Early quantitative pupillary response parameters have high predictive value for 30-day mortality in patients resuscitated from out-of-hospital cardiac arrest

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Funding Acknowledgement: Type of funding sources: Private company. Main funding source(s): Novo Nordisk Foundation

Background: Despite adequate post-resuscitation treatment following out-of-hospital cardiac arrest (OHCA), early risk of death remains high due to irreversible anoxic brain injury.

Objective: Neuroprognostication is pivotal, and automated quantitative pupillometry has become an essential part of early multimodal approach. Several quantitative pupillary response parameters are now available, but little evidence exist on their value and timing in neuroprognostication.

Purpose: To evaluate prognostic value of standard parameters of quantitative pupillometry in OHCA patients.

Methods: In this observational study we included 138 comatose patients resuscitated from OHCA admitted to a tertiary cardiac intensive care unit. With quantitative pupillometry, change in pupil size (%CH, %), Neurological Pupil index (NPI, scalar value 0–5), constriction velocity (CV, mm/s), maximum CV (MCV, mm/s), dilation velocity (DV, mm/s) and latency of constriction (Lat, s) were measured at admission, at the 24 hours (24h), and 48-hours (48h) time points. Receiver operating characteristics (ROC) curves with calculation of area under the curve (AUC) were applied for assessment of association with 30-day mortality.

Results: The population were predominantly males, had a mean age of 61±12 years, and 120 (87%) had shockable primary rhythm, 122 (88%) had witnessed cardiac arrest and 51 (37%) died in the first 30 days. Median %CH, CV, MCV, DV and NPI values were significantly lower for diseased patients compared to survivors.

ROC analyses (Figure 1) present all parameters, except NPI, at admission with numerically highest values of AUC at 0.82, 0.76, 0.73, and 0.81 for %CH, CV, MCV, and DV respectively, and for NPI at 48h with AUC at 0.81. The admission time point still presented the highest AUC values, >0.84, for CV, MCV, and DV in an adjusted model. Of all the parameters, %CH and NPI maintained the highest prognostic values through all time points, and %CH performed best at admission with AUC at 0.87 and NPI at 24h with AUC at 0.91.

At admission the threshold value with 100% specificity for predicting 30-day mortality were 3.75, 0.09, 0.33, and 0.05, with negative predictive value (NPV [95% confidence interval]) at 71% [67–74], 66% [64–69], 67% [65–70], and 69% [66–72] for %CH, CV, MCV, and DV respectively. NPI had best performance at 24h with a cutoff value of 2.90 and NPV at 64% [63–64].

Conclusion: %CH and NPI were the strongest prognostic tools for 30-day mortality. Values below 3.75% for %CH at admission and 2.90 for NPI at 24h after archived 100% specificity for 30-day mortality, with NPV at 71% [67–74] and 64% [63–64] respectively. Although performance was persistently high, %CH, CV, MCV, and DV presented numerically highest AUC at admission. Additional parameters of CV, MCV, and DV were also significantly associated with outcome and future research should focus on validation and possible combining these measures into useful indices.