

Very Early Pupillometry, EEG Suppression, and BIS Data Predict Outcome 6 Hours After Cardiac Arrest

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Abstract

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Introduction/Hypothesis:

Predicting outcome after cardiac arrest is complicated; current guidelines recommend delaying prognostication at least 72 hours after return of spontaneous circulation (ROSC). Earlier methods to accurately quantify severity of injury are needed to stratify hypoxic-ischemic encephalopathy, facilitating enrollment in cardiac arrest treatment trials. Quantitative EEG and pupillometry techniques may provide very early prognosis information.

Methods:

Data from adult patients treated with Targeted Temperature Management (TTM) after cardiac arrest were prospectively entered into the International Cardiac Arrest Registry (INTCAR) database. Data from the Neuroptics NPi-200 pupillometer (Neurological Pupil index–NPi, constriction velocity–CV, percent constriction-%C) and the bispectral index (BIS), and suppression ratio (SR) were recorded at start of TTM and 6 hours after ROSC. Continuous EEG was interpreted by Neurologists and categorized as malignant EEG Pattern, Burst Suppression, or Other. Discharge outcomes were defined as Good if Cerebral Performance Category Score was 1 or 2, and Poor (PO) if 3-5. Receiver Operator Characteristic curves were constructed to predict PO.

Results:

55 patients were enrolled, with a median age of 57 years; 35 patients were male (65%). 37 patients (69%) had a PO predicted by peak Neuron Specific Enolase (NSE) levels ($AUC=0.90, p<0.001$) and malignant EEG features ($0.81, p<0.001$) within 72 hours of ROSC. Very early predictors of PO included initial BIS ($0.89, p<0.001$), SR ($0.85, p<0.001$), and NPi ($0.70, p=0.003$) and 6 hour CV ($0.73, p=0.002$) and %C ($0.68, p=0.01$). Spearman correlation was strong between NSE and initial BIS ($r=0.77, p<0.001$) and SR ($0.75, p<0.001$), less so for NPi ($0.37, p=0.01$). Combining initial BIS and NPi also predicted PO ($AUC=0.90, p<0.001$).

Conclusions:

Although EEG features and NSE values in the first 72 hours after ROSC can predict outcome after cardiac arrest as recommended by the American Heart Association in 2015, very early monitoring with bispectral index, suppression ratio, and quantitative pupillometry also appear accurate predictors. These tools may provide accurate very early stratification of brain injury, facilitating appropriate enrollment in therapeutic trials after cardiac arrest.

Patient Type:

Adult

Category:

CPR/Resuscitation

Category Alternate 1 (optional):

Neuroscience

Keywords:

cardiac arrest, out-of-hospital

electrophysiology

hypothermia

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