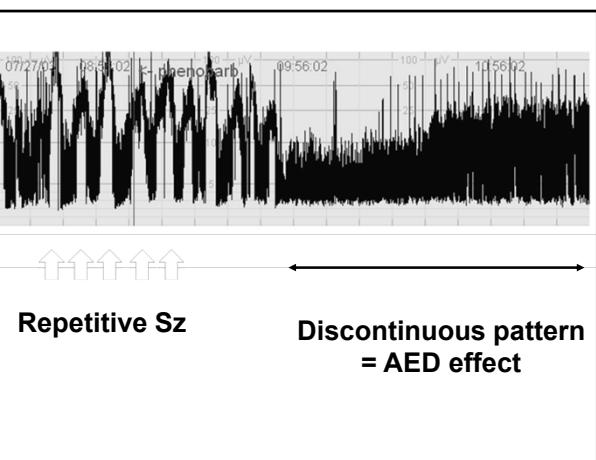
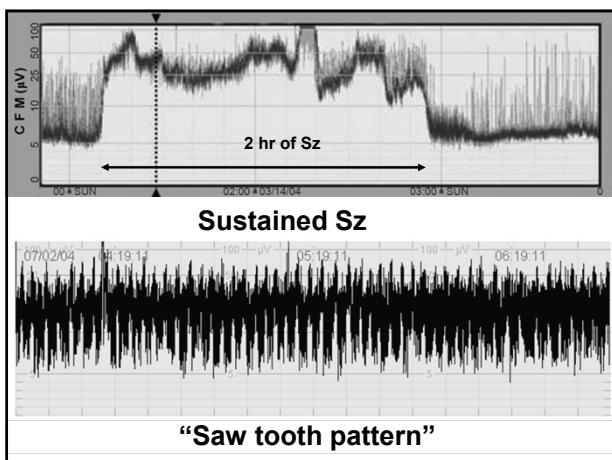
## Seizure in aEEG

- Sudden change
- Raised lower border
- Raised upper border
- Narrow bandwidth
- Sudden drop to normal



## Status epilepticus

- Starts like "Sz" but sustains > 30 min
- "Saw tooth pattern"
  - = repetitive Sz without gap



## cEEG

- All or selected leads
- Raw data processed by software
- Multiple parameters analysis
- Automatic Seizure detection
- Enable raw EEG analysis
- For neurointensive care

## Why cEEG?

- ICU: NCS 18-34%, NCSE 10%
- 8-48% in comatose pts
- Post treated GCSE:
  - 20-48% electrographic Sz
  - 14% NCSE, most without clinical signs
- 9% of pt with no acute neuro condition
- Cardiac arrest & sepsis - at risk
- 1<sup>st</sup> Sz
  - 95% in 24 hr (non-coma),
  - 87% in 48 h (coma)

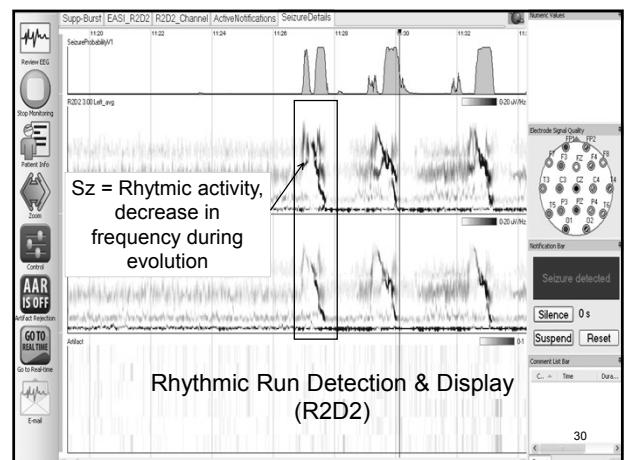
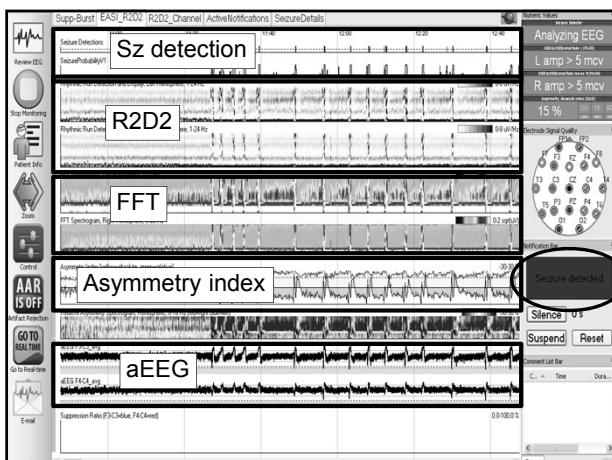
Friedman, Claassen, Hirsch, cEEG in  
ICU. Anesthesia & Analgesia 2009

