

Clinical Guideline

Title: Critical Care Management after Cardiac Arrest

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Version:	V2
Supersedes :	-
Approval Group:	ICU MDT
Ratified by:	ICU MDT
Date ratified:	
Date issued:	
Review date:	

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1. Introduction

High-quality post-resuscitation care is increasingly recognised as a vital link in the “Chain of Survival”. While return of spontaneous circulation (ROSC) is an important resuscitation goal, this is only the first step of the pathway towards full recovery from cardiac arrest. The complex combination of pathophysiological processes which occurs after ROSC has been termed the post-cardiac arrest syndrome, and may comprise neurological injury, myocardial injury, systemic ischaemia/reperfusion injury, as well as any ongoing pathology which precipitated the arrest. While some patients recover rapidly after cardiac arrest, the majority will require consideration of multi-organ support in order to optimise their outcome.

The International Liaison Committee on Resuscitation (ILCOR) in 2015 considered the accumulated evidence on the entire resuscitation process, leading to the 2015 Consensus on Science and Treatment Recommendations (CoSTR 2015). The European Resuscitation Council (ERC) and European Society of Intensive Care Medicine (ESICM) produced joint guidelines on post-resuscitation based on CoSTR 2015. This local guideline for Bradford Teaching Hospitals Foundation Trust has in turn been written with the intention of facilitating local implementation of the ERC-ESICM guidelines.

2. Purpose/Scope

The purpose of this guideline is to ensure post-resuscitation care at BTHFT which is both consistent with international consensus guidelines and locally appropriate/achievable. This guideline may act as a reference for clinical care and for audit purposes.

The issue of scope requires some careful consideration. There are three variables in particular which may affect how these guidelines should be applied:

Patients with poor baseline quality of life, poor performance status or life-limiting co-morbidities

- Much of this guideline concerns provision of multi-organ support in an intensive care setting, and is not intended to mandate such treatment for patients who would be considered unlikely to benefit from it.

Type and location of arrest

- Many trials have included only patients with out-of-hospital cardiac arrest (OHCA) or VF/VT arrests. The ERC-ESICM guidelines do, however, advocate mostly identical post-arrest management for in-hospital cardiac arrest (IHCA) and non-shockable rhythms, acknowledging the weak evidence to support this, on the basis that the pathophysiology of the post-arrest syndrome is likely to be identical regardless of cause.

Conscious level after ROSC

- Only patients with GCS < 8/15 after ROSC were included in the major trials on temperature management. While it seems irrational to sedate, intubate and cool patients with GCS 15/15 after ROSC in order to

improve their neurological outcome, there exists no consensus on the management of patients with GCS 8-14.

All patients being considered for intensive care management after cardiac arrest must be, as per usual practice, discussed with the intensive care consultant on-call, who remains the final decision-maker with regard to admission and specifics of further treatment within intensive care.

Patients whose neurology recovers rapidly after cardiac arrest may still require consideration of intensive care management in order to treat the underlying cause and prevent further deterioration; their management is not within the scope of this guideline.

