Prognostic value of routine EEG after cardiac arrest

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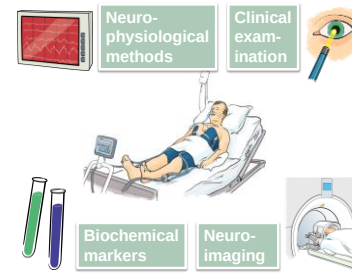
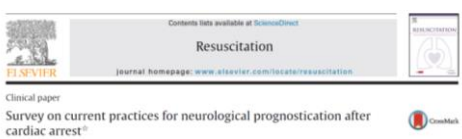
Toolbox of different tests for prognostication

SSEP

EEG





Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

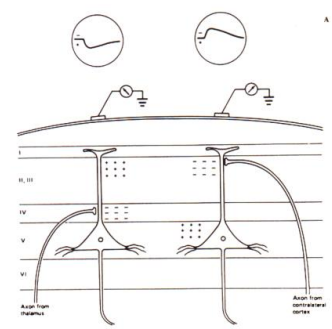
Survey on current practices for neurological prognostication after cardiac arrest

- Routine EEG is a commonly used method for prognostication after CA

EEG, intermittent	(63%)
Neuroimaging (CT-scan)	(58%)
Evoked potentials	(36%)
Neuroimaging (MRI)	(40%)
Biomarkers, NSE	(19%)
EEG, continuous	(11%)
Biomarkers, S-100B	(5%)
Other	(4%)

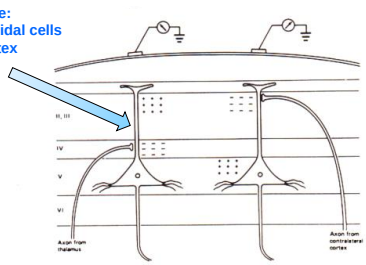
Friberg, *Resuscitation*, 2015

What is EEG - electroencephalogram?



What is EEG - electroencephalogram?

Source: pyramidal cells in cortex



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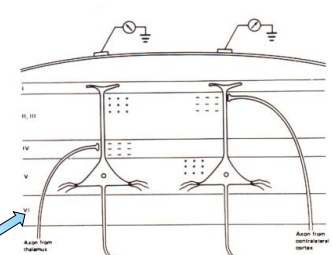
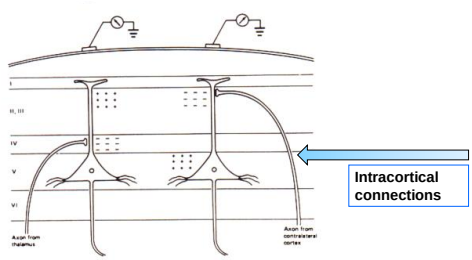


Synchronized via input from "pacemaker neurons" in the thalamus

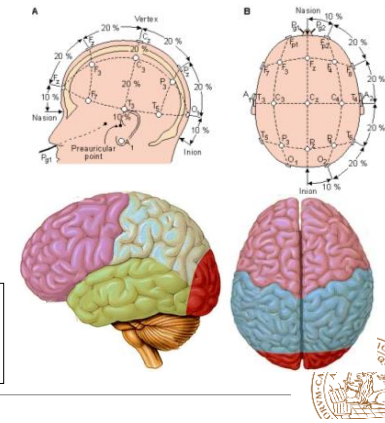
What is EEG - electroencephalogram?



10-20 System of Electrode Placement

- F = Frontal
- P = Parietal
- T = Temporal
- O = Occipital
- C = Central

Duration: 20-30 minutes

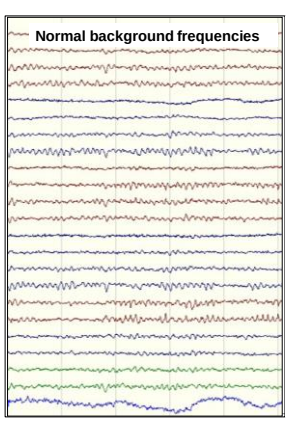


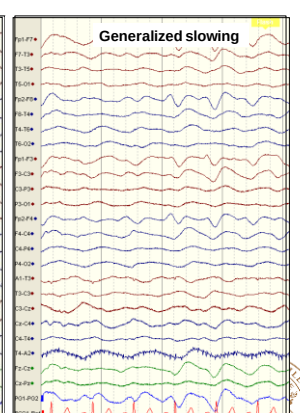
Aspects of routine EEG after cardiac arrest