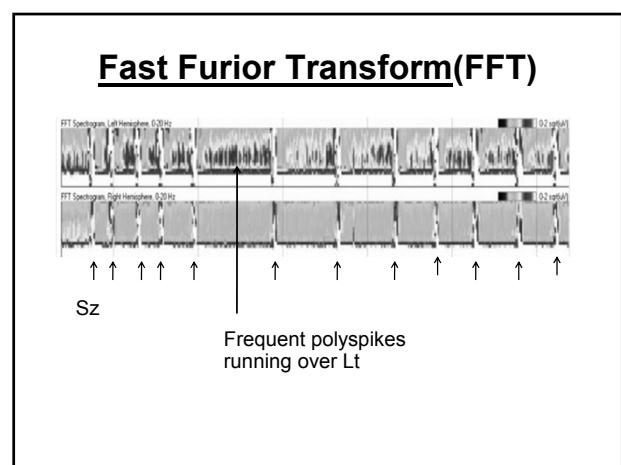
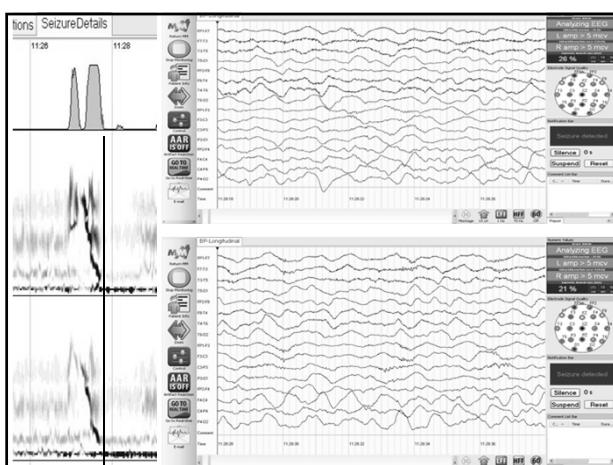
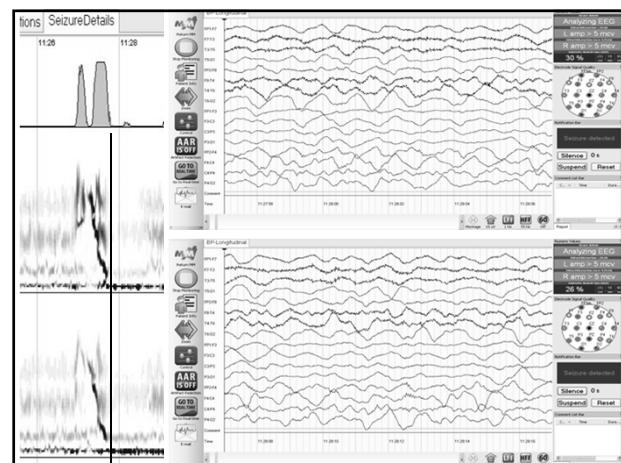
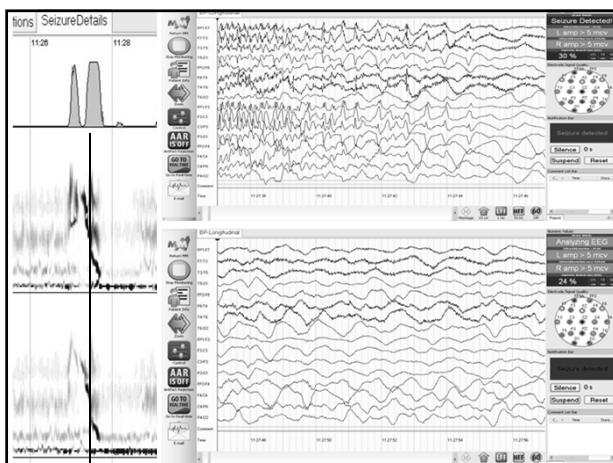
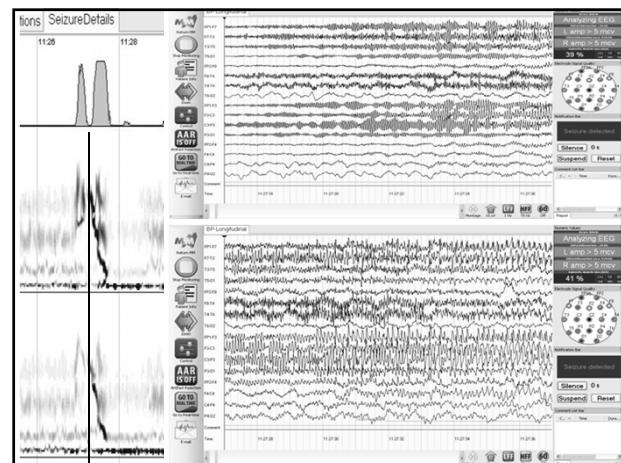
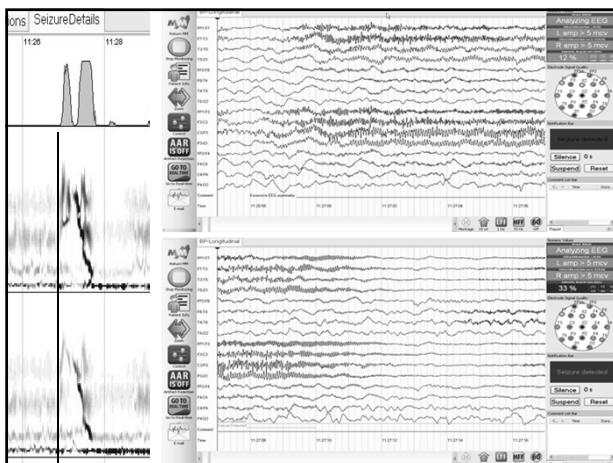
## Clinical indications

1. Detection of nonconvulsive seizures
2. Monitoring of Induced coma or sedation
3. Ischemia detection
  - vasospasm in subarachnoid hemorrhage
  - patients at high risk for stroke
4. Prognosis:
  - cardiac arrest
  - acute brain injury

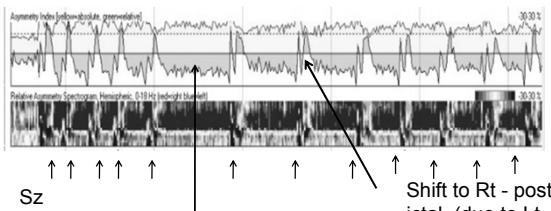
## Analysis modalities

- aEEG
- Compressed spectral array (CSA)
- enveloped trend
- asymmetry index & spectrogram
- frequency & rhythm analysis
- Sz Detection & Sz probability





## Aysmmetry Index



Relative asymmetry to Lt could be:

1. Lt side "hot" - e.g. spikes/ sharp/ ictal
2. Rt side dysfunction - e.g. ischemia

Need raw EEG or other parameter

## Case

- Acute onset of encephalitis
- Stuporus & ventilated in ICU
- Got GTC Szs