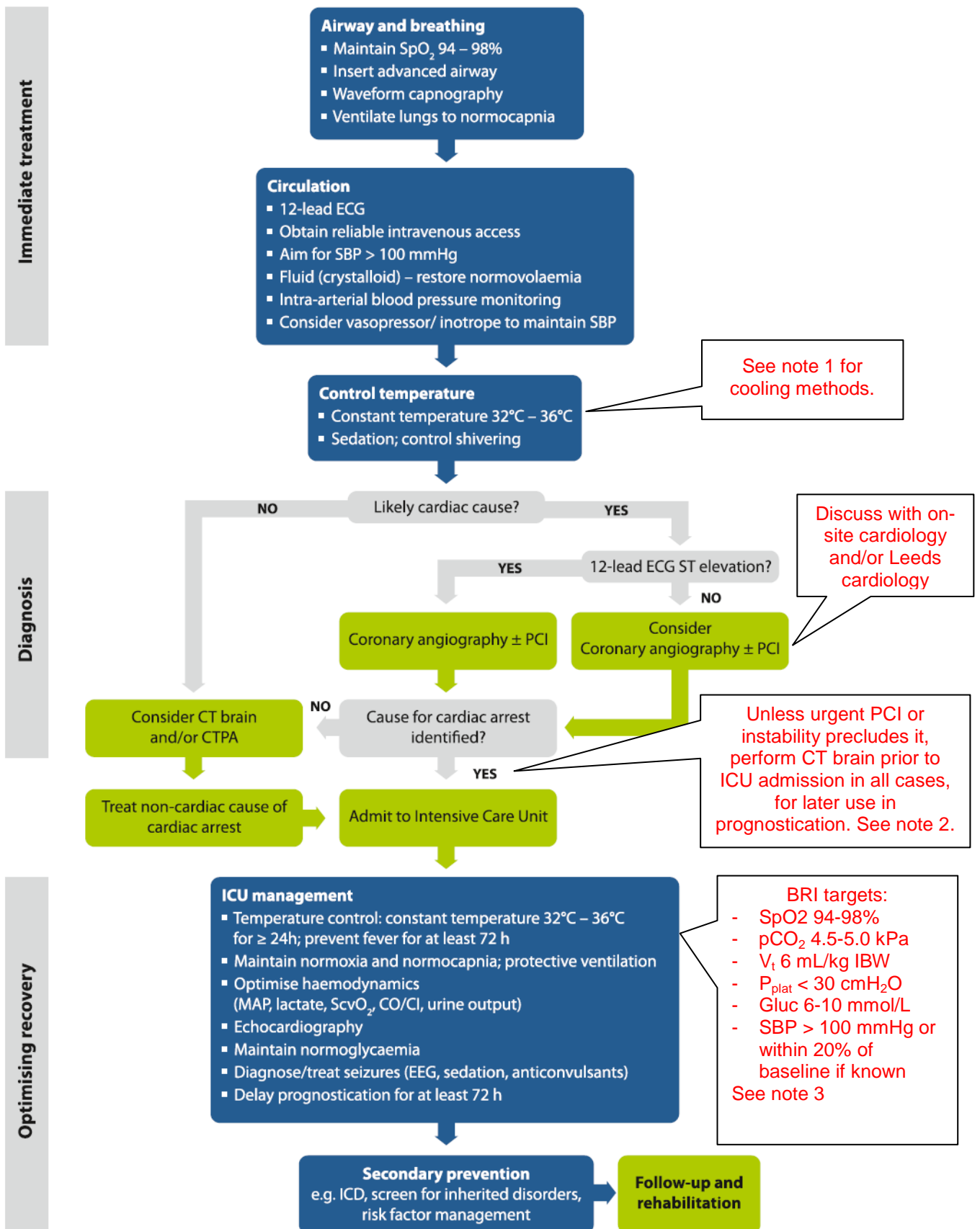
3. Responsibilities

- **Nursing staff and trainee/non-consultant doctors working on ICU** should be aware of this guideline's existence and may consult it for general clinical guidance; where any doubt exists regarding the appropriate management of a particular patient, they should seek advice from the intensive care consultant on duty or on call.
- **Intensive care consultants** should be aware of this guideline's existence; they retain responsibility for final decision-making with regard to admission to intensive care or clinical management while on ICU

4. Guideline/Procedure

The full text of the ERC-ESICM guidelines is referenced at the end of this guideline. For quick reference and for local implementation, the overall management flowchart is reproduced below, with annotations.

Return of spontaneous circulation and comatose



Note 1 – Temperature Control

Pyrexia is common in the first 48 hours after ROSC and should be treated with antipyretics in all patients. In unconscious patients, Target Temperature Management should be used for 24 hours, with the following principles:

- Maintain a constant target temperature between 33-36°C, avoiding swings between pyrexia and hypothermia.
- This is best achieved with continuous temperature monitoring from admission, ideally using a rectal or oesophageal probe.
- Patients are usually mildly hypothermic after ROSC; passive rewarming up to 33-36°C may be allowed, following which cooling measures should be instituted. Do not wait for pyrexia to occur.
- On ICU at BRI we use ice packs on the axillae and groins (made from ice machines on Ward 22 or 11, wrapped in towels/pillowcases) and/or wet towels on the trunk/face, and/or a Bair Hugger set to ambient/cold.
- If temperature exceeds 37°C, 20 mL/kg Hartmann's or 0.9% NaCl at 4°C can be used to rapidly reduce temperature by 1-1.5°C. We do not keep any stores of fluid at this temperature routinely, so putting two 1-Litre bags in the fridge should be considered at the time of admission.
- Sedation is required to prevent shivering and/or tachypnoea/dyssynchrony. If sedation is insufficient, magnesium sulphate 20 mmol over 1 hour can be used for shivering. If this fails, neuromuscular blocking agents should be used.

