Increased energy required to reach target temperature in post-cardiac arrest patients is associated with better outcomes

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Introduction: We hypothesized the amount of energy required by the surface device to reach target temperature (T_{target}) in post-cardiac arrest patients treated with therapeutic hypothermia (TH) may be associated with outcomes by serving as a proxy for patient thermoregulatory ability and may modify the relationship between the time to T_{target} and outcomes. Some studies have shown that TH-treated post-arrest patients who reach T_{target} quickly have worse outcomes than those who cool more slowly. However, the ischemia-reperfusion insult of cardiac arrest may cause temperature derangements that affect the time trajectory of TH independent of external cooling factors.

Methods: Adult patients with sustained return of spontaneous circulation treated with TH between 2008-2015 with serial temperature data were included. Time to T_{target} was defined as time from TH initiation to the first time the patient temperature was <=34°C. Patients with T_{target} >34°C were excluded. The energy required to bring a patient to T_{target} ("energy units") was calculated as average inverse water temperature x 100 x hours between initiation and T_{target}. Primary outcome was neurologic status (measured by Cerebral Performance Category [CPC] score); secondary outcome was survival, both at hospital discharge. Univariate analyses were performed using Wilcoxon rank-sum tests; multivariate analyses used logistic regression. $P < 0.05$ was considered statistically significant.

Results: Of 205 patients included, those with CPC 3-5 required less energy to reach T_{target} (median 8.1 (IQR: 3.6-21.6) vs median 20.0 (IQR: 9.0, 33.5) energy units, p=0.001) and reached T_{target} quicker (median 2.3 (IQR: 1.5, 4.0) vs median 3.6 (IQR: 2.0, 5.0) hours, p= 0.01) than patients with CPC 1-2. Patients who did not survive required less energy than survivors (median 8.1 (IQR: 3.6-20.8) vs median 19.0 (IQR: 6.5, 33.5) energy units, p=0.001) and reached T_{target} quicker (median 2.2 (IQR: 1.5, 3.8) vs median 3.6 (IQR: 2.0, 5.0) hours; p=0.01). Controlling for average water temperature between initiation and T_{target}, the relationship between outcomes and time to T_{target} was no longer significant. Controlling for location, witnessed arrest, age, initial rhythm, and neuromuscular blockade use, increased energy was associated with better neurologic (aOR: 1.01 (95%CI 1.00-1.03), p=0.039) and survival (aOR: 1.01 (95%CI 1.00-1.03), p=0.045) outcomes.

Conclusion: Increased energy requirement during TH initiation is associated with better outcomes at hospital discharge and may affect the relationship between time to T_{target} and outcomes.