

Therapeutic hypothermia: the coolest part of the bundle of post-cardiac arrest care

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Organised post-cardiac arrest care targeting cardiovascular and neurological outcomes can improve survival to hospital discharge among victims who achieve return of spontaneous circulation (ROSC) after cardiac arrest. A recent international resuscitation review and consensus process has searched the published evidence to determine the impact of therapeutic hypothermia on morbidity and mortality in the context of patients with ROSC after cardiac arrest. Therapeutic hypothermia forms an integral element of this “bundle of care” that has been shown independently to improve outcome after adult witnessed out-of-hospital ventricular fibrillation (VF) cardiac arrest, and after neonatal hypoxic-ischaemic insult. Furthermore, two recent non-randomised studies have shown the possible benefit of hypothermia after cardiac arrest from other initial rhythms in hospital and out of hospital, with further studies with historic controls also showing benefit for therapeutic hypothermia after out-of-hospital, all-rhythm adult cardiac arrests.

Therapeutic hypothermia (33.5–34.5°C) up to 72 hours after resuscitation in newborns with birth asphyxia has demonstrated a reasonable safety profile and better survival and long-term neurological outcome. However, retrospective studies of children following cardiac arrest have failed to demonstrate the benefit of therapeutic hypothermia, but research continues in this area.

Who to cool?

The current International Committee on Resuscitation (ILCOR) Consensus on Science and Treatment Recommendations document points out that to date, all studies looking at post-cardiac arrest

therapeutic hypothermia have included only patients in coma, which has been defined in one study as “not responding to verbal commands”. Other trials used the Glasgow Coma Score (GCS) ≤ 8 , or did not provide a clear definition. Improved neurological outcome at hospital discharge or at six months after hospital discharge has been demonstrated in comatose patients after out-of-hospital VF cardiac arrest. Cooling was initiated within minutes to hours after ROSC, and a temperature range of 32–34 °C was maintained for 12–24 hours. Two studies with historical control groups showed improvement in neurological outcome after therapeutic hypothermia for comatose survivors of VF cardiac arrest, while one systematic review demonstrated that conventional cooling methods were more likely to reach a best cerebral performance category score of one or two and more likely to survive to hospital discharge compared with standard postresuscitation care.

Six studies with historical control groups showed the benefit of using therapeutic hypothermia in comatose survivors of out-of-hospital cardiac arrest after all-rhythm arrests. One study with historical controls showed better neurological outcome after VF cardiac arrest, but no difference after cardiac arrest from other rhythms. Two non-randomised studies with concurrent controls indicated the possible benefit of hypothermia following cardiac arrest from other initial rhythms in and out of hospital. One registry study, which included almost 1 000 cooled comatose patients following cardiac arrest from all rhythms, showed that survival with good outcome at six months was 56% after initial ventricular tachycardia (VT)/VF, 21% after initial asystole, and 23% after initial pulseless electrical activity (PEA).

How to cool?

Several methods have been reported in the literature. Many studies suggest that cooling could be safely initiated with intravenous (IV) ice-cold fluids (30 mL/kg of saline 0.9% or Ringer's Lactate), even started in the pre-hospital phase. The use of an intravascular heat exchanger to induce and maintain hypothermia has been widely described, as has been the use of ice packs and either water- or air-circulating blankets. Seven studies have documented the use of ice packs (sometimes combined with wet towels) alone to induce and maintain hypothermia, and a further seven accounts of the use of cooling blankets or pads alone have been reported. Water-circulating, gel-coated pads, cold air tents and cooling helmets have all been tried to induce and maintain hypothermia post ROSC. In one registry study, cooling was maintained with ice packs (17%), air cooling (8%), circulating water blankets (63%), an intravascular cooling device (16%), and other methods (8%).

When to cool?

One registry-based case series of 986 comatose post-cardiac arrest patients suggested that time to initiation of cooling (median 90 min; interquartile range [IQR] 60-165 min) was not associated with improved neurological outcome post discharge. A case series of 49 consecutive comatose post-cardiac arrest patients who were intravascularly cooled after out-of-hospital cardiac arrest also documented that time-to-target temperature (median 6.8 hr; IQR 4.5-9.2 hr) was not an independent predictor of neurological outcome.

Five studies have indicated that the combination of therapeutic hypothermia and percutaneous coronary intervention (PCI) is feasible and safe after cardiac arrest caused by acute myocardial infarction.

ILCOR CoSTR Treatment Recommendation

Comatose adult patients (not responding in a meaningful way to verbal commands) with spontaneous circulation after out-of-hospital VF cardiac arrest should be cooled to 32-34 °C for 12-24 hours.

Induced hypothermia might also benefit comatose adult patients with spontaneous circulation after out-of-hospital cardiac arrest from a non-shockable rhythm, or cardiac arrest in hospital. Rapid infusion of ice-cold IV fluid 30 mL/kg or ice packs are feasible, safe, and simple methods for initially lowering core temperature up to 1.5 °C. When IV fluids are used to induce hypothermia, additional cooling strategies will be required to maintain hypothermia.

Limited available evidence suggests that PCI during therapeutic hypothermia is feasible and safe and may be associated with improved outcome.

Knowledge gaps

Although the data support cooling to 32-34 °C, optimal temperature has not been determined. Furthermore, the optimal method, onset, duration, rewarming rate, and therapeutic window remain unknown. Further investigation is also needed to determine the benefit of post-cardiac arrest therapeutic hypothermia after non-shockable cardiac arrest, in-hospital cardiac arrest, and in children. Epidemiological and safety data would help describe the safety and adversity when cooling is interrupted across the system of care. Clinical and cost comparisons are required of the methods used for inducing and maintaining therapeutic hypothermia in and out of hospital. The safety and efficacy of therapeutic hypothermia during cardiac arrest resuscitation needs to be explored through controlled clinical trials.

Prognostication

Many studies have recently attempted to identify comatose post-cardiac arrest patients who have no prospects of good neurological recovery, and it is now recognised that the use of therapeutic hypothermia invalidates the prognostication decision criteria that were established before hypothermia therapy was implemented. Recent studies have documented occasional good outcomes in patients who would previously have met criteria predicting poor outcome (Cerebral Performance Category 3, 4, or 5). There is inadequate evidence to recommend a specific approach to predicting poor outcome in post-cardiac arrest patients treated with therapeutic hypothermia.

Implementation: translation of science into survival

The best scientific evidence for resuscitation interventions will have little impact on patient outcomes if it is not effectively translated into clinical practice. Successful implementation is dependent on effective educational strategies to ensure that resuscitation providers have the necessary knowledge and skills in combination with the necessary infrastructure and resources. Institutions or communities planning to implement complex guidelines, such as therapeutic hypothermia, should consider using a comprehensive, multi-faceted approach. This includes clinical champions, a consensus-building process, multidisciplinary involvement, formal written protocols with detailed process description, practical logistic support, multimodality and multilevel education and rapid cycle improvement methods.

Primary reference

2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation. 2010;81Suppl. (Full CoSTR document available free of charge at www.heart.org/cpr/)