

The Effectiveness of Therapeutic Hypothermia on Out-of-Hospital Cardiac Arrest Patients

Paramedic Mini CAT – Fanshawe College

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Clinical Scenario:

A 34-year-old male found unresponsive by their partner, contacts 911 after no pulse was confirmed. The operator instructs that the patient who is laid supine in bed, to be transferred to the floor and for compressions to be initiated. In the meantime, a Primary Care Paramedic (PCP) crew is dispatched code 4 for a VSA patient and arrives on scene within 8 minutes. The PCP confirms an absent pulse and initiates cardiac arrest protocols. As per the BLS Cardiac Arrest Standard, CPR was administered with 3 defibrillations. On the third analysis, a King-LT was inserted to establish a more patent airway and in preparation for transport. On the fourth analysis, patient had return of spontaneous circulation (ROSC) with a strong, regular pulse at 88bpm however remained unconscious. Rescue breaths were initiated, patient was loaded onto the stretcher with head elevated at 30°, and transported to the hospital as CTAS 1. Upon hospital admission, patient had normal sinus rhythm at 90bpm, blood pressure of 104/59mmHg and GCS 4 (E1, V2, M1). Within 2 hours of ROSC, patient remained in a deep coma and was sedated with midazolam and fentanyl infusion prior to mechanical ventilation. Preparations for targeted temperature management (TTM) was made, as cold saline was administered into the femoral vein via an IV, and cooled ice packs were placed on larger areas of the body. After 3 hours of ROSC, patient's body temperature reached 33° with it maintained for 24 hours prior to the rewarming process.

Background

Most out-of-hospital cardiac arrest (OHCA) patients with ROSC, exhibit neurological deficits upon recovery from a comatose state. Such deficit results when a lack of oxygenated blood perfuses to the brain when the patient is in cardiac arrest. In an effort to understand how these neurological deficits can be mitigated, researchers compared normothermia and induced hypothermia in OHCA patients, to determine which method would yield better neurological outcomes. Patient neurological outcome must be documented and compared at discharge, to determine which method yielded less neurological deficits. The research papers below, will examine these outcomes in further detail.

Review question

In comparison to normothermia, does therapeutic hypothermia improve survival and neurological outcomes in OHCA patients?

Search strategy Academic Search Ultimate: [(hypothermia) AND (cardiac arrest)]

Search strategy MedLine: [(cardiac arrest patient) AND (hypothermia) AND (neurological outcome)] OR [(cardiac arrest) AND (hypothermia)] OR [(comatose cardiac arrest patient) AND (hypothermia) AND (neurological outcome)] OR [(comatose cardiac arrest patient) AND (hypothermia)]

Limits: 5 years, Linked Full Text, English Language

Databases searched: Academic Search Ultimate, MedLine

Search results: 207 results (Academic Search Ultimate: 175, MedLine: 32)

Included for review: 3 papers were relevant to this CAT, as patient neurological outcome at hospital discharge served as a comparable factor.

Title, author, year	Study design & LOE	Population	Intervention	Outcomes	Results	Weaknesses & Strengths
<p>Title Observed survival benefit of mild therapeutic hypothermia reanalysing the Circulation Improving Resuscitation Care trial</p> <p>Author(s) Nürnberg, Herkner, Sterz, Olsen, Lozano Jr, van Grunsven, Lerner, Persse, Malzer, Brouwer, Westfall, Souders, Travis, Herken & Wik</p> <p>Year 2017</p>	<p>Cohort study LOE 2</p>	<p>Inclusion OHCA patients who required ≥ 60 seconds for return of spontaneous circulation (ROSC).</p> <p>Exclusion Excluded from the study were patients presumed to be pregnant, possess a DNR order, prisoner or state ward.</p> <hr/> <p>n=4,231 OHCA patients</p> <p>263 OHCA patients with ROSC received in and out-of-hospital TTM.</p> <p>230 OHCA patients with ROSC received in-hospital TTM.</p> <p>357 OHCA patients with ROSC did not receive TTM.</p>	<p>TTM of 33° ($\pm 1^\circ$) was quickly provided to OHCA patients with ROSC and absent neurological status for a duration of 24 hours. Cooling methods included: ice packs, cold fluids via IV, cooling pads, surface and/or endovascular cooling.</p>	<p>Survival of comatose cardiac arrest patients with returned neurological status upon discharge from hospital.</p>	<p>37% (n=98) of patients treated with in and out-of-hospital TTM were discharged from hospital.</p> <p>34% (n=80) of patients treated with in-hospital TTM were discharged from hospital.</p> <p>19% (n=68) of patients not treated with TTM were discharged from hospital.</p> <p>Conclusion Comatose cardiac arrest patients treated with TTM (36%) demonstrated better survival and neurological outcomes than those without TTM (19%).</p>	<p>+ Randomization of participants ensured no selection bias existed + Large, strong study size</p> <p>- Optimal time for TTM administration was not considered, which can affect neurological outcome - Financial conflict of interest existed, as hospitals were sponsored to participate</p>

