Prognostic value of routine EEG after cardiac arrest

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Toolbox of different tests for prognostication

- SSEP
- EEG
- Neuro-physiological methods
- Clinical examination
- Biochemical markers
- Neuro-imaging

What is EEG - electroencephalogram?

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

- EEG, intermittent (63%)
- Neuroimaging (CT-scan) (58%)
- Evoked potentials (30%)
- Neuroimaging (MRI) (40%)
- Biomarkers, NSE (19%)

- EEG, continuous (11%)
- Biomarkers, S-100B (5%)
- Other (4%)

Source: pyramidal cells in cortex

Synchronized via input from “pacemaker neurons” in the thalamus
What is EEG - electroencephalogram?

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!

Aspects of routine EEG after cardiac arrest

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

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

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

Location

Discharges

Modifiers

Background

Continuity

Amplitude

Frequency

Reactivity
**Background patterns ACNS**

- Suppression: amplitudes <10μV
- Burst-suppression: suppression ≥50%
- Discontinuous: suppression 10-49%
- Nearly continuous: suppression <10%
- Continuous: amplitudes >20μV

**Unequivocal / definitive electrographic seizure**

- ≥ 3 Hz generalized spike-wave discharges

**Periodic discharges < 3Hz same significance?**

**European guidelines 2015**

<table>
<thead>
<tr>
<th>Poor outcome predicted by:</th>
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<tbody>
<tr>
<td>• burst-suppression + unreactive</td>
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<tr>
<td>or electrographic status epilepticus + unreactive</td>
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<tr>
<td>after rewarming</td>
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<td>always in combinations with other predictors</td>
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**American guidelines 2015**

<table>
<thead>
<tr>
<th>Suggest poor outcome to be predicted by:</th>
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</thead>
<tbody>
<tr>
<td>• Persistent absence of EEG reactivity ≥ 72h after ROSC</td>
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<tr>
<td>or Persistent burst-suppression after rewarming</td>
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<tr>
<td>or Intractable and persistent status epilepticus</td>
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“Future studies should comply with recently recommended definitions”
Highly malignant patterns

A

Sensitivity 50%
Specificity 100%
κ 0.71

B

EEG at 77 hrs (IQR 53-102) after cardiac arrest

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

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.