

Guidelines for the management of non-traumatic cardiac arrest

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Flowchart for the management of non-traumatic cardiac arrest

ROSC following non-traumatic cardiac arrest

Baseline targets for all patients

Oxygen saturation 94-98%
 Urine Output \geq 0.5mls/kg
 Normalising Lactate
 Blood Glucose 8-10mmol/L
 Plasma Potassium 4.0 -4.5 mmol/L
 Plasma Magnesium & Phosphate $>$ 1mmol/L

What is the patients neurological condition ?

Requires airway protection

Lung protective ventilation 6-8ml/kg IBW
 PaCO₂ 4.5 – 6.1 kPa

Alert

Monitor for evidence of shivering and treat as required

Target Temperature Management as soon as possible

36°C for first 24 hours
 37°C for another 48 hours

Seizure Management if required

Is there ST Elevation or potential new LBBB on ECG?

Yes

Immediate Referral to cardiology for urgent angiogram / PCI

No

Urgent Diagnostic workup in 2 hours
 Bystander history, Past Medical History, Laparotomy results, Arterial Blood Gas, consider CTPA and / or CT head, urgent Echocardiogram

No

Is there an alternative cause found?

Yes

Treat as appropriate

Abbreviations/symbols
 \geq Equal to or more than
 $>$ Greater than
IBW Ideal Body Weight

NEUROPROGNOSTICATION AT 72 HOURS OR LATER

see Prognostication Strategy Algorithm. Resuscitation Council UK & ESICM 2015

Explanatory Notes

Oxygenation and ventilation targets

Adequate oxygen delivery is essential^{1,2,3}, however some caution should be noted as hyperoxia may exacerbate existing neuronal damage^{4,5}. The aim is to target oxygen saturations between 94% and 98%. If a peripheral saturation probe is thought to be providing unreliable readings due to circulatory problems arterial gas analysis can be performed to determine oxygen saturation.

There is no specific data to support the targeting of a specific arterial PaCO₂ level after resuscitation. Hypocapnia has been shown to cause cerebral ischemia^{2,6} while a possible association between mild hypercapnia and better neurological outcome² has yet to be proven. We suggest it is reasonable that PaCO₂ should be kept between 4.5 and 6.1 kPa whenever possible.

Although protective lung ventilation has not been studied specifically in this group of patients, these patients develop a marked inflammatory response, it is rational to use lung protective ventilation as per Trust guidelines i.e. Tidal Volume 6-8ml/kg ideal body weight^{1,2}

Coronary angiography +/- PCI

All patients with a suspected cardiac cause of arrest OR no obvious non-cardiac cause of cardiac arrest should undergo urgent coronary angiography.

In the context of ST elevation or new left bundle branch block (LBBB) post return of spontaneous circulation (ROSC) this must be within 120 minutes as per national guidelines. Acute coronary occlusion with myocardial infarction is shown to be a common cause of sudden cardiac death and coronary artery disease accounts for two thirds of all sudden cardiac deaths^{7,8,9}, even in the absence of ST elevation up to 58% of patients are found to have a significant lesion at angiography¹⁰.

In the presence of potential intra-cranial bleeding an urgent CT head may be performed immediately pre coronary angiography.

Restoring early coronary blood flow and myocardial perfusion either by thrombolysis or percutaneous coronary intervention (PCI) has been systematically shown to significantly improve outcomes in this patients groups and the benefit of early post-cardiac arrest coronary angiography with subsequent PCI has been well documented^{11,12,13}.

Several studies indicate that the combination of therapeutic hypothermia and Percutaneous Coronary Intervention is feasible and safe after cardiac arrest caused by acute myocardial infarction^{14,15,16,17,18}.

Shorter intervals to reperfusion have been shown to increase myocardial salvage, delays to reperfusion increase the morbidity and mortality ratio in these patients¹⁹. Where thrombolysis is chosen as the reperfusion strategy for ST segment elevation, it should be started as per NICE guidance²⁰.

Targeted temperature management (TTM)

TTM has been shown to improve survival and decrease neurological injury in comatose survivors of cardiac arrest^{21,22,23,24,25} and is currently recommended by the UK Resus Council, ILCOR (International Liaison Committee on Resuscitation 2015), UK ICS (UK Intensive Care Society), ESICM (European Society of Intensive Care Medicine 2015) and NICE (National Institute for health and Care Excellence).

