1. PURPOSE AND INTENT

1.1. The overall purpose of this guideline is to support clinical decision-making in the care of a patient post-cardiac arrest from admission, through Temperature Control, to neuroprognostication.

1.2. Clinical decision-making should be made in collaboration with the patient's substitute decision maker or proxy and should reflect the patient's goals of care, clinical status based on expert assessment, and evidence-based recommendations.

1.3. The purpose of Temperature Control is to maintain normothermia to limit anoxic brain injury and support optimal neurological recovery following cardiac arrest.[2]

1.4. The purpose of neuroprognostication is to select appropriate physical assessments and diagnostic testing to better predict the spectrum of potential neurologic outcomes. The aim of neuroprognostication is to support families/substitute decision makers in determining acceptable outcomes and goals of care for the patient.[1]

1.5. This guideline also aids in the practical application of the Temperature Control Post Cardiac Arrest order set.

2. BACKGROUND

2.1 Randomized controlled and observational studies have been conducted to investigate the optimal temperature goals to support optimal neurologic outcomes for patients who suffer cardiac arrest.[1]

2.2 As evidence emerges to support changing temperature goals, clinical practice must also shift.

3. DEFINITIONS

3.1 **Temperature Control**: The process of achieving and maintaining body temperature at a set point or pre-defined range for a set period of time.

3.2 **Normothermia:** A core body temperature between 36.5°C and 37.5°C.

3.3 **Hyperthermia:** A core body temperature above 37.6°C.

3.4 **Mild hypothermia:** A core body temperature of 32°C to 36.4°C.

3.5 **Core Body Temperature:** Temperature measured through either an esophageal or rectal temperature probe or a pulmonary artery catheter.

3.6 **Active Cooling:** Cooling the patient using forced air, water-cooling blankets or vest and leggings, cold intravenous (I.V.) fluids, or ice packs.

3.7 **Passive Rewarming:** The gradual reduction or withdrawal of active cooling to allow the patient to return to normothermia.

3.8 **Active Rewarming:** Warming the patient using warm blankets, warm forced air, and/or warm I.V. fluids.

3.9 **Neuroprognostication:** The clinical and neurophysiologic assessments and neuroimaging used to determine neurologic prognosis.

3.10 **Return of Spontaneous Circulation (ROSC)**: The time that a pulse and blood pressure is maintained after cardiac arrest.

4. GUIDELINES

Temperature Control

4.1 Temperature Control is to be ordered by the Critical Care/Cardiology/Emergency Attending physician or delegate utilizing the Temperature Control Post Cardiac Arrest order set. While the procedure may be initiated in the ED, the patient is to be transferred to the Intensive Care Unit (ICU) as soon as possible after initiation.

4.2 The Critical Care / Cardiology Attending physician has final responsibility for determining whether or not Temperature Control should be continued if the procedure has been initiated outside of the ICU.

4.3 Coronary reperfusion strategies may be implemented during Temperature Control and may be indicated in all cases of ST-elevation myocardial infarction (STEMI) and cardiogenic shock. An urgent Cardiology consult or discussion with the Interventional Cardiologist is recommended if the primary cause for the arrest is thought to be of cardiac origin.

4.4 Temperature Control can be continued for patients going to the cardiac catheterization lab. Consider the use of ice packs or other easy-to-transport cooling modalities. Active cooling may be stopped if necessary and resumed when the patient returns.

4.5 Inclusion Criteria for Temperature Control (ALL criteria must be met):

- Cardiac arrest (shockable or non-shockable rhythm, inpatient or outpatient)
- Unconscious patient (GCS <8) who may have non-purposeful movements
- Sustained hemodynamic and cardiac rhythm stability

4.6 Absolute Exclusion Criteria for Temperature Control:

- Patient care goals not consistent with ICU-level care
- GCS ≥ 10 or rapidly improving neurologic exam (e.g.: following commands)
- Comatose state (not medically induced) prior to cardiac arrest

4.7 The goal of Temperature Control is to maintain normothermia until the patient is awake, following commands, and extubated, or for a maximum of 48 hours after establishing ROSC.