Note 2 - Investigations

All patients admitted to ICU post-ROSC should have the following investigations:

- Routine ICU blood profile including magnesium, calcium, phosphate.
- Serial 12-lead ECGs every 6 hours for first 24 hours (unless confirmed non-cardiac diagnosis causing arrest)
- Chest X-ray (unless CTPA performed after intubation)
- CT brain (within 24 hours of ROSC, for later prognostication)
- Echocardiogram (unless confirmed non-cardiac cause AND minimal pressor requirement)

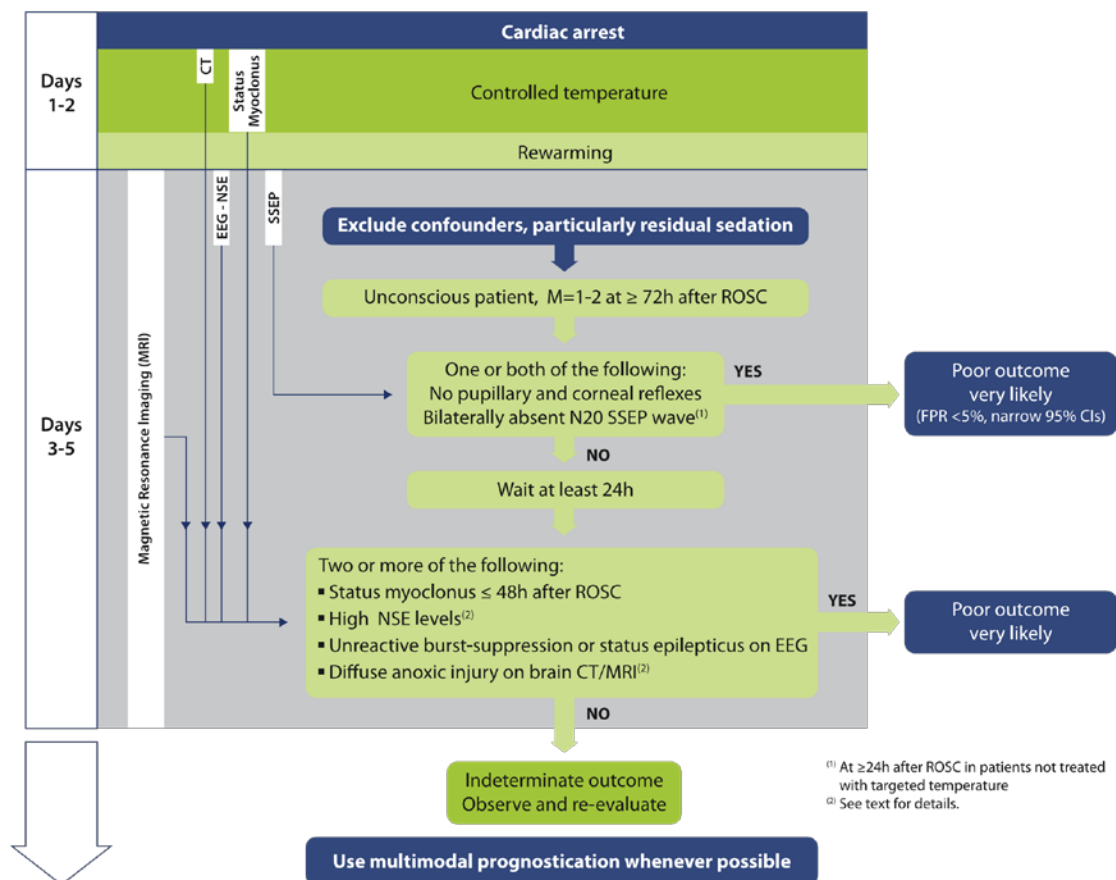
Note 3 – Supportive Management inc Seizure Control