Hyperthermia is common in the first 48 hours after cardiac arrest^{26,27,28}. It contributes to on-going brain ischemia^{29,30,31,32 (10,11)} and is associated with poor neurological outcome^{29,33} while mortality increases significantly with fever greater than 38.5°C^{27,34,35}.

Whilst the precise temperature to target is not known, evidence indicates selecting and maintaining a constant core body temperature between 33°C and 36°C is neuroprotective and improves outcome of patients who have suffered a cerebral hypoxic ischemic event at the time of arrest^{1,2,36,37,38,39,40,41,42,43,44}.

An active targeted temperature of 36°C has been selected, because;

- it is easier to manage
- it is associated with less risk factors
- there is reduced risk of rebound hyperthermia
- there is no evidence it is inferior to temperature management of 33 °C^{1,2}.

TTM should commence as soon as possible and continue for at least 24 hours^{45,46}. Hypothermic patients should be actively warmed to target temperature by 0.25 – 0.5°C per hour^{1,47}, to prevent rebound hyperthermia, sudden vasodilation, rapid electrolyte shifts and hypoglycaemia instability^{48,49 (15,16)}. Fever control after initial 24 hours of TTM should continue until 72 hours post ROSC.

Haemodynamic Optimisation

Appropriate initial haemodynamic goals and management aims^{1,50,51}:

- Targeting a urine output of 0.5 ml/kg/hr
- Targeting a normal or decreasing plasma lactate
- Serum potassium 4 to 4.5 mmol/l
- Serum magnesium greater than 1 mmol/L
- Serum phosphate greater than 1 mmol/L

These targets may well be difficult to achieve in this patient group and expert support from cardiology and intensive care should be sought early. Cardiac output monitoring as per local guidelines should be considered.

Blood Glucose Levels

Hyperglycaemia is a common finding following cardiac arrest and is associated with a worse functional outcome ^{1,2,37,50,52,53,54-59}.

The consensus of evidence at present suggests that blood glucose levels after cardiac arrest should be maintained between 6 and 10 mmol/L ^{64,65}.

The Trust's diabetic management guidelines should be considered. Expert advice from the diabetology team may be required.

Sedation

To reduce oxygen consumption, prevent shivering and enable ventilation adequate sedation and analgesia is required. To enable earlier, reliable neurological assessment ^{1,2} short acting agents should be selected e.g. propofol and alfentanil infusions.

Seizure Control

Seizures are common after cardiac arrest ^{2 (8)}, myoclonus being the most common and the remainder being focal, generalised tonic-clonic seizures or a combination of seizure types ¹. Seizure activity will increase cerebral metabolic rate and may exacerbate brain injury ⁶⁶⁻⁷⁰, therefore early pharmacological treatment is indicated once other potential precipitating causes have been excluded e.g. intracranial haemorrhage, electrolyte imbalance. The Trust's first line recommended anticonvulsant therapy is levetiracetam, dosing as per BNF.

Shivering

Disruption of normal central thermoregulatory response post ROSC ^{71,72 (19,20)} alongside targeted temperature management may engender shivering ⁷³. Shivering increases cerebral metabolic rate, metabolic demand, oxygen consumption and carbon dioxide production. It can also retard the cooling process and lead to episodes of hyperthermia ^{74 (21)} Therefore regular assessment and treatment for shivering is important. See appendix 1 for suggested assessment and treatment regime.

Neuroprognostication

It is now understood that neuro-prognostication in this patient group is extremely difficult to predict and in the first 72 hours post cardiac arrest it is not currently possible to accurately predict neurological outcome⁷⁵⁻⁷⁷.

For this reason no treatment decisions should be based neuro-prognostication in the first 72 hours post cardiac arrest as supported by the UK Resus Council, ILCOR, UK ICS and the ESICM.

One suggested approach from the ESICM is outlined below and may be used to form a sound approach to this area. Any approach should be interpreted by staff groups with expertise in this area; often neurology, critical care and neuro-rehabilitation specialists.