4.8 Conservative methods should initially be used to maintain normothermia, such as the removal of blankets, the administration of acetaminophen, and environmental modifications that mitigate elevations in ambient temperature (e.g.: closing the window blinds).

4.9 If conservative methods are unsuccessful and the patient's temperature reaches 37.5°C, active cooling to a goal of normothermia should be initiated.

4.10 Sedation with a short-acting agent, such as propofol, is suggested for the first 24 hours to support subsequent waking and neurologic testing.

4.11 Shivering while normothermic is possible and should be treated with meperidine 12.5 to 50 mg I.V..

Neuroprognostication

4.12 As noted previously, clinical decision-making should be made in collaboration with the patient's substitute decision maker or proxy and should reflect the patient's goals of care, clinical status based on expert assessment, and evidence-based recommendations.

4.13 The Critical Care / Cardiology Attending physician should select appropriate physical assessments and diagnostic tests specific to patient symptoms.

4.14 The physical assessment and diagnostic test results should be conveyed to the patient's substitute decision maker or proxy to support the development of a patient-centric care plan that reflects the patient's goals of care.

4.15 Physical assessments should include, but are not limited to, pupillary light reflexes (at 24 hours after ROSC), motor examination (at 72 hours after ROSC), and observation of the presence of myoclonus or seizure activity.[1]

4.15.1 24-48 hours after ROSC, if there is suspicion for progression towards brain death, a full neurologic determination of death) exam should be performed by physicians with experience performing this assessment.

4.16 Available diagnostic tests can include, but are not limited to, electroencephalography (EEG), computed tomography (CT), and magnetic resonance imaging (MRI).[1]

4.16.1 Early diagnostic testing (within 24 hours after establishing ROSC) in an attempt to identify a cause of the cardiac arrest or as part of a general diagnostic work up should not be used for neuroprognostication before an unconfounded clinical exam is performed.[1]

4.17 A prediction of poor neurologic prognosis based on peri-arrest factors, physical assessment, and laboratory testing should generally not be made in the first 24 hours after establishing-ROSC.[1]

4.18 Conclusions related to neuroprognostication should generally be delayed until at least 72 hours after establishing-ROSC. During this time, confounding factors, such as sedation, infection, metabolic / physiologic derangements, or seizure activity, should be treated or removed as soon as possible.[1]

4.19 Decisions about withdrawal of life-sustaining treatment should be made on the basis of adverse prognostic features in at least 2 different modalities. Potential modalities include, but are not limited to, physical assessment, EEG, CT, and/or MRI.[1] Results of common assessments that may contribute to a global assessment of poor neurologic prognosis are outlined below in *Guidelines: 4.20 - 4.27.*

4.20 In patients who remain comatose post-cardiac arrest (with or without Temperature Control)[1]:

4.20.1 Absent pupillary light reflexes after 72 hours after establishing ROSC should be considered predictive of poor neurologic outcome.

4.20.2 A Glasgow Coma Motor Score of 1-2 (no response or abnormal extension) at 72 hours after establishing ROSC should not be the sole criterion used to conclude that the neurologic prognosis is necessarily poor in the absence of supportive diagnostic testing, as suggested in *Guideline: 4.18*.

4.21 Status myoclonus noted within the first 7 days in comatose post-cardiac arrest patients should be considered a marker of poor neurologic prognosis when combined with other findings indicative of poor prognosis (absent pupillary light reflexes ≥ 72 hours after ROSC, status myoclonus, isoelectric EEG, reduced gray-white differentiation on CT or MRI).[1]

4.22 EEG should be performed in all comatose post-cardiac arrest patients exhibiting myoclonic jerks to differentiate benign and malignant forms of myoclonus and to assess for electrographic seizures.[1]

