



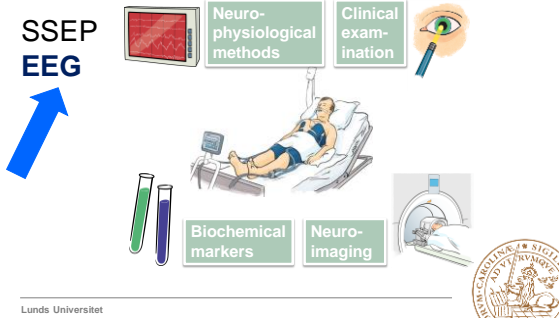
Prognostic value of routine EEG after cardiac arrest

Sofia Backman, Dept of Clin Neurophys, Skane University Hospital
 3rd International Symposium on Post Cardiac Arrest Care
 Lund 2017-09-04

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Toolbox of different tests for prognostication



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Clinical paper
 Survey on current practices for neurological prognostication after cardiac arrest

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

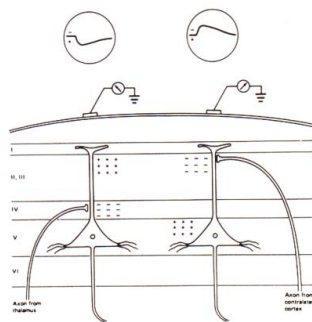
- ➡ EEG, intermittent (63%)
- ➡ Neuroimaging (CT-scan) (58%)
- ➡ Evoked potentials (36%)
- ➡ Neuroimaging (MRI) (40%)
- ➡ Biomarkers, NSE (19%)
- ➡ EEG, continuous (11%)
- ➡ Biomarkers, S-100B (5%)
- ➡ Other (4%)

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Fiberg, Resuscitation, 2015



What is EEG - electroencephalogram?

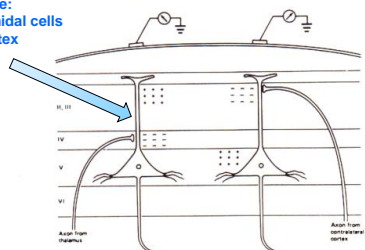


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What is EEG - electroencephalogram?

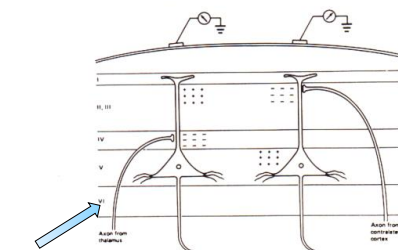
Source: pyramidal cells in cortex



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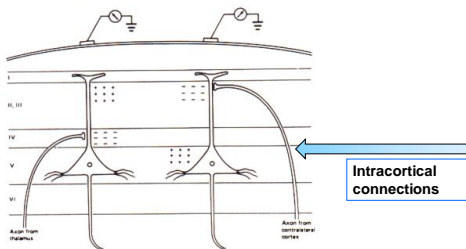
What is EEG - electroencephalogram?



Synchronized via input from "pacemaker neurons" in the thalamus



What is EEG - electroencephalogram?



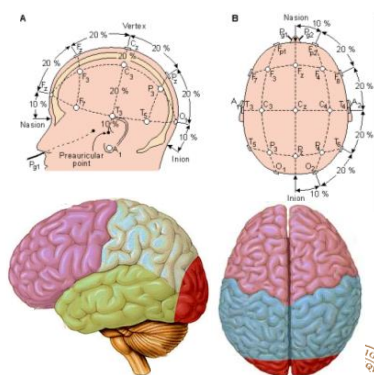
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10-20 System of Electrode Placement

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

Duration:
20-30
minutes



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Aspects of routine EEG after cardiac arrest

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

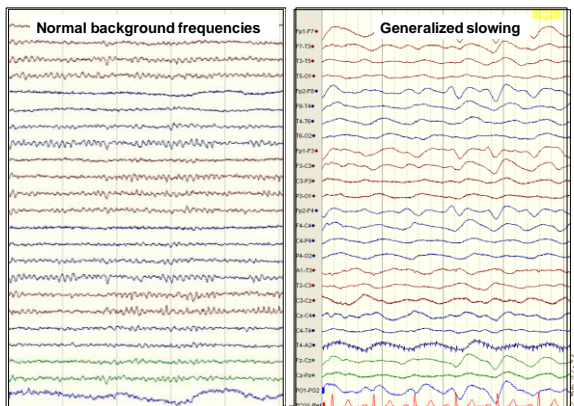
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Aspects of routine EEG after cardiac arrest