- Background activity
- Background reactivity
- Electrographic seizure activity, periodic patterns and epileptiform discharges

Aspects of routine EEG after cardiac arrest

- Background activity

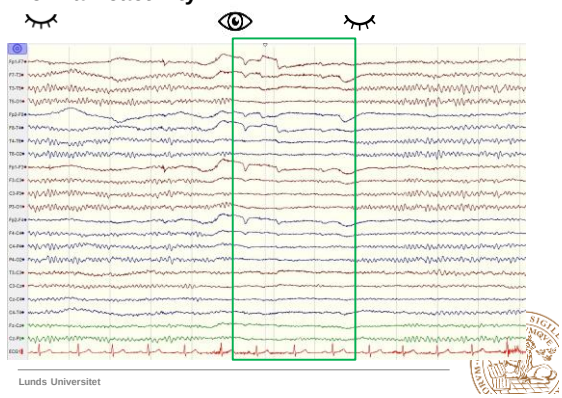




Aspects of routine EEG after cardiac arrest

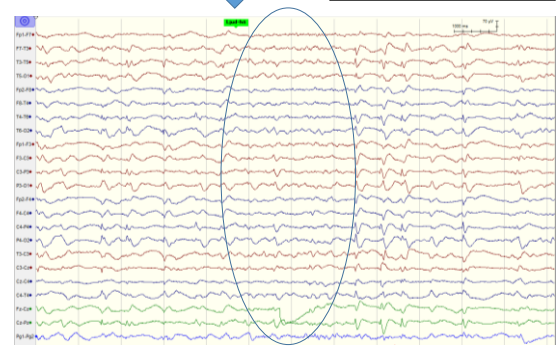
- Background activity
- Background reactivity

Normal reactivity



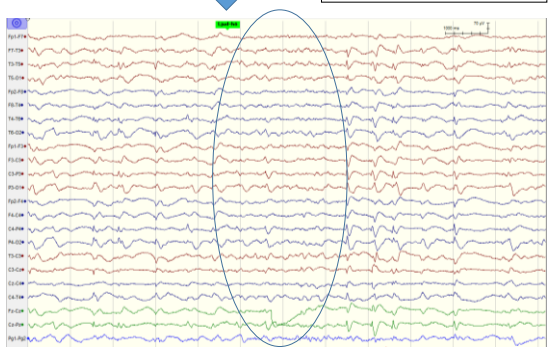
Comatose patient Reactivity testing

- Absent reactivity - correlation to poor outcome
- But survivors!



Comatose patient Reactivity testing

- No standardized definition or protocol
- High interrater variability



Aspects of routine EEG after cardiac arrest

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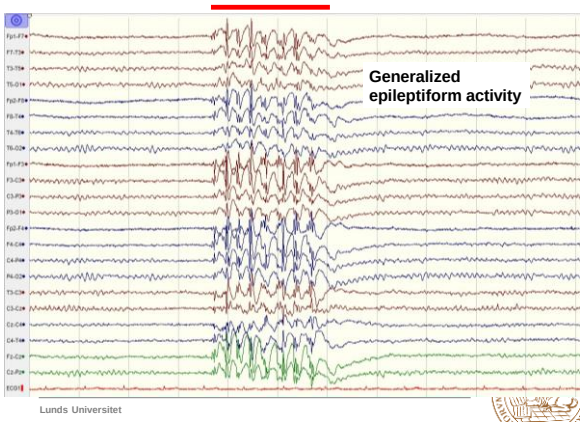
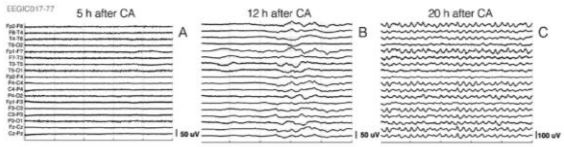


Problems with conclusions from studies

- Different terminology and classification systems
- High interrater variability
- Time point of EEG differs
  - EEG abnormalities evolve over time

- Evolution of EEG abnormalities



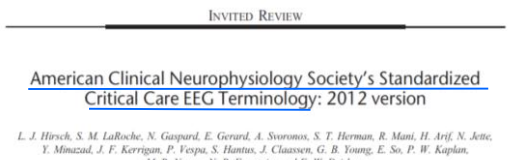
V Putten, Hofmeijer, *J Clin Neurophysiol*, 2016