4.23 Electrographic status epilepticus within the first 7 days post-cardiac arrest should not be considered a definitive marker for poor neurologic prognosis when used in isolation. Status epilepticus should only be used as an indicator of poor outcomes when combined with other modalities also indicating poor prognosis.[1]

4.24 Status epilepticus should be treated with sedative and antiseizure medications while awaiting results of physical assessments and diagnostic tests. In patients with ongoing seizures and absence of other poor prognostic indicators, delay prognostication until electrographic seizures resolve[1]

4.25 The absence of EEG reactivity within the first 72 hours after establishing ROSC should not be used to conclude that the prognosis is poor post-cardiac arrest.[1]

4.26 CT of the brain should be performed within the first 72 hours in patients who remain comatose after ROSC as part of a multimodal approach to neuroprognostication. Loss of grey-white differentiation (GWD) is a reliable

indicator of poor prognosis when combined with other parameters also suggestive of poor prognosis.

4.27 MRI of the brain should be performed within 7 days after ROSC if uncertainty remains regarding neurologic prognosis after assessment with other diagnostic modalities, including CT of the brain.[1]

5. EQUIPMENT

- Continuous core temperature monitoring equipment (e.g. esophageal or rectal probe; pulmonary artery catheter)
- Active cooling device
- External cooling wraps (e.g. vests and / or leggings)
- Refrigerated Lactated Ringers I.V. solution (dependent on baseline temperature)

6. PROCEDURE

Part A: Maintaining Normothermia

Part B: Active Cooling Measures

Part C: Timeline for Neuroprognostication

PART A: Maintaining Normothermia

6.1 Perform hand hygiene before direct patient contact and throughout all care following the four moments of hand hygiene.

6.2 Perform and document a comprehensive baseline neurological exam and skin assessment prior to initiation of Temperature Control.

6.3 The patient's temperature goal is 36.5-37.5°C. The goal is to maintain normothermia.

6.4 Core temperature is to be monitored continuously by at least one of the following methods:

- Esophageal temperature probe
- Rectal temperature probe
- Pulmonary artery catheter
- If unable to continuously monitor core temperature using methods from 6.4, then check temperature hourly via alternate sources (i.e. oral, forehead, ear) and base interventions from the higher temperature reading.

6.5 Insert temperature probe for continuous core temperature monitoring.

6.5.1 Refer to WRHA / SH EIPT: Esophageal and Rectal Temperature Probe for Continuous Monitoring – Insertion and Removal (Adult).

6.6 Record the time Temperature Control was started.

6.7 Record baseline temperature.

6.7.1 If baseline temperature is above 37.5°C, begin active cooling (Part B: Active Cooling Measures).

6.7.2 If baseline temperature is below 32°C, consider active rewarming to normothermia.

6.7.3 If baseline temperature is between 32°C – 36.5°C, allow patient to passively rewarm to normothermia. Passively allowing the patient to warm to goal temperature is preferred as actively warming the patient can cause peripheral vasodilation and hemodynamic instability. Active rewarming is not recommended for patients with baseline temperature 32°C – 36.5°C

6.8 Record patient's temperature hourly and any temperature modifying interventions in the patients' health record.

6.9 Observe for and treat shivering.

6.9.1 Follow "Shivering Therapy" as ordered in the order set: Care of a Patient Post Cardiac Arrest (Temperature Control).

6.9.2 Shivering works against cooling measures making it more difficult to reach and maintain target temperature

6.10 Maintain the patient's temperature between 36.5 – 37.5 °C until patient is awake, following commands, and extubated or for a maximum of 48 hours.

PART B: Active Cooling Measures

6.11 Notify physician if active cooling measures are required (core temperature above 37.5°C).

6.12 Set the goal temperature on the active cooling device to achieve the desired patient temperature of 36.5 – 37.5°C.

6.12.1 This is ideally achieved using an automated modality. Refer to device specific instructions.

6.13 Place the external active cooling wraps (vest and / or leggings) on the patient.

6.13.1 Ensuring there are no folds or creases in the wraps as this reduces the risk of pressure ulcer development and interferes with the flow of water through the wraps.

