Rewarming from severe accidental hypothermic cardiac arrest with ECMO vs. traditional heart-lung machine: A systematic review and meta-analysis

Proposed chapters - and under-chapters

Abstract

Background

• Methods
• Results
• Comments

Introduction

• Definition of accidental hypothermia (AH) on the basis of core temperature
  – We use the most comprehensive terms, mild – moderate and severe AH, not the numeric stages published by some authors.

• Etiology and epidemiology of AH
  – Emphasize that AH is not only a problem for the underprivileged, poor people and those addicted to drug – and alcohol abuse, but also affects athletes involved in a variety of sports activities.

• Pathophysiology of AH
  – Respiratory changes
    • Possible to breathe while being cooled?
    • Breath-hold due to laryngospasm
    • Submersion or suffocation
  – Circulatory changes
    • Microvascular changes
    • Myocardial changes
    • Presence/absence of a “diving response”
    • Is there an initial “diving response” in victims of submersion or suffocation?

• Metabolic changes
  • Overall metabolic effect of an initial “diving response”. Is it useful, and is it possible to make an estimation of the overall benefits?
• Effect on cerebral oxygenation and function of an initial “diving response”.

• Blood coagulation/fibrinolysis and AH - interaction between blood – and membrane surfaces during rewarming
  • Effects of hypothermia on platelets
  • Effects of hypothermia on coagulation
  • Effects of hypothermia on fibrinolysis

• What do we know about AH in association with:
  – Liver function
  – Renal function
  – Water – and electrolytes
  – Acid-base changes
  – Immune system

Methods

Systematic literature review announced on PROSPERO. Approval by Committee on Human Research Ethics not required.

Inclusion criteria:

Limited to both case reports and observational studies published in international peer reviewed journals of patients with cardiac arrest due to accidental hypothermia (AH) at core body temperatures < 35 degrees.

Eligible for the study are all reports assessable on Medline and Google of patients with hypothermic cardiac arrest due to all etiologies such as drowning, near-drowning, burial by avalanches, intoxication, major trauma and sea transport accidents that are being exposed to cold surroundings and re-warmed on Extracorporeal circulation (ECMO or heart-lung machine) and at least, with an abstract in English.

Exclusion criteria:

Hypothermic patients with maintained circulation. Patients with hypothermic cardiac arrest secondary to terminal stage of malignant disease, serum potassium > 12 mmol/L [4].

(Schaller et al. JAMA 1990; 264(14):1842---1845.

Primary outcomes: Patients found with – and/or arriving to hospital with hypothermic cardiac arrest and discharged from hospital alive

Secondary outcomes: Days in hospital. Functional neurologic outcome at discharge, and/or at last follow-up

Methods will present a Consort diagram with an overview of the included literature on rewarming from accidental hypothermia in human encompassing all subgroups of articles, distinguishing between case reports, observational studies and review articles.
Results

Treatment of AH with cardiac arrest

– Heart-Lung Resuscitation (HLR) at the site of accident
– HLR during transfer to center for extracorporeal circulation
– Extracorporeal circulation (ECC) with heart-lung machine or ECMO team transferred by air-or car ambulance to the site of accident. Patient is subsequently transported on ECC to center for open heart surgery
– ECC for hypothermic cardiac arrest established at a local hospital
– Patients rewarmed on ECMO
– Patients rewarmed on heart-lung machine
– Comparison of outcomes of the two rewarming techniques with regard to 30-Day survival, survival at discharge from hospital and neurological outcome
– Fluid therapy during rewarming and transfer

Monitoring during re-warming and transfer

• Core temperatures (esophagus, bladder, central venous blood)
• Standard monitoring (ECG, Pulse oximetry, arterial blood pressure)
• Transesophageal echocardiography

Discussion

• **First paragraph**: Summarizing the main findings of the review and meta-analysis subsequently followed by a discussion of our findings in the light of existing knowledge. What is new in the present study as compared to similar studies from the last two decades or recently? What differs when comparing with these studies?

• **Hypothermic cardiac arrest chain of survival**
  • Impact of modern logistics. What role plays a well equipped - and staffed dispatch center? Is it reasonable to compare between centers known from the literature, either referred to in specific studies, or centers that have known (published) guidelines for handling victims of hypothermic cardiac arrest? What do we know about telecommunication possibilities - with the site of accident, - with the local hospital?
  • Possibilities for real-time video-conferences including high resolution live pictures and biological variables.
  • If one method of rewarming seems superior to another, f. example, if there is a statistically significant difference in outcome variables between those rewarmed on heart-lung machine as compared with those rewarmed on ECMO, the reviewers will be discussing the most likely reasons.

• **Strengths of the study**
• Advantage with rapidly increasing numbers of successful resuscitations by means of extracorporeal circulation, both of normothermic and hypothermic individuals. How successful is resuscitation of previously healthy victims of hypothermic cardiac arrest in comparison with those resuscitated from normothermic cardiac arrest? The influence on the results of comorbidities.

• **Limitations of the study**
  • Many confounding factors because patients in both observational studies and case reports have been differently treated. Therefore, we will try to limit the groups to patients treated as uniformly as possible, which means that we must establish a checklist with items we will be emphasizing. If essential items are lacking, the article is not eligible for inclusion.

• **Summary**
  • Main significant findings in terms of survival and neurological outcomes. Did we demonstrate any different effects on outcome depending on type of re-warming or adjunct therapies?

On behalf of The task force in treatment of accidental hypothermic cardiac arrest

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Lars J. Bjertnaes

Professor Dr. Med.

Contact person