- In all cases a specific cause of arrest should be sought and treated. A parent specialty must be involved in this process.
- Note that hyperoxia and hypocapnia are just as undesirable as hypoxia and hypercapnia.
- Seizures occur in up to a third of patients who remain comatose after ROSC; myoclonus is the most common seizure type. It is unknown whether continuous EEG monitoring improves outcome, and we do not currently have this facility on ICU at BRI.
- Clinical seizure activity should be treated either with benzodiazepines or increased propofol sedation, alongside maintenance therapy. Levetiracetam, sodium valproate and clonazepam are appropriate choices for myoclonus (phenytoin is less effective).

- Prophylactic anticonvulsants should not be used.
- In the presence of neuromuscular blockade, sympathetic activation may be the only clinical evidence of seizure activity.
- Portable EEG is available from neurophysiology (based at St Luke's Hospital) on a non-urgent basis during working hours, depending on staff availability.
- In exceptional cases, use of a Narcotrend monitor from theatres for a single-channel EEG display may be useful to detect generalised seizure activity or to target a burst-suppression pattern. Discussion regarding transfer to neurointensive care at Leeds General Infirmary may also be considered.

Prognostication

The ERC-ESICM multimodal prognostication algorithm outlined below applies **only** to those patients with a Glasgow motor score of 1-2 at 72 hours post-arrest, and is intended to assist with prognostication in this group, but not to advise any particular approach to prognostication in those with a higher Glasgow motor score, or in those who do not have any criteria reliably predicting a poor neurological outcome. It is anticipated that the majority of patients will benefit from a longer period of clinical observation and a holistic approach to prognostication. This algorithm also relates purely to neurological outcome, whereas overall prognosis clearly depends on many other factors.



Notes

- SSEPs are not currently available in BRI ICU, nor in many other UK centres.
- Myoclonic jerks are common and may be associated with a good outcome. Status myoclonus (variably defined, but for example continuous for >30 minutes and across multiple body areas) starting within 48 hours after ROSC is highly predictive of poor neurological outcome, although should still be combined with another prognostication modality.
- Neuron-specific enolase (NSE) is currently accepted by BRI blood sciences in a gold-top (serum) tube, and is referred to Sheffield Protein Reference Unit (tel 0114 271 5552) for processing (cost ~£17). Turnaround time can be up to a week with normal transport so for this indication should be sent by taxi/courier (liaise with lab for this). Results from Sheffield are returned to BRI by post; obtaining a verbal result by telephone may be required.

A variety of cut-offs exist in the literature at different time points for predicting outcome. One of the largest studies gives a false-positive rate (FPR) of 5% with an NSE > 40 ng/mL (or mcg/L) taken at 48h post ROSC; the FPR falls to 2% with values > 44 ng/mL. The ERC-ESICM guidelines recommend sampling at multiple time points (e.g. 48h and 72h) to reduce the risk of sample error and as an increase between two time points predicts a poorer outcome.
- Portable EEG is available Monday to Friday as mentioned in the previous section. An unreactive, malignant EEG pattern (burst-suppression, status epilepticus) off sedation is predictive of poor outcome.
- CT brain taken within the first 24 hours or MRI brain at 2-5 days post-ROSC should be examined by a consultant neuroradiologist. Early CT is predictive if it demonstrates diffuse cerebral oedema or reduced grey/white matter differentiation.

Appendix 1 - References

- Nolan JP, Soar J, Cariou A, Cronberg T, Moulaert VR, Deakin CD, Bottiger BW, Friberg H, Sunde K, Sandroni C. European resuscitation council and European society of intensive care medicine 2015 guidelines for post-resuscitation care. *Intensive care medicine*. 2015 Dec 1;41(12):2039-56.
- Stammet P, Collignon O, Hassager C, Wise MP, Hovdenes J, Åneman A, Horn J, Devaux Y, Erlinge D, Kjaergaard J, Gasche Y. Neuron-specific enolase as a predictor of death or poor neurological outcome after out-of-hospital cardiac arrest and targeted temperature management at 33 C and 36 C. *Journal of the American college of cardiology*. 2015 May 19;65(19):2104-14.