

Optimization of Temperature Control Post-Cardiac Arrest: A Protocol Shift to Normothermia and Light Sedation

Background:

Temperature control is a neuroprotective intervention used in post-cardiac arrest patients to mitigate secondary hypoxic-ischemic brain injury. The 2025 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care recommend maintaining a temperature between 32 and 37.5 degrees Celsius for at least 36 hours following return of spontaneous circulation. Although this range allows for clinical flexibility, recent studies have suggested no difference in outcomes between hypothermic and normothermic temperature targets. Clinical trials have historically targeted deep sedation during temperature control, with variable sedative and analgesic practices, offering limited guidance for clinicians. With mounting literature demonstrating no significant difference in outcomes between hypothermia or normothermia, temperature control practice was transitioned to a normothermia-based protocol targeting light sedation, given a lack of evidence supporting deep sedation practices. Concurrently, shivering management was updated to optimize non-neuromuscular blocker interventions. The purpose of this study is to evaluate the safety and efficacy of the revised temperature control protocol in post-cardiac arrest patients.

Methodology:

This single-center, Institutional Review Board-approved, retrospective cohort study included adult post-cardiac arrest patients initiated on a temperature control protocol. In August 2022, a pharmacist-driven protocol modification removed 33 degrees Celsius as a temperature target and prioritized normothermia (36 or 37 degrees Celsius). Additionally, sedation practices were revised from deep sedation (Richmond Agitation-Sedation Score [RASS] -4 to -5) to lighter sedation (RASS 0 to -3). Patients were included in the pre-group if admitted from April 2019 to July 2022, and in the post-group if admitted from August 2022 to November 2025. Patients were excluded if they left against medical advice, transferred from an outside facility, died or were discharged to hospice within 96 hours, were COVID-19 positive, underwent endovascular cooling, or did not awaken. The primary outcome, time to first awakening, was defined as a Glasgow Coma Scale (GCS) motor score of 6 on at least two assessments. Key secondary outcomes included GCS at ICU discharge, ICU and hospital length of stay, patient disposition, and total analgo-sedation required during the temperature control period. Safety outcomes included incidence of hypokalemia, arrhythmias, and use of anti-shivering agents. Subgroup analyses assessed the association between time to awakening and temperature in each cohort. Data was sourced from the institution's electronic health record, Allscripts®, and stored using REDCap®. Continuous data was assessed using Wilcoxon rank sum test, while categorical data was assessed utilizing Chi-square or Fischer's Exact test as appropriate. All analyses were conducted through JMP®.

Results/Discussion:

Of 649 patients initiated on the temperature control protocol between April 2019 and November 2025, 110 patients met inclusion criteria. Fifty-seven patients were included in the pre-group, and fifty-three patients were included in the post-group. Baseline characteristics were similar between groups apart from GCS and temperature at presentation being higher in the post-group (Table 1). The primary outcome of median time to awakening was 11.1 hours shorter in the post-group, although this was not statistically significant (45.8 vs 34.7 hours, $p=0.180$). In a subgroup analysis of the pre-group cohort, a significantly longer time to awakening was observed in patients cooled to 33 degrees Celsius (67.8 vs 40.8 hours, $p=0.021$). The post-group achieved goal temperature faster by 1.9 hours ($p=0.029$), had higher rates of light sedation (56% vs 77%, $p=0.019$), and used more fentanyl compared to hydromorphone ($p<0.05$), with no statistically significant difference in fentanyl equivalents (10.26 vs 18.64 mcg/kg, $p=0.363$). Shivering rates were similar, though buspirone use increased (39% vs 81%, $p<0.05$) and neuromuscular

blocker use decreased (35% vs 2%, $p<0.05$) in the post-group. Additional secondary and safety outcomes can be observed in Table 2.

Limitations of this study include the single-center retrospective design, small sample size, variability in sedation and analgesic practices, and variability in RASS and GCS documentation by nursing staff.

