# Assessment of neurological prognosis after cardiac arrest – clinical and neurophysiological aspects

AKADEMISK AVHANDLING

som för avläggande av medicine doktorsexamen vid Sahlgrenska akademin, Göteborgs universitet kommer att offentligen försvaras i Arvid Carlsson, Academicum, Medicinaregatan 3, Göteborg, onsdagen den 5 maj 2021, klockan 9.00.

av

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Avhandlingen baseras på följande delarbeten:

I. L. Arvidsson, S. Lindgren, L. Martinell, S. Lundin, C. Rylander. Target temperature 34 vs. 36°C after out-of-hospital cardiac arrest – a retrospective observational study. *Acta Anaesthesiologica Scandinavica 2017; 61:1176–1183*

II. L. Lilja, S. Joelsson, J. Nilsson, S. Lindgren, C. Rylander. Application of a standardized EEG pattern classification in the assessment of neurological prognosis after cardiac arrest – a retrospective analysis. *Submitted manuscript*

III. L. Lilja, S. Joelsson, J. Nilsson, M. Thuccani, P. Lundgren, S. Lindgren, C. Rylander. Assessing neurological prognosis in post-cardiac arrest patients from short vs plain text EEG reports: A survey among intensive care clinicians. *Resuscitation 2021; 159:7–12.*

IV. L. Lilja, M. Thuccani, S. Joelsson, J. Nilsson, P. Redfors, P. Lundgren, C. Rylander. The capacity of neurological pupil index to predict absence of somatosensory evoked potentials after cardiac arrest – a study protocol. *Accepted for publication in Acta Anaesthesiologica Scandinavica*

**SAHLGRENSKA AKADEMIN**
**INSTITUTIONEN FÖR KLINISKA VETENSKAPER**

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## Abstract

**Background:** Post-resuscitation care after cardiac arrest in adults includes targeted temperature management (TTM) to mitigate secondary brain injury. The recommended target temperature is between 32°C and 36°C after a large, international, randomized trial showed comparable outcomes (33°C vs. 36°C). Neurological prognostication is an essential part of post-resuscitation care, where clinical neurologic examination, including pupillary light reflex, is the cornerstone. Neurophysiologic methods such as electroencephalogram (EEG) and somatosensory evoked potentials (SSEP), are often used because of their relative insensitivity to other organ failures.

**Aim:** The aim was to evaluate a clinical routine change in TTM from 34°C to 36°C (Paper I) and prognostic accuracy, as well as the interrater agreement of standardized EEG patterns (Paper II). Additionally, we described how the information in written EEG reports is perceived by intensive care unit (ICU) clinicians assessing neurological prognosis (Paper III). The study protocol is provided for an ongoing study focused on describing possible interrelationships between the neurological pupil index (NPi) and SSEP (Paper IV).

**Methods:** The first study was a retrospective, before-and-after, observational study that included out-of-hospital cardiac arrest (OHCA) patients admitted to the central-ICU, Sahlgrenska University Hospital, either 2010 or 2014. The EEG studies (Papers II and III) were retrospective and included OHCA patients evaluated with EEG, during the period 2010–2014. The EEG recordings were reviewed by three clinical neurophysiologists and classified according to standardized EEG pattern categories ("highly malignant", "malignant", and "benign"), and the pattern category was compared with patient neurological performance at hospital discharge (Paper II). The third study (Paper III) was an answer-sheet survey based on a fictional, cardiac arrest patient with one marker of poor neurological prognosis present. ICU clinicians at two university hospitals were presented with two types of EEG reports (plain-text and short standardized statement) and then asked to assess the neurological prognosis of the patient ("poor", "not affected", or "good"). The study protocol (Paper IV) describes a prospective, observational study with consecutive inclusion.

**Results:** The 34°C and 36°C TTM groups displayed similar survival and neurological outcomes at all time points (Paper I). "Highly malignant" patterns were 100% specific for poor prognosis, whereas many survivors had a "malignant" pattern. The interrater agreement varied between kappa 0.62 and 0.29 (Paper II). The standardized statement "highly malignant EEG pattern present" was associated with a higher proportion of correct identification of poor prognosis by clinicians as compared with the descriptive plain-text reports (Paper III). The study protocol (Paper IV) will include all post-cardiac patients evaluated with pupillometry, including NPi, and SSEP, at >48 h after cardiac arrest. The ability of NPi to predict an absent SSEP response and their prognostic accuracy for poor outcome will be calculated based on neurological performance at hospital discharge.

**Conclusion:** Either 34°C or 36°C can be used for TTM at our department with sustained patient outcomes. "Highly malignant EEG patterns" are highly specific for poor prognosis and the clinical value of the EEG report might be improved by clearly stating the presence of such patterns. If specific NPi thresholds can predict the absence of SSEP response, a bedside NPi measurement can be used as a proxy for SSEP testing. In certain patients, SSEP can be excluded to save resources during multimodal prognostication after cardiac arrest.



**Keywords:** cardiac arrest, neurological prognosis, prognostication, electroencephalography, somatosensory evoked potentials

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