Title, author, year	Study design & LOE	Population	Intervention	Outcomes	Results	Weaknesses & Strengths
<p>Title The influence of therapeutic hypothermia on the outcomes of cardiac arrest survivors: a retrospective cohort study</p> <p>Author(s) Pavlov, Babić, Đuzel, Crljenko, Nedić & Brkljačić</p> <p>Year 2020</p>	<p>Case control study LOE 1</p>	<p>Inclusion OHCA patient—cardiac arrest cannot be witnessed by healthcare professional, with ROSC and Glasgow Coma Scale (GCS)<8 upon admission to ICU.</p> <p>Exclusion OHCA patient pronounced dead in ED with no ROSC.</p> <hr/> <p>n=152 OHCA patients</p> <p>35 OHCA patients with ROSC and GCS 3 received TTM via analgosedation.</p> <p>35 OHCA patients with ROSC and 3≤GCS≤15, did not receive TTM.</p>	<p>TTM of 33° (±1°) was provided within 6 hours of OHCA. Cooling methods included: 2000mL of cold saline injected in femoral vein and ice packs on large surface areas of the body for a duration of 24 hours.</p>	<p>OHCA patient with improved neurological outcome—Cerebral Performance Category (CPC)≤2, upon discharge from hospital.</p>	<p>48.5% (n=17, GCS=3) of ROSC patients with TTM, demonstrated improved neurological outcome at discharge (CPC≤2).</p> <p>34.3% (n=12, 3≤GCS≤15) of ROSC patients with no TTM, exhibited improved neurological outcome at discharge (CPC≤2).</p> <p>Conclusion OHCA patients with TTM, demonstrated improved neurological outcome—an initial GCS≤3 to a CPC≤2 at discharge, compared to patients with no TTM.</p>	<ul style="list-style-type: none"> + Variables and procedures for TTM was extremely controlled, which ensured consistency + No conflict of interest existed - Small sample size can result in an unreliable conclusion - Despite large data collection period, study was limited to 2 cooling methods which resulted in newer and more effective methods to be excluded from the study