Conclusion:

This retrospective cohort study demonstrated that a revised temperature control protocol targeting light sedation and normothermia was safe and effective. Although the reduction in time to awakening did not reach statistical significance, a numerically shorter awakening time was observed following implementation. The updated protocol increased adherence to light sedation targets, reduced neuromuscular blocker utilization, and maintained similar overall analgesic and sedative exposure with no difference in safety outcomes.

Clinical Implications:

This study supports the safe implementation of normothermic temperature control with targeted light sedation in post-cardiac arrest patients. This pharmacist-led protocol modification reduced neuromuscular blocker use and need for deep sedation while maintaining similar neurologic and safety outcomes. By standardizing sedation and shivering management, this project offers a reproducible framework that can be adopted by other health systems seeking to optimize temperature control practices aligned with current evidence.

Presentation objective: Evaluate the impact of a pharmacist-driven updated temperature control protocol in patient's post-cardiac arrest.

Self-assessment: Which of the following statements is false regarding temperature control in patients post-cardiac arrest?

1. The shortest recommended duration of temperature control is 36 hours per the 2025 AHA guidelines
2. TTM2 (2021) demonstrated no significant difference in functional outcomes between hypothermia and normothermia
3. 2025 AHA Guidelines recommend maintaining a temperature between 32 and 37.5 degrees Celsius
4. **Targeting deep sedation (RASS -4 to -5) is an AHA guideline recommendation during temperature control**

Table 1. Baseline Characteristics

Characteristic	Pre-group (n=57)	Post-group (n=53)
Age, median (IQR)	65 (54-75)	64 (53.5-74)
Female, n (%)	14 (24.6)	22 (41.5)
Actual body weight in kg, median (IQR)	86.0 (73.9 – 99.9)	82.2 (67.1 – 95.2)
Past medical history		
HTN, n (%)	37 (67.3)	28 (57.1)
Dyslipidemia, n (%)	28 (50.9)	19 (38.8)
Diabetes, n (%)	17 (30.9)	12 (24.5)
Myocardial infarction, n (%)	3 (5.5)	3 (6.1)
Cardiac arrest, n (%)	4 (7.3)	1 (2.0)
Percutaneous coronary intervention, n (%)	5 (9.1)	8 (16.3)
Coronary artery bypass graft, n (%)	6 (10.0)	7 (14.3)
Cardiac device, n (%)	7 (12.7)	1 (2.0)
Congestive heart failure, n (%)	8 (14.8)	8 (16.3)
Alcohol use, n (%)	15 (27.3)	9 (18.4)
Current smoker, n (%)	13 (23.6)	14 (28.6)
Unknown, n (%)	2 (3.5)	4 (7.6)
Arrest morphology		
Out of hospital arrest, n (%)	30 (52.6)	37 (69.8)
Bystander CPR, n (%)	25 (83.3)	26 (70.3)
In hospital arrest, n (%)	27 (47.4)	16 (30.2)
Shockable rhythm, n (%)	22 (38.6)	26 (49.1)
Ventricular fibrillation	19 (90.5)	23 (88.5)
Ventricular tachycardia	2 (10.5)	3 (11.5)
Non-shockable rhythm, n (%)	35 (61.4)	27 (50.9)
Asystole	7 (20.6)	8 (29.6)
Pulseless electrical activity	24 (68.6)	19 (70.4)
Arrest etiology		
Cardiac, n (%)	29 (50.9)	33 (62.3)
Respiratory, n (%)	15 (26.3)	14 (26.4)
Neurologic, n (%)	1 (1.8)	3 (5.7)
Substance abuse, n (%)	3 (5.3)	6 (11.3)
Drowning, n (%)	1 (1.8)	2 (3.8)
Other, n (%)	14 (24.6)	7 (13.2)
At presentation		
GCS, median (IQR)*	4 (3 - 7)	6 (4 – 8)
Presence of shock, n (%)	34 (59.6)	40 (75.5)
Baseline temperature (in Celsius), median (IQR)	36.5 (35.1 – 36.9)	36.7 (36 – 37.4)
Initial goal temperature, median (IQR)**	36 (36 - 36)	36 (36 - 37)
33 degrees Celsius	8 (14)	0 (0)
36 degrees Celsius	49 (86)	39 (74)
37 degrees Celsius	0 (0)	14 (26)

