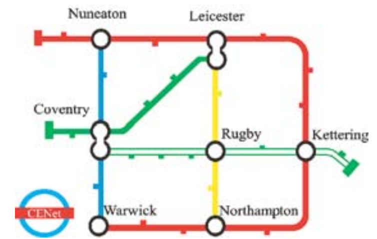

Central England Network

Therapeutic Hypothermia Following Adult Cardiac Arrest

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THERAPEUTIC HYPOTHERMIA FOLLOWING ADULT CARDIAC ARREST

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1.0 Introduction

The UK Resuscitation Council 'Guidelines for Resuscitation' (2005), the ILCOR Advisory Statement (2003) and the Intensive Care Society 'Standards for the Management of Patients After Cardiac Arrest' (2008) recommend the use of therapeutic hypothermia in selected patients who remain neurologically unresponsive on return of spontaneous circulation (ROSC) after out of hospital cardiac arrest.

Indeed therapeutic hypothermia is included as a key component in a 'post cardiac arrest care bundle' proposed in the ICS Standards & Guidelines. This bundle comprises:

- Early coronary reperfusion and haemodynamic optimisation.
- Control of ventilation.
- Blood glucose control
- Temperature control
- Treatment of seizures.

The purpose of this brief paper is to make recommendations regarding temperature control in the post cardiac arrest context. It is emphasised that therapeutic hypothermia is only part of this comprehensive bundle and should not be used as an isolated therapy.

2.0 Evidence

Historical evidence has always suggested that hypothermia might have a neuroprotective effect after global cerebral ischaemia.
Recently two randomised clinical trials and a meta-analysis showed improved outcome in adults, who remained comatose after resuscitation from VF out-of-hospital cardiac arrest (OHCA), who were cooled within minutes to hours after ROSC. One of these studies included a subset of patients who suffered in hospital cardiac arrest. Three other studies, using historical control groups, showed benefit in comatose survivors of non VF OHCA. Other observational studies suggest possible benefit following cardiac arrest in other settings including in hospital cardiac arrest.

3.0 Inclusion/Exclusion criteria

Inclusion criteria:

- Any survivor of a cardiac arrest regardless of initial rhythm recognising that the strongest evidence pertains to the witnessed VF/pulseless VT OHCA scenario.

- ROSC within 60 minutes of initial collapse and/or within 30 minutes of the commencement of CPR.
- Patient remains unconscious with GCS < 8 or GC motor score < 4 (if intubated) despite ROSC.
- Absence of refractory hypotension/cardiac failure i.e. return of spontaneous circulation (ROSC) to systolic blood pressure (SBP) >90mmHg without vasopressor/inotrope assistance.
- The patient is in all other respects a suitable candidate for intensive therapy based on pre-morbid status and capacity to benefit as judged by an experienced Intensivist.

Exclusion criteria: **Absolute contraindications**

- Advanced directives or do not attempt resuscitation (DNAR) order in place.
- Underlying condition rendering ICU admission inappropriate (E.g. uncontrolled malignancy, other medical conditions considered terminal and irreversible).

Relative Contraindications

- Cardiac arrest with primary rhythm other than VF or VT.
- Other reason for coma (e.g. drug overdose, major head injury, stroke or status epilepticus).
- Uncontrolled bleeding or known coagulopathy.
- Pre-existing hypothermia <30 deg C

4.0 Procedure for Induction of Hypothermia

- Cooling should be started as soon as possible after ROSC and the patient has been identified as a suitable candidate for continued interventional care.
- Rapid infusion of 20-30ml/kg of 0.9% Saline at 4 deg C via wide bore peripheral cannula is an effective, simple method of initiating cooling. This is followed by the internal or external cooling method as used in the local unit. The authors recommend the use of an external servo-controlled cooling/warming device such as the Arctic Sun. A target temperature of 34 deg C should be achieved within 4 hours.
- Sedation as per institutional protocol
- Neuromuscular blocking drugs to prevent shivering as required (more of a problem during re-warming phase).
- Artificial ventilation to normocarbia and normoxaemia
- Most experts recommend cooling for at least 24 hours.
- The following standard ICU monitoring is mandatory:

- Continuous ECG
- Invasive arterial and central venous pressure measurement.
- End tidal CO_2 monitoring.
- Continuous temperature monitoring using nasopharyngeal, tympanic membrane or bladder temperature probe.
- Hourly urine output.
- Nasogastric tube.

5.0 Maintenance of therapeutic hypothermia

Once the target temperature has been reached and all mandatory monitoring has been instituted it is necessary to consider maintenance cooling. This can be achieved using any internal or external technique familiar to the local clinicians/institution. The expert group use a commercially available external servo-controlled technique that employs disposable adhesive external heat exchangers that allow precisely controlled cooling and rewarming (Arctic Sun). Whichever method is employed the maintenance of hypothermia requires consideration of:

- Tight glycaemic control is paramount as this also affects neurological prognosis and insulin resistance occurs with hypothermia. Aim for blood glucose between 4-8 mmol/l.
- Maintain mean arterial pressure (MAP) >65 mm Hg with cautious volume preloading to CVP 8-12 mmHg and/or inotropes/vasopressors as per institutional protocol.
- Prevent shivering using neuromuscular blockade recognising this may mask seizure activity. Monitor for seizures and treat promptly.
- Monitor magnesium levels and maintain within normal range using infusions of magnesium sulphate.

6.0 Procedure for Rewarming

After a minimum of 24 hours of therapeutic hypothermia the patient should be rewarmed at a rate of 0.25-0.5^{0}C per hour so that normothermia (37deg C) is achieved in 8-16 hours. Re-warming can be active or passive. The Arctic Sun allows slow active re-warming and the avoidance of overshoot hyperthermia is aided by the use of an external servo-controlled apparatus.
Maintenance of volume status is important during the rewarming process and cardiac preload should be monitored closely and maintained as necessary.
Neuromuscular blockade then sedation may be discontinued during or after rewarming to 36^{0}C and should be stopped before sedative drugs.

7.0 Potential Complications

The following complications are a feature of hypothermia and consideration should be given to appropriate monitoring/surveillance so they are recognised and managed as and when they occur.

- Immuno-compromise and increased risk of infection.
- Coagulopathy/bleeding tendency.
- Hyperglycaemia.
- Cardiovascular instability.
- Electrolyte abnormalities – hypomagnesaemia / hypophosphataemia.
- Abnormal pharmokinetics.

8.0 Documentation

Clear and accurate documentation must be maintained. This should include neurological status before stating the cooling process, the time that cooling commenced, time target temperature was achieved, duration of hypothermia, time to normothermia, cooling technique(s) employed, and peak temperature within the first 24 hours of rewarming, outcome and the presence of any complications. This will allow audit of institutional practice and relate this to outcome and quality of care.

9.0 References

(1)Standards for the Management of Patients after Cardiac Arrest. Intensive Care Society Standards and Guidelines. 2008.

(2) Holzer M, Bernard SA, Buist MD, et al. Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia: systematic review and individual patient meta-analysis. Crit Care Med 2005; 33: 414-8.