<p>Title Targeted temperature management after out-of-hospital cardiac arrest in three young patients</p> <p>Author(s) Godinjak, Iglica, Kukuljac, Tančica, Jusufović, Ajanović & Rožajac</p> <p>Year 2017</p>	<p>Case report LOE 3</p>	<p>Case Report 1 24-year-old male suddenly collapsed during a lecture and bystander CPR was immediately initiated. 35 minutes into CPR, patient had ROSC. Upon admission patient was unconscious with GCS 6 (E1, V1, M3).</p> <p>Case Report 2 26-year-old male found unconscious and pulseless after a party. In-hospital CPR was initiated, with ROSC after 35 minutes of compressions. Patient in deep coma with GCS 3 (E1, V1, M1) upon admission.</p> <p>Case Report 3 23-year-old female suddenly collapsed during dinner. Bystander CPR was initiated with ROSC achieved after 25 minutes of compressions. Patient was in a coma with GCS 4 (E2, V1, M1) upon MICU admission.</p>	<p>Case Report 1 Sedated and mechanically ventilated patient before TTM. Analgosedation, cold saline, proton pump inhibitor and anticoagulant administered via IV within 2 hours of ROSC. Within 4 hours, achieved TTM of 33°.</p> <p>Case Report 2 Sedated and mechanically ventilated patient before TTM. Cold saline, proton pump inhibitor, antibiotics and anticoagulant were administered via IV within 3 hours of ROSC. Within 6 hours, achieved TTM of 33°.</p> <p>Case Report 3 Sedated and mechanically ventilated patient before TTM. Analgosedation, cold saline, antibiotics, anticoagulants and anti-arrhythmics administered within 2 hours of ROSC. Within 6 hours, achieved TTM of 33°.</p>	<p>OHCA patients who regained consciousness and were fully recovered upon discharge from hospital.</p>	<p>Case Report 1 Next day, patient regained partial consciousness after TTM was completed. After full recovery, patient was discharged from hospital with the origin of OHCA being Wolff-Parkinson-White syndrome.</p> <p>Case Report 2 Next day, patient regained full consciousness after TTM was completed. With aggressive medication and treatment, patient was discharged from hospital as fully recovered. Origin of OHCA was drug overdose.</p> <p>Case Report 3 Next day, patient regained full consciousness with no neurological deficits. After full recovery, patient was discharged from hospital with the origin of OHCA as prolonged QT-interval.</p> <p>Conclusion The 3 OHCA patients who received TTM regained full consciousness with no presumed neurological deficits at discharge.</p>	<ul style="list-style-type: none"> + Good case reports that examined OHCA to post-TTM in detail + Identified mechanism of injury - Neurological outcome was solely dependent on successful recovery of consciousness and discharged from hospital - Limited cooling methods were used for TTM
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Comments:

The final paper contained multiple case reports of patient neurological outcome at discharge. Even though TTM was reported to reduce neurological deficits in OHCA patients, no CPC measurement was collected, which made it difficult to determine how effective TTM was in various cardiac arrest patients. The measurement of full recovery and successful discharged, were not sufficient to assess patient neurological outcome.

Considerations:

Even though research supported the administration of hypothermia on OHCA patients, the sample size served as a limitation to this CAT. The small sample size and inconsistency in treatment—for instance, utilized cooling methods and optimal time to induce hypothermia after ROSC, made it difficult to determine the validity of the research results. Moreover, a standard method was not adopted for comparison purposes, of the patient's neurological status at admission and discharge, which made it difficult to determine the effectiveness of each treatment. A more defined scale such as GCS at admission, and CPC at discharge, should be used to obtain an accurate depiction of improvements in neurological outcome for TTM in OHCA patients.

Clinical bottom line:

Although evidence suggests hypothermia is more effective than normothermia to reduce neurological deficits in OHCA patients, more controlled trials and research must be completed with a larger sample size to understand the level of effectiveness and complications associated with such treatment. However, with current research and case reports, it can be concluded that therapeutic hypothermia can effectively reduce neurological deficits in OHCA patients.

References

- Godinjak, A., Igllica, A., Kukulijac, A., Tančica, I., Jusufović, S., Ajanović, A., & Rožajac, Š. (2017). Targeted temperature management after out-of-hospital cardiac arrest in three young patients. *Acta Medica Academica*, 46(1), 50-54. doi:10.5644/ama2006-124.186
- Nurnberger, A., Herkner, H., Sterz, F., Olsen, J., Lozano Jr, M., Van Grunsven, P. M., . . . Wik, L. (2017). Observed survival benefit of mild therapeutic hypothermia reanalysing the Circulation Improving Resuscitation Care trial. *European Journal of Clinical Investigation*, 47(6), 439-446. doi:10.1111/eci.12759
- Pavlov, M., Babić, Z., Đuzel, A., Crljenko, K., Nedić, M., & Brkljačić, D. D. (2020). The influence of therapeutic hypothermia on the outcomes of cardiac arrest survivors: A retrospective cohort study. *Croatian Medical Journal*, 61, 40-48. doi:https://doi.org/10.3325/cmj.2020.61.40