Problems with conclusions from studies

- Different terminology and classification systems
- High interrater variability
- Time point of EEG differs
  - EEG abnormalities evolve over time
  - **Sedation affects the EEG**

Standardized EEG interpretation and prognostication

- American recommendations on terminology

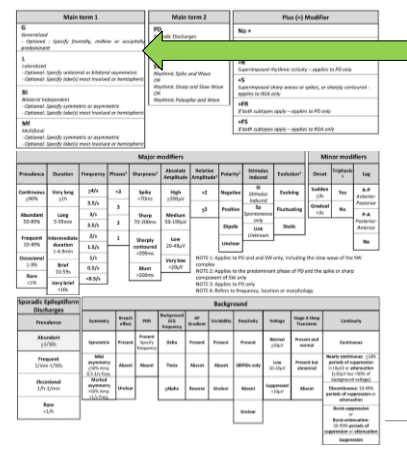


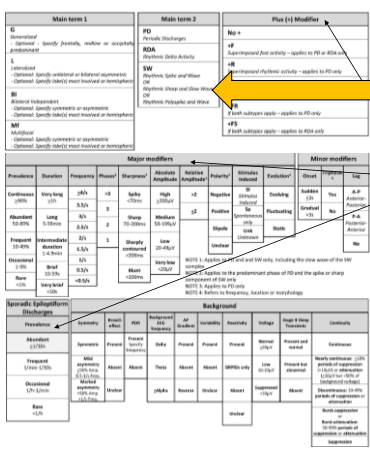
INVITED REVIEW

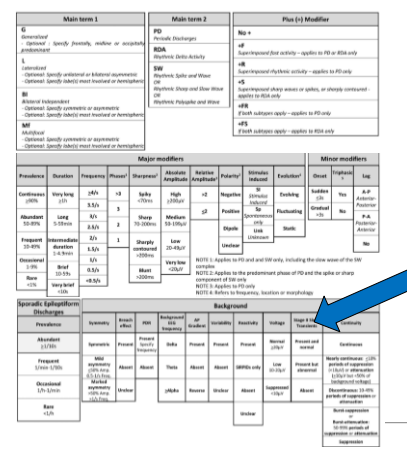
American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology: 2012 version

L. J. Hirsch, S. M. LaRoche, N. Gaspard, E. Gerard, A. Svoronos, S. T. Herman, R. Mani, H. Arif, N. Jette, Y. Minazad, J. F. Kerrigan, P. Vespa, S. Hantus, J. Claassen, G. B. Young, E. So, P. W. Kaplan, M. R. Nuwer, N. B. Fountain, and F. W. Drislane

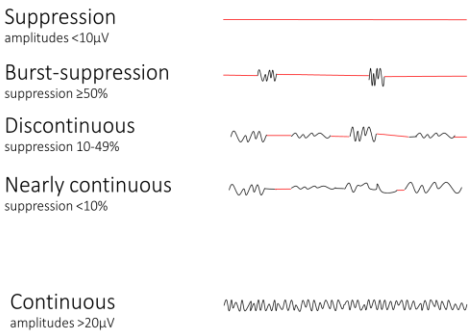
Hirsch, *J of Clin Neurophysiol*, 2013



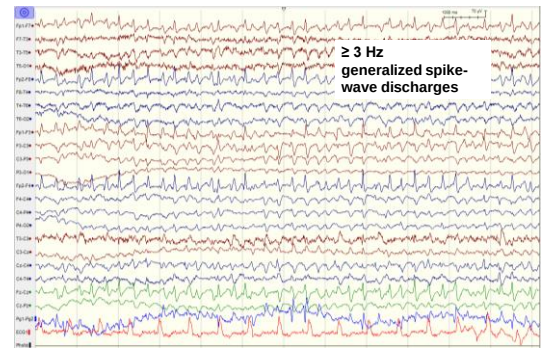




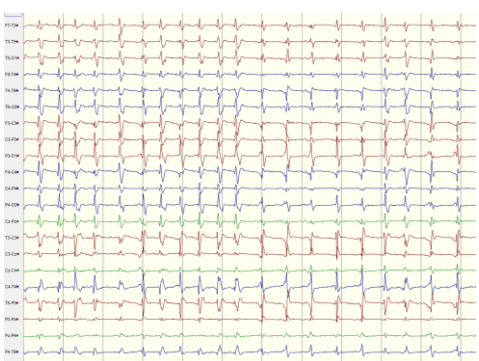
Background patterns ACNS



Unequivocal / definitive electrographic seizure



Periodic discharges < 3Hz same significance?