6.14 Start the active cooling device.

6.15 Wrap hands and feet with warm dry blankets or towels.

6.15.1 Warming the hands and feet can communicate to the hypothalamic thermoregulatory reflexes to suppress shivering.

6.16 Observe for and treat shivering.

6.16.1 Follow "Shivering Therapy" as ordered in the Temperature Control Post Cardiac Arrest order set.

6.16.2 Shivering works against cooling measures making it more difficult to reach and maintain target temperature.

6.17 Assess skin integrity every 2 hours while external active cooling wraps (vest and / or leggings) are on the patient.

6.18 Maintain the patient's temperature between 36.5 – 37.5 °C until patient awake, following commands, and extubated or for a maximum of 48 hours.

PART C: Timeline for Neuroprognostication (See Appendix A)

24 hours After ROSC

6.19 Begin sedation vacation 24 hours after establishing ROSC and restart sedation only as required at the lowest dose possible to support regular unconfounded clinical assessment. Longer acting agents, such as barbiturates and benzodiazepines, should be avoided as they may confound clinical assessment.

6.19.1 Potential confounders include seizures, pharmacologic interventions (medications with sedative effects), untreated Infection, and metabolic/ physiologic derangements that persist at the time of clinical assessment.

6.20 If the patient wakes, there is no need for further testing.

6.21 Consider an EEG at 24 hours or greater after establishing ROSC for patients who remain unresponsive off sedation.

48 Hours After ROSC

6.22 Minimize all sedation to continue unconfounded clinical assessments.

6.23 If the patient is not waking, consider CT Brain. CT imaging results suggestive of loss of GWD should be used as part of a multimodal assessment of which ≥ 2 findings are suggestive of a poor prognosis with a low false positive rate.

6.24 If the clinical trajectory is dynamic or improving, then repeat clinical assessment and CT brain at intervals at the discretion of the attending physician. In this instance, definitive neuroprognostication is not possible.

Within 7 Days After Establishing ROSC

6.25 Minimize all sedation to continue unconfounded clinical assessments.

6.26 Consider MRI Brain following CT Brain as part of multimodal neurologic imaging.

7. DOCUMENTATION

Document the following information and times in the Integrated Progress Notes, Flow Sheet or Electronic Patient Record, as applicable:

7.1 Baseline and routine neurological assessment (every 4 hours and PRN)

7.2 Skin assessment (every two hours and PRN)

7.3 Time Temperature Control started

7.4 Temperature (including route of measurement) and vital signs (every hour and PRN)

7.5 Actual time normothermia is achieved (goal 36.5 – 37.5°C)

7.6 Active cooling measures if required

7.7 Time Temperature Control discontinued or completed

7.8 Any deviations from normothermic protocol above

8. REFERENCES

8.1 Fordyce CB, Kramer AH, Ainsworth C, et al. Neuroprognostication in the Post Cardiac Arrest Patient: A Canadian Cardiovascular Society Position Statement. *Canadian Journal of Cardiology*. 2023;39(4):366-380. doi:10.1016/j.cjca.2022.12.014

8.2 Barker M, Sekhon M, Krychtiuk KA, et al. Temperature Control After Out-of-Hospital Cardiac Arrest: Integrating Evidence Into Real World Practice. *Canadian Journal of Cardiology*. 2023;39(4):385-393. doi:10.1016/j.cjca.2022.12.026

