Therapeutic hypothermia after cardiac arrest

Hypothermia is now standard care for some types of cardiac arrest

Out-of-hospital cardiac arrest is a leading cause of unexpected death in the developed world, occurring in about 1 in 1500 adults each year.[1] Successful recovery from out-of-hospital cardiac arrest depends on the rapid activation of the "chain of survival": an immediate call to the ambulance service, bystander delivery of external cardiac massage and expired-air breathing, defibrillation and the provision of advanced life support by paramedics.[2]

Unfortunately, survival with good neurological outcome at hospital discharge is rare after out-of-hospital cardiac arrest. Studies in Perth and Melbourne show that less than 5% of these patients survive to hospital discharge.[3,4] As the average response time of ambulances in most Australian cities is between 7 and 12 minutes, considerable neurological injury occurs during this prolonged period of cardiac arrest, even with bystander cardiopulmonary resuscitation. While paramedics may restore spontaneous circulation and transport some patients alive to an emergency department, most remain comatose because of the severe anoxic brain injury.[4]

To improve outcome, considerable emphasis has been placed on shortening the time between cardiac arrest and defibrillation. As decreasing ambulance response times towards 5 minutes would be prohibitively expensive, alternative approaches to earlier defibrillation have been proposed. These include fire-fighters co-responding with ambulance services to patients with suspected cardiac arrest,[5] or installation of automatic defibrillators in public places.[6] On the other hand, recent data from Canada have cast doubt on the effectiveness of paramedic advanced life-support programs, which did not improve survival rates when introduced.[7]

What therapies are available after arrival at the hospital? In most cases, no immediate cardiology intervention is required, and treatment has therefore been largely supportive until the neurological outcome could be determined. Common intensive care practice has been to defer neurological assessment for at least 3 days, to allow more accurate clinical assessment.[8]

Recently, an "old" therapy for anoxic brain injury — therapeutic hypothermia — has been re-introduced into clinical practice. In this issue of the Journal, Williamson and colleagues (*page 500*) describe the use of this therapy in a patient who was comatose after near-drowning.[9] The use of mild therapeutic hypothermia after cardiac arrest was first described in the 1950s, but later abandoned without being formally tested in clinical trials.[10] Interest in hypothermia was revived in the early 1990s when animal studies and preliminary clinical studies suggested benefit. Subsequently, two prospective, randomised, controlled clinical trials have been conducted.[11,12]

In a recent Australian trial, patients who remained comatose after resuscitation from out-of-hospital cardiac arrest were treated with either 12 hours of therapeutic hypothermia (33°C) or standard care.[11] At hospital discharge, 49% of those treated with hypothermia were discharged home or to rehabilitation, compared with 24% of those treated with standard care. In a European study, 55% of patients treated with hypothermia (33°C for 24 hours) had a favourable outcome at 6 months, compared with 39% of those treated with standard care.[12] Subsequently, the International Liaison Committee on Resuscitation (which includes the Australian Resuscitation Council) endorsed the use of therapeutic hypothermia for patients with anoxic brain injury after out-of-hospital cardiac arrest, particularly when the initial cardiac rhythm is ventricular fibrillation (Box).[13] Therefore, this treatment should now be regarded as a standard of care for this condition.

Recommendations on therapeutic hypothermia from the International Liaison Committee on Resuscitation

In October 2002, the Advanced Life Support Task Force of the International Liaison Committee on Resuscitation recommended:

- Unconscious adult patients with spontaneous circulation after out-of-hospital cardiac arrest should be cooled to 32°C–34°C for 12–24 hours when the initial rhythm was ventricular fibrillation.
- Such cooling may also be beneficial for other rhythms or in-hospital cardiac arrest.
- Preliminary data from clinical trials of perinatal asphyxia indicate that induced hypothermia is feasible and safe, but data on long-term neurological morbidity are not yet available.
- Until additional paediatric data become available, clinicians should tailor therapy for individual patients based on their assessment of the risks and benefits of hypothermia.

However, a number of issues require further consideration if therapeutic hypothermia is to be applied more widely. Firstly, uncertainty remains about the effectiveness of this therapy in patients with out-of-hospital cardiac arrest due to causes other than ventricular fibrillation. Patients with asystolic out-of-hospital cardiac arrest have a dismal prognosis,[14] as do those with coma after near-drowning, hanging, or other causes of asphyxia. Clinical data on the effects of therapeutic hypothermia in these groups are lacking. The role that therapeutic hypothermia played in the recovery of the patient reported by Williamson and colleagues is uncertain.

Secondly, a protocol needs to be established in the emergency department for the rapid induction of hypothermia in patients who are unconscious after out-of-hospital cardiac arrest. In most hospitals, this will require consensus to be reached between emergency physicians, intensive care physicians and cardiologists on the indications for the provision of this treatment.

Finally, there are technical issues to be considered in the rapid induction of hypothermia. In previous studies, hypothermia was induced through surface cooling with ice packs and/or refrigerated air blankets.[11,12] This approach is slow and logistically difficult in busy emergency departments. Other technologies for the rapid induction of hypothermia are therefore under investigation.[10] Currently, we are exploring the use of a rapid intravenous infusion of large-volume (30 mL/kg), ice-cold crystalloid fluid to induce hypothermia. Preliminary data suggest that this is relatively simple, effective, inexpensive and not associated with pulmonary complications.[15]

As there is often a delay between resuscitation and emergency department initiation of hypothermia, cooling in the ambulance would be ideal. In a study supported by the National Heart Foundation, paramedics in Melbourne are now infusing large-volume (2000 mL), ice-cold crystalloid fluid, together with a muscle relaxant, immediately after out-of-hospital cardiac arrest to induce hypothermia as soon as possible after resuscitation. If this is confirmed as feasible, further studies are planned which will examine the use of therapeutic hypothermia after asystolic and asphyxial cardiac arrest.

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