* p=0.006

** p=<0.05

Table 2. Study Outcomes

		Pre-group (n=49)	Post-group (n=53)	p-value
Primary Outcome				
Time to awakening (hrs), median (IQR)		40.8 (27.7-62.1)	35.2 (26.8-63.3)	0.630
Subgroup analysis of time to awakening (hrs), median (IQR)	33°C	67.8 (56.0 – 161.1)		0.021
	36°C	40.8 (27.7 – 62.1)		
			36°C 34.4 (26.6 – 63.6) 37°C 37 (26.9-63.0)	0.785
Secondary Outcomes				
Time to goal temperature in hours, median (IQR)		5.3 (3.5 – 8.01)	3.4 (1.6 – 6.8)	0.029
GCS at spontaneous awakening, median (IQR)		11 (10 – 11)	11 (10 – 11)	0.115
Light sedation during cooling (RASS > 2), n (%)		32 (56.14)	41 (77.36)	0.019
Highest RASS during TTM, n (%)	+3 to +5	6 (10.5)	5 (9.4)	0.849
	+1 to +2	37 (64.9)	38 (71.7)	0.445
	0 to -1	9 (15.8)	5 (9.4)	0.318
	-2 to -3	2 (3.5)	5 (9.4)	0.203
	-4 to -5	2 (3.5)	1 (1.9)	0.602
RASS goal adjusted during temperature control, n (%)		45 (79.0)	15 (28.3)	<0.05
Analgo-sedation				
Fentanyl				
Continuous infusion, n (%)		20 (35.09)	35 (66.04)	<0.05
Intermittent doses, n (%)		19 (33.93)	46 (86.79)	<0.05
Cumulative fentanyl (mcg), median (IQR)		2755 (557.5-4831.25)	1840 (800 – 3100)	0.501
Hydromorphone				
Continuous infusion n (%)		14 (25)	1 (1.96)	<0.05
Intermittent doses n (%)		40 (71.43)	3 (5.77)	<0.05
Cumulative hydromorphone (mg), median (IQR)		7.25 (3 - 12.15)	0.75 (0.4 – 6)	0.045
Fentanyl equivalents (mcg), median (IQR)		800 (433.33-3195)	1715 (582.5 – 2785)	0.270
Fentanyl Equivalents (mcg/kg), median (IQR)		10.26 (5.56 – 38.56)	18.64 (5.43-38.52)	0.363
Dexmedetomidine infusion, n (%)		12 (21.05)	9 (16.98)	0.587
Propofol infusion, n (%)		56 (98.25)	52 (98.11)	0.959
Propofol (mcg), median (IQR)		5435 (2780 – 9298)	5585 (2755-7420)	0.694
Propofol (mcg/kg), median (IQR)		58.51 (28.75 – 93.11)	58.47 (30.49 – 95.62)	0.963
Disposition				
ICU length of stay (hrs), median (IQR)		145.1 (86.4 – 212.47)	109.45 (732.23 – 191.38)	0.1822
Hospital length of stay (hrs), median (IQR)		323.3 (195.2 – 623.2)	306.5 (161.72-528.7)	0.406
Discharge, n (%)	Home	14 (24.56)	20 (37.74)	0.135
	Rehab	10 (17.54)	7 (13.21)	0.530
	SNF	16 (28.07)	14 (26.42)	0.846
	Other facility	10 (17.54)	5 (9.43)	0.216
	Withdrawal/Expired	6 (10.53)	7 (13.21)	0.663
Safety Outcomes				
Shivering, n (%)		31 (54.4)	23 (43.4)	0.249
Medications utilized for shivering	Meperidine	27 (47.37)	17 (32.08)	0.102
	Buspirone	22 (38.60)	43 (81.13)	<0.05
	Neuromuscular Blockers	20 (35.09)	1 (1.89)	<0.05
Hypokalemia		10 (17.54)	17 (32.08)	0.077
Arrhythmia		10 (17.54)	4 (7.55)	0.116