- Background activity

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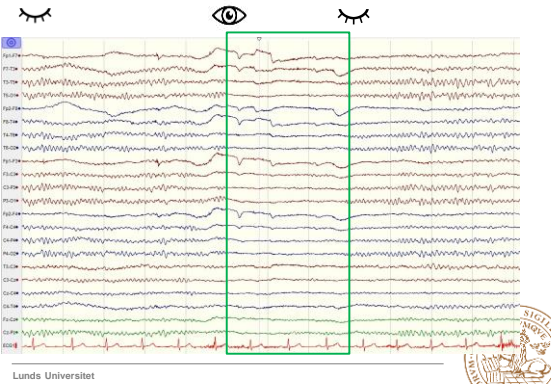
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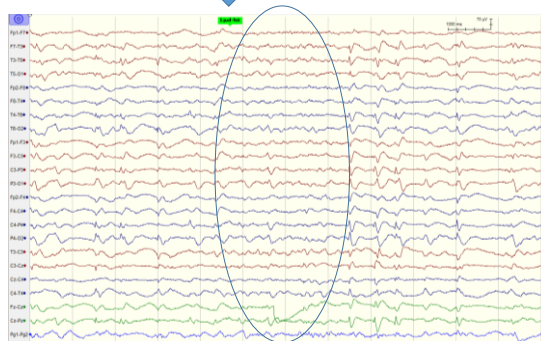


Normal reactivity



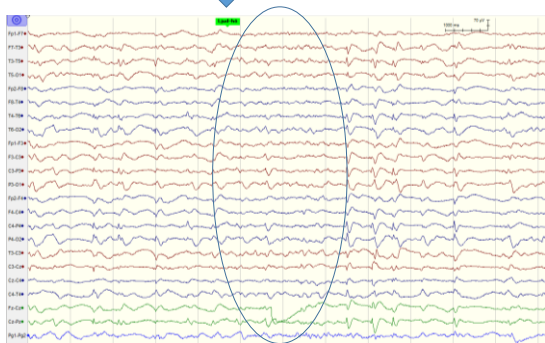
**Comatose patient
Reactivity testing**

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



**Comatose patient
Reactivity testing**

- No standardized definition or protocol
- High interrater variability

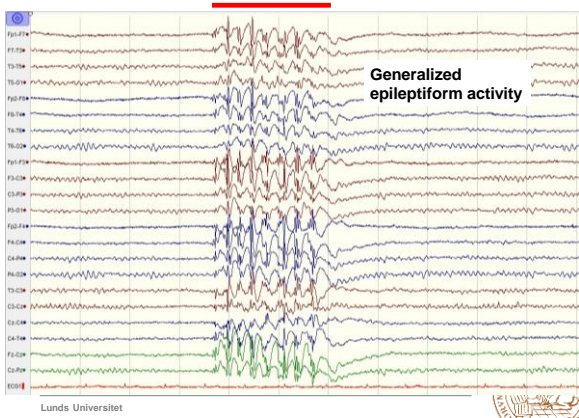


Aspects of routine EEG after cardiac arrest

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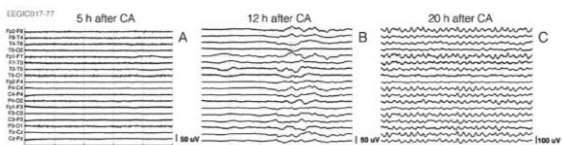
Problems with conclusions from studies

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



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- Evolution of EEG abnormalities



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

Lunds Universitet V Putten, Hofmeijer, J Clin Neurophysiol, 2016



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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. Niuwer, N. B. Fountain, and F. W. Dridlane

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Hirsch, J of Clin Neurophysiol, 2013



Main term 1	Main term 2	No +	Plus (+) Modifier
G Generalized Spontaneous epileptic discharges	PD Periodic Discharges	No +	
I Interictal abnormalities	NSA Non-specific Abnormalities	No +	
BI Bilateral Independent Abnormalities	SI Sustained Ictal Abnormalities	No +	
MI Multifocal Independent Abnormalities	SI Sustained Ictal Abnormalities	No +	

