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The Neuroprotective Effects of Targeted Temperature Management in Post Cardiac Arrest Patients

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Abstract

Introduction

- Novel methods of ensuring survival following cardiac arrest and resuscitation are of supreme importance to the medical community.
- Targeted temperature management (TTM) has been increasingly utilized pre-hospital, in emergency departments, and within intensive care units in an effort to improve survival outcomes from cardiac arrest. Although these efforts have resulted in improved outcomes, several unanswered questions remain.

Methods

- To acquire relevant research PubMed, Clinical Key, Cochrane review and Cochrane Database were utilized.

Search terms included: targeted temperature management, therapeutic hypothermia, cardiac arrest, return of spontaneous circulation (ROSC) and temperature. The trials were used in several combinations to obtain appropriate research materials.

- Dynamic and the American Heart Association (AHA) were further assessed before recommendations on patient selection, implementation, and methodology behind TTM.

- Studies were only included in adult cardiac arrest (OHCA) as well as out-of-hospital cardiac arrest (OHCA) were included to assess the use of TTM pre-hospital. Furthermore, TTM use in pediatric patients as well as in unstable and non-shockable rhythms was assessed through literature review.

Literature Review

- Pathophysiology
  - Fan et al. (2017) utilized a rat model to show increased DRP-1 and CYT-C as a result of temperature manipulation. Good neurological outcome is 8.5% (Buck et al., 2018).
  - Targeted temperature management has become a mainstay within hospital systems to improve neurological function in patients after cardiac arrest.
  - Proponents further suggest that implementation improves survival to hospital discharge.
  - Temperature-regulated neuroprotection mechanism, improvements in survival and neurological function, and recommendations for implementation were assessed through literature review.

Statement of Problem

- Targeted temperature management is a poorly understood intervention. It is believed to confer benefit to survival and neurological outcome, though the mechanism is still under research. The magnitude of potential benefit to survival and neurological functioning also remains under scrutiny. Finally, the method of TTM induction remains poorly standardized. Assessment into the methods and procedures of several studies may yield further information on efficacious and effective method to confer the greatest benefit to survival and neurological function.

Research Questions

- By what proposed mechanisms does targeted temperature management improve survivability and neurological functioning following cardiac arrest and resuscitation efforts?
- Do studies evaluating the benefit of targeted temperature management demonstrate statistically significant improvements in survival to hospital discharge as well as improvements in cognitive function following resuscitation?
- What is the current agreed upon method of inducing targeted temperature management and what is its ease of implementation?

Discussion

- Animal studies performed by Fan et al. (2017) and Chan et al. (2017) demonstrate inhibition of mitochondrial induced cellular apoptosis through alteration of mediators of mitochondrial pore opening such as CYT-C, DRP-1, and ROS.
- Pathways and mechanisms involved in cardiac arrest (OHCA) were assessed to provide a backdrop for further investigation.
- Further protection is offered due to the increase in anti-apoptotic factors such as Bcl-2. This interferes with neuronal apoptosis as well as ensuring the continued function of microvascular endothelium.
- As a result, further injury due to damage to the BBB and subsequent free radical damage and cerebral edema was prevented.
- There is a clear benefit to survival and neurological recovery when TTM is applied to adults undergoing OHCA and OHCA with an initially shockable rhythm.

Clinic Applicability

- TTM is most effectively accomplished by rapidly decreasing core body temperature to 32-36 degrees Celsius, though fever and shivering are managed accordingly. For TTM to be safe and effective, several factors need to be considered. As such, a modified approach to TTM may be safer and require fewer interventions such as antipyretics and sedation.
- Dexamethasone may improve cerebral circulation following ROSC with non-shockable rhythms or following IHCA. Core body temperature should be decreased to 32-34 degrees Celsius and maintained for 24 hours.
- The AHA does not currently endorse routine pre-hospital cooling methods.
- TTM can be readily applied in rural ER practice and maintained for transport to a higher level of care by EMS, decreasing the time to therapeutic effect.

- An endovascular, epiaortic, bladder or rectal temperature probe should be placed for continuous core temperature monitoring.

Acknowledgements

- A Randomized, Double Blinded, Double Dummy, Clinical Trial. Mild Therapeutic Hypothermia Reanalyzing the Circulation Improving Resuscitation Care Trial. Reduces Oxidative Damage and Alters Antioxidant Defenses After Cardiac Arrest. Cardiac Arrest Patients. A Randomized, Double Blinded, Double Dummy, Clinical Trial.

References