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Therapeutic Hypothermia after Cardiac Arrest. ARC and NZRC Guideline 2010

Australian Resuscitation Council, New Zealand Resuscitation Council

Background

Induced hypothermia has been successfully used during cardiac surgery to protect against global cerebral ischaemia. Its use has been described in other clinical settings since the 1950s, particularly following cardiac arrest. Several animal and human studies have demonstrated the potential for therapeutic hypothermia to improve survival and neurological outcome in victims of cardiac arrest.

Who to cool?

All studies of post-cardiac arrest therapeutic hypothermia have included only patients in coma. One trial defined coma as "not responding to verbal commands". The other trials defined coma similarly, used GCS ≤8, or did not provide a clear definition.[1]

One randomized trial[2] and a pseudo-randomised trial[3] demonstrated improved neurological outcome at hospital discharge or at 6 months after hospital discharge in comatose patients after out-of-hospital ventricular fibrillation cardiac arrest. Cooling was initiated within minutes to hours after return of spontaneous circulation 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 ventricular fibrillation cardiac arrest. One systematic review demonstrated that conventional cooling methods were more likely to reach a best cerebral performance category score of 1 or 2 (five point scale where one is good and five is brain death) with a relative risk of 1.55 995% CI 1.22–1.96) and more likely to survive to hospital discharge (relative risk of 1.35 95% CI 1.1 to 1.65) compared with standard post resuscitation care.[4]

One small (n = 30) randomized trial showed reduced plasma lactate values and oxygen extraction ratios in a group (n = 16) of comatose survivors after cardiac arrest with asystole or pulseless electrical activity who were cooled with a cooling cap.[5]

Six studies with historical control groups showed benefit 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 ventricular fibrillation cardiac arrest but no difference after cardiac arrest from other rhythms. Two non-randomised studies with concurrent controls indicated possible benefit of hypothermia following cardiac arrest from other initial rhythms in- and out-of-hospital.[6,7]

One registry study that included almost 1000 cooled comatose patients following cardiac arrest from all rhythms, the survival with good outcome at six months was 56% after initial VT/VF, 21% after initial asystole and 23% after initial PEA.[1]

How to cool?

Nineteen studies indicated that cooling could be initiated safely with intravenous ice-cold fluids (30 ml/kg of saline 0.9% or Ringer's lactate).[1] Six studies indicated that cooling with IV cold saline could be initiated in the prehospital phase.[1] Thirteen studies documented the use of an intravascular heat exchanger to induce and maintain hypothermia.[1] Twelve studies documented the use of ice packs and either water or air circulating blankets to induce and maintain hypothermia.[1]

Seven studies documented the use of ice packs (sometimes combined with wet towels) alone to induce and maintain hypothermia. Four studies documented the use of ice packs alone to maintain hypothermia. Seven studies documented the use of cooling blankets or pads alone to induce and maintain hypothermia.[1] Eight studies documented the use of water circulating gel-coated pads to induce and maintain, or just maintain, hypothermia.[1]

One randomized controlled trial used a cold air tent and another used a cooling helmet to induce and maintain hypothermia. 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%).[1]

Studies that documented improved outcome with therapeutic hypothermia after cardiac arrest used continuous temperature monitoring.[1]Shivering may necessitate sedation and intermittent or continuous neuromuscular blockade. Use of continuous neuromuscular blockade could mask seizure activity.[1]

When to cool?

One registry-based case series of 986 comatose post-cardiac arrest patients suggested that time to initiation cooling (median 90 min; interquartile range 60–165 min) was not associated with improved neurological outcome post discharge.[8]

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 hours [IQR 4.5 to 9.2 hours]) was not an independent predictor of neurologic outcome.[9]

Safety with Percutaneous Coronary Intervention?

Five studies indicate that the combination of therapeutic hypothermia and primary percutaneous intervention was feasible and safe after cardiac arrest caused by acute myocardial infarction.[1]

Treatment recommendations

Comatose adult patients (not responding in a meaningful way to verbal commands) with spontaneous circulation after out-of-hospital ventricular fibrillation cardiac arrest should be cooled to 32–34°C for 12–24 hours.[1] [Class A; LOE 1]

Induced hypothermia might also benefit comatose adult patients with spontaneous circulation after out-of-hospital cardiac arrest from a nonshockable rhythm, or cardiac arrest in hospital.[1] [Class B; LOE III-2]

The vast majority of the patients studied with induced hypothermia were from cardiac arrests due to presumed cardiac causes. Despite the fact that no studies specifically addressed cardiac arrests due to non-cardiac causes, it is reasonable to assume that these patients might also benefit from induced hypothermia. [Class B; Expert consensus opinion]

Rapid infusion of ice-cold intravenous fluid 30 ml kg-1 or ice packs are feasible, safe and simple methods for initially lowering core temperature up to 1.5 degrees. When intravenous fluids are used to induce hypothermia additional cooling strategies will be required to maintain hypothermia.[1][Class B; LOE III-3, IV]

Limited available evidence suggests that percutaneous coronary intervention during therapeutic hypothermia is feasible and safe and may be associated with improved outcome.[1][Class B; LOE III-3, IV]

Institutions or communities planning to implement complex guidelines, such as therapeutic hypothermia, should consider using a comprehensive, multifaceted approach, including: clinical champions; a consensus-building process; multidisciplinary involvement; written protocols; detailed process description; practical logistic support; multi-modality, multi-level education; and rapid cycle improvement methods.[10] [Class B; Expert consensus opinion]

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