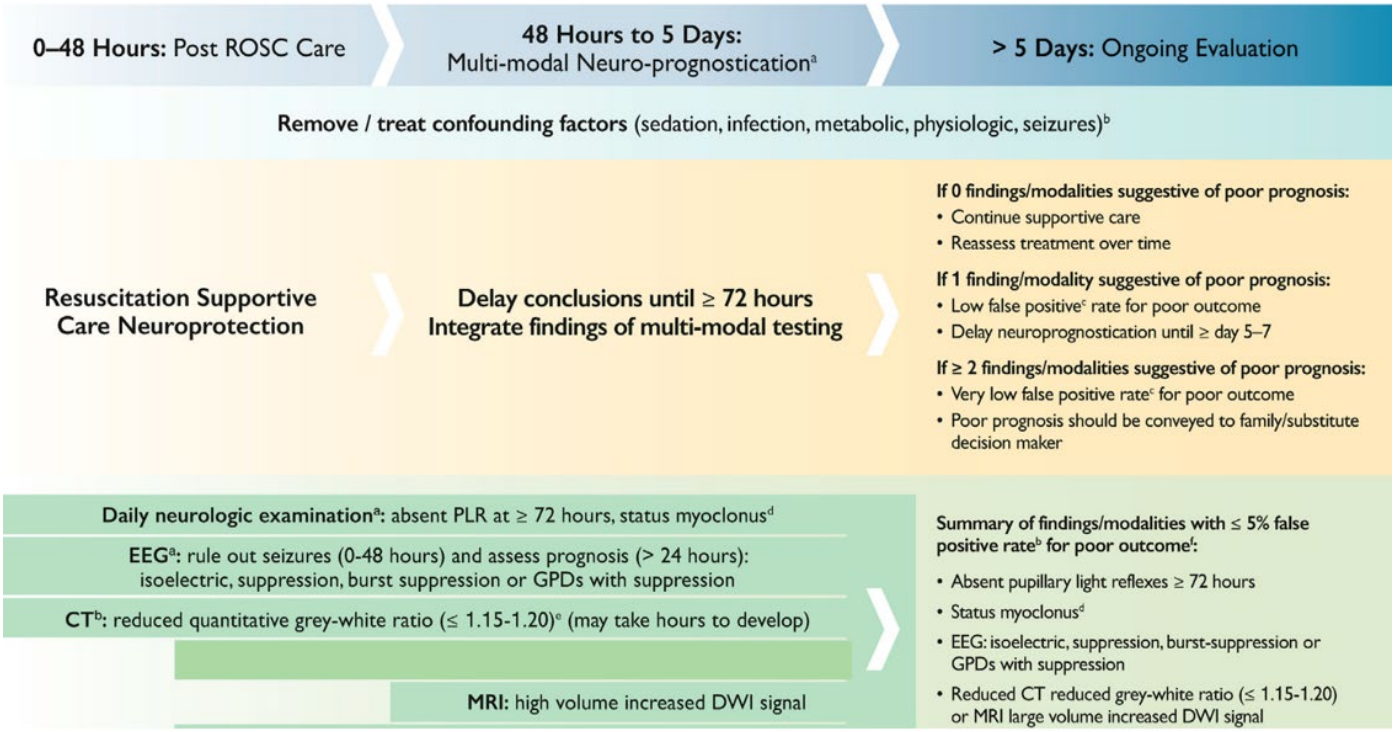
8.3 Jain, A., and others. (2018). Shivering treatments for Temperature Control: A review. Journal of Neuroscience Nursing. Vol. 50(2), 63 – 67.

8.4 Woo, J. and others. (2019). Effectiveness and safety of early enteral nutrition for patients who received Temperature Control after out of hospital cardiac arrest. Resuscitation. Vol 135, 191-196.

8.5 WRHA Critical Care Outcomes Improvement Team. (2020). Temperature Control Post Cardiac Arrest Orderset. WRHA Critical Care Program.

8.6 Shared Health / WRHA Critical Care Outcomes Improvement Team. (2024). Draft Care of a Patient Post Cardiac Arrest (Temperature Control) Orderset. SH / WRHA Critical Care Program.

APPENDIX A: Assessment of neurologic prognosis in patients who remain comatose post-cardiac arrest.[1]



Adapted from Fordyce CB, Kramer AH, Ainsworth C, et al. Neuroprognostication in the Post Cardiac Arrest Patient: A Canadian Cardiovascular Society Position Statement