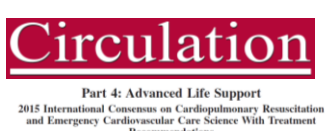


Poor outcome predicted by

- burst-suppression + unreactive
  or
- electrographic status epilepticus + unreactive

after rewarming
always in combinations with other predictors

Nolan, *Intensive Care Med*, 2015

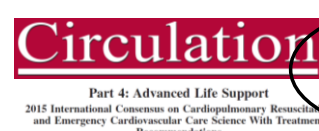


American guidelines 2015

Suggest poor outcome to be predicted by:

- Persistent absence of EEG reactivity ≥ 72h after ROSC
  or
- Persistent burst-suppression after rewarming
  or
- Intractable and persistent status epilepticus

Callaway, *Circulation*, 2015



"Future studies should comply with recently recommended definitions"

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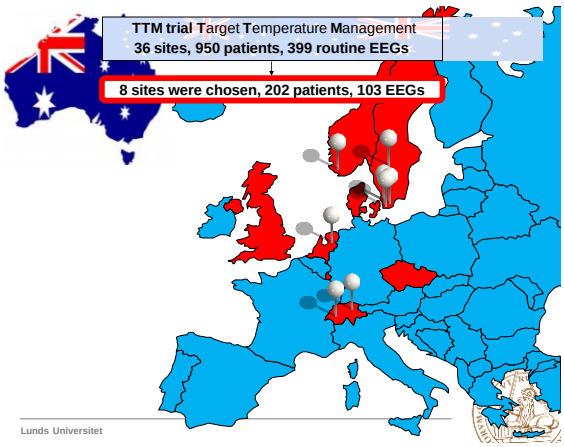
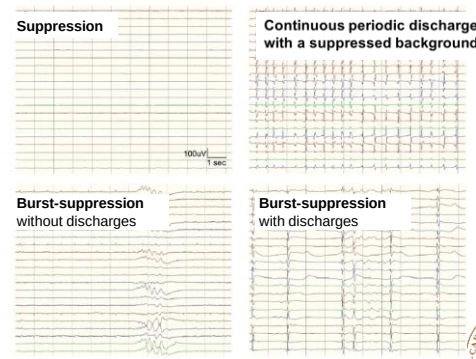
Callaway, *Circulation*, 2015

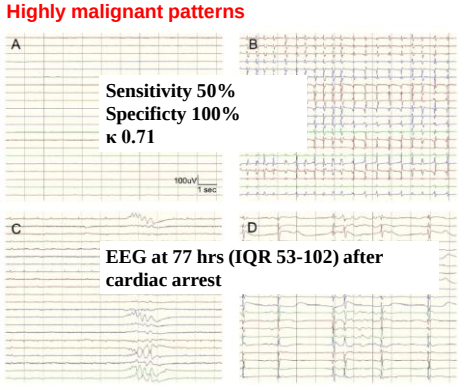


Highly malignant patterns



Westhall, *Neurology,* 2016

Highly malignant patterns



Westhall, *Neurology,* 2016

Pathological patterns

- Discontinuous background
- Continuous low amplitude
- Unreactive EEG
- Periodic, rhythmic or epileptiform discharges

Benign patterns

Continuous normal voltage background with reactivity and lack of discharges

Westhall, *Neurology,* 2016

Guidelines from the Swedish Resuscitation Council 2017

Poor outcome is predicted by:

- Highly malignant EEG
  - Suppression
  - Continuous periodic discharges with suppressed background
  - Burst suppression with or without discharges
- around 72h or later after cardiac arrest
- in combination with other independent methods

Rylander, *Läkartidningen,* 2017

Take home message

- Routine EEG is recommended in guidelines for prognostication after cardiac arrest and for seizure detection
- Routine EEG is an important tool and commonly used in the multimodal prognostic setting
- Using standardized interpretation, Highly malignant patterns are strongly correlated to a poor outcome.