Frequency	Duration	Amplitude	Phase	Suppression	Asymmetric	Relative Asymmetry	Stimulus	Evolution	Other	Special	Log
Continuous (20%)	Very long (>1h)	>5V	>10	None	High (>20%)	>10	Suppression	None	Evolution	Yes	A.P.
Abundant (20-25%)	Long (30-120s)	3-5V	3	Sharp	Medium (10-20%)	>5	Partial	Revolving	Steady	No	P.A.
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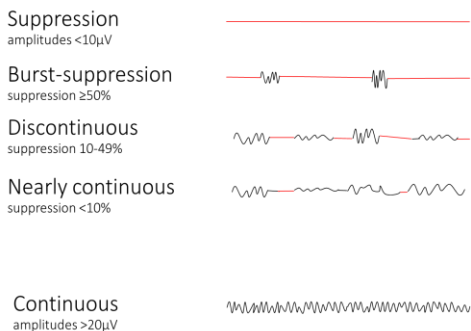
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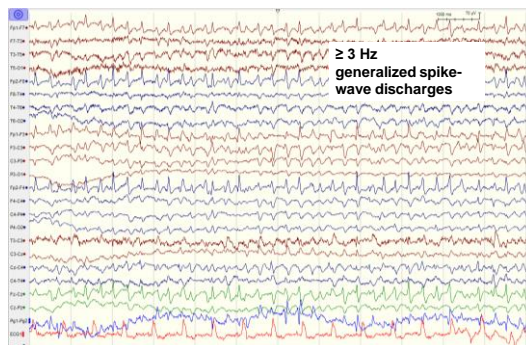
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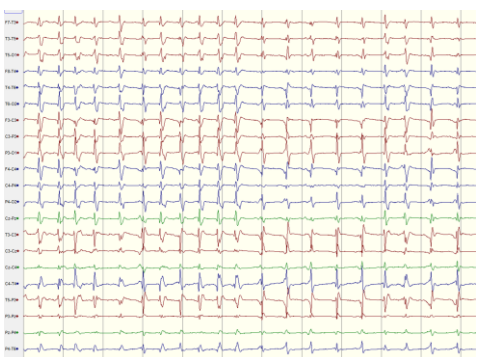
Background patterns ACNS



Unequivocal / definitive electrographic seizure



Periodic discharges < 3Hz same significance?



Intensive Care Med (2015) 41:2099–2096
DOI 10.1007/s00134-015-4401-3

CONFERENCE REPORTS AND EXPERT PANEL

CrossMark

European guidelines 2015

European Resuscitation Council and European Society of Intensive Care Medicine 2015 guidelines for post-resuscitation care

Poor outcome predicted by

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

after rewarming
always in combinations with other predictors

Lunds Universitet Nolan, Intensive Care Med, 2015

Circulation

Part 4: Advanced Life Support
2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations

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

Circulation

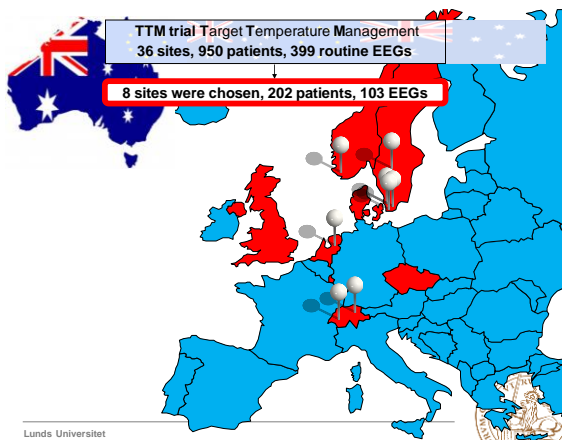
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"Future studies should comply with recently recommended definitions"

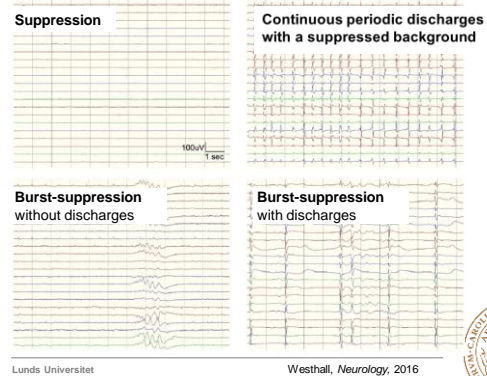
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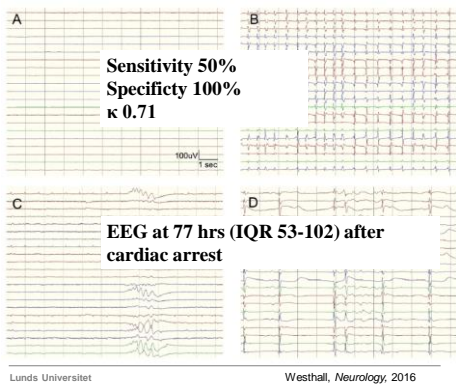




Highly malignant patterns



Highly malignant patterns



Pathological patterns

Benign patterns

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

Continuous normal voltage background with reactivity and lack of discharges

Lunds Universitet

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

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.

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Rylander, Läkartidningen, 2017



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