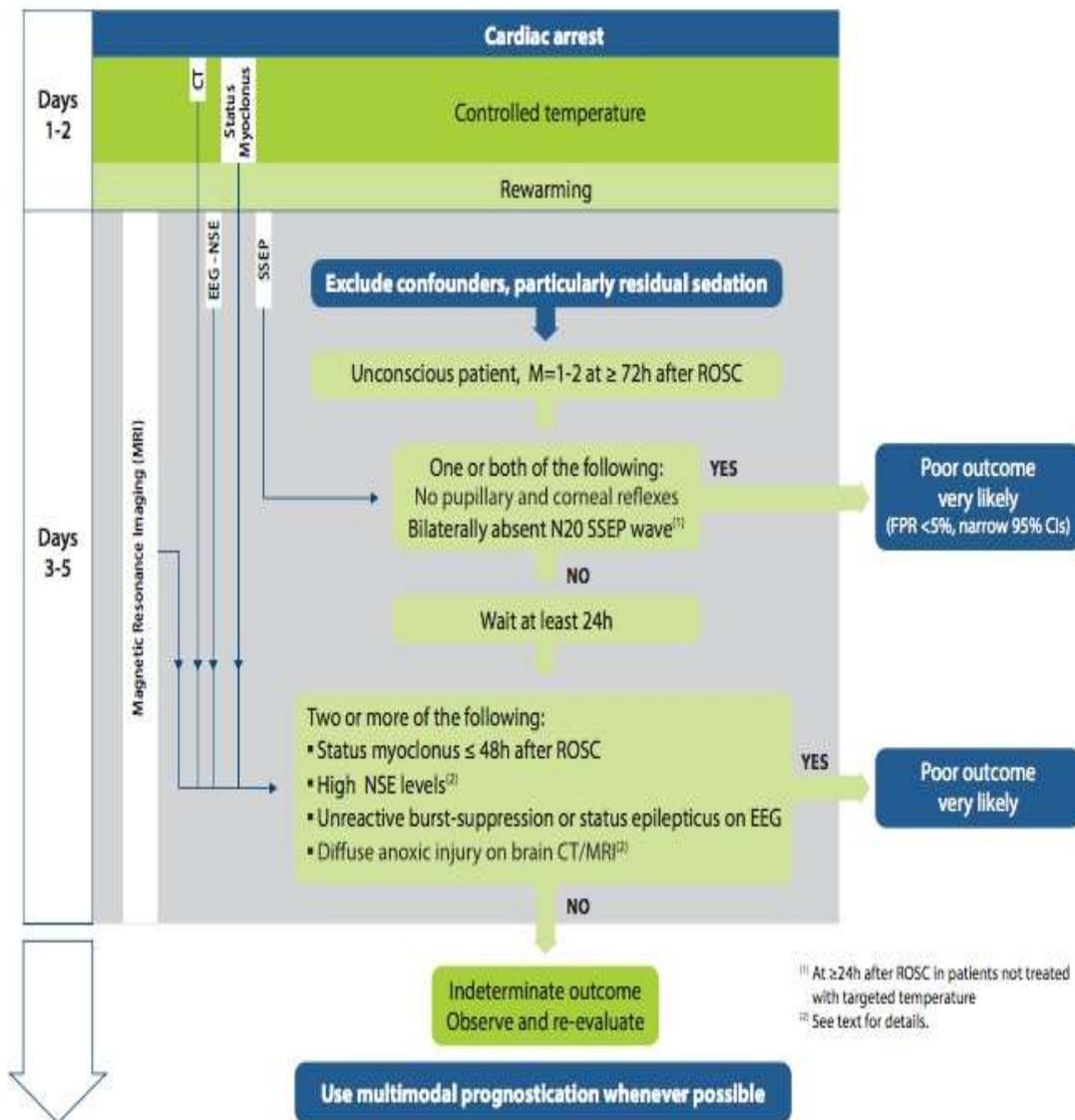


Fig. 2 Prognostication strategy algorithm. EEG electroencephalography, NSE neuron specific enolase, SSEP somatosensory evoked potentials, ROSC return of spontaneous circulation, FPR false positive rate, CI confidence interval

Assessment and Management of Shivering

Use Bedside Shivering Assessment Score if either:

- Shivering is observed
- Every hour until target temperature is reached
- Temperature rise $\geq 1^\circ$ and/or $> 36.5^\circ\text{C}$ despite active TTM



Bedside Shivering Assessment Score (BSAS)

- 0 = No shivering felt in masseter, neck or chest muscles
- 1 = Mild shivering localised only to neck & thorax
- 2 = Moderate shivering seen as gross movement upper extremities in addition to neck & thorax shivering.
- 3 = Severe shivering involves gross movement trunk, upper & lower extremities.

(Badjatia et al 2008)



Treatment Options

Dependant on severity and efficacy of treatment

- Increase sedation
- Counter warm (wrap hands & feet or use warm air device over cooling pads)
- Magnesium (target serum level 1-1.4 mmol/L)
- Neuromuscular blockage

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