GUIDELINE FOR NEUROLOGICAL PROGNOSTICATION AFTER HYPOXIC ENCEPHALOPATHY

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Key Amendments

Date	Amendment	Approved by
8th October 2019	Document extended with no changes as part of Disease Management section in critical care	Dr Nick Cowley/Dr Andy Burtenshaw
8th October 2021	Updated to include guidance from ERC and Resus Council UK	ICM Forum
April 2023	Updated to include guidance on sedation and EEG and with detailed EEG appendix. Temperature targets clarified.	Dr Sarah Green Kelly Bill ICM Forum

INTRODUCTION

Over recent years we have seen a steady increase in the numbers of patients admitted to intensive care with a return of spontaneous circulation after resuscitation for cardiorespiratory arrest. However, mortality in this group of patients remains high at approximately 50%, with over 70% of deaths attributable to hypoxic encephalopathy [1].

Therapeutic hypothermia had been shown to improve neurological outcome and was widely practiced over the last decade. However more recent evidence has shown that prevention of pyrexia in the 24 hours following return of spontaneous circulation (ROSC) is equally efficacious. Our current practice is to target a temperature of 36°c.

Neurological prognostication is essential as a foundation for informing relatives, prioritising intensive care resources, avoiding futile care in cases where a vegetative state or death can be anticipated, and ensuring that treatment withdrawal decisions are appropriate. Poor neurological outcome is widely regarded as requiring full nursing care, persistent vegetative state or death.

Prediction of poor neurological outcome has been based on guidance published in 2006 from the American Academy of Neurology [5]. In particular, the early presence of myoclonus status epilepticus, the absence of pupillary and corneal reflexes and a motor response no better than extension at 72 hours were considered reliable predictors of poor outcome.

However, there is mounting evidence that patients who have undergone therapeutic hypothermia / targeted temperature management and who have the potential to make a good recovery are not reliably identified based on neurological examination at 72 hours alone [6-8]. In a recent case series, 16% of patients with a poor initial motor score progressed to make a good recovery [7]. The reasons for this discrepancy are not established, although there is evidence that the metabolism and clearance of sedative drugs is delayed in patients who have undergone hypothermia [9]. Patients who improve their level of consciousness after withdrawal of sedative medication usually have a good outcome [10]. For those that remain in a coma, prognosis becomes gradually worse with increasing time from the insult [11].

In 2014, the European Resuscitation Council (ERC) and the European Society of Intensive Care Medicine acknowledged the uncertainty surrounding prognostication and published an advisory statement addressing this.[12] This trust guideline was initially constructed to incorporate this statement, combined with the available evidence base to provide a structured approach to neurological prognostication in patients with hypoxic encephalopathy.
In 2021, the ERC and UK Resuscitation Council published updated advice on prognostication. Some minor adjustments to our trust guideline have subsequently been made to reflect this advice.

DETAILS OF GUIDELINE (summarised in flowchart)

0-24 hours post arrest:

Where appropriate, patients who regain spontaneous circulation after cardiorespiratory arrest and who remain comatose are admitted to the Intensive Care Unit. They are sedated and ventilated, may have undergone percutaneous coronary intervention.
Targeted temperature management should be actively utilised to ensure a target core temperature of <36^{o}c in the first 24 hours and <37.7^{o}c upto 72 hours post ROSC.
Any organ dysfunction is actively supported during this time.

24-72 hours post arrest:

Period of passive rewarming if patient has been actively cooled.
If clinically able, sedation is discontinued to allow assessment of neurological state.

Reasons for withdrawing active support in the first 72 hours include:

- Progressive multiple organ failure
- Evidence of a pre-morbid state that would limit Intensive Care Support
- Evidence of advanced directive / DNAR stating not for resuscitation or ICU
- Evidence of brainstem death.
- Status myoclonus (persistent myoclonic jerks for greater than a minimum of 30 minutes) **in combination** with absent bilateral N20 response on somatosensory evoked potential (SSEP)

72 hours post arrest: Patients who remain comatose with GMS ≤3

- Perform EEG and SSEPs. (Refer to Appendix A for process)

This should occur no earlier than 72 hours post ROSC (unless myoclonus) and only in patients with GMS ≤3

- Consider CT / MRI

Reasons for withdrawing active support at 72 hours:
Two of more of:

- Bilateral absence of pupillary and corneal reflexes
- Bilateral absence of SSEP N20 response
- Status myoclonus >30 minutes within the first 48 hours
- Highly malignant EEG (suppressed background ± periodic discharges or burst suppression)
- Diffuse and extensive anoxic injury on brain CT or MRI

If patient remains comatose without meeting criteria for withdrawal of support then continue active management for further 48 hours.

Days 4 – 5 post arrest:

- Twice daily clinical neurological assessment.
- Repeat EEG

If at day five, patient remains comatose with GMS ≤3, then poor outcome remains likely.
Withdrawal of active life sustaining therapy should be considered.
This decision should ideally be supported with a second ICU Consultant opinion.

Neurophysiological considerations

For detailed information about EEG / SSEP:
See appendix A – Guideline for median somatosensory (SEP) evoked potential ICU
See appendix B – Guideline for EEG for Neuroprognostication ICU

EEG procedure:

- If performed for suspected non-convulsive status then can be performed at any time after ROSC, even if patient is sedated. If possible, stopping sedation temporarily will improve diagnostic accuracy.
- If performed for Neuroprognostication (after 72 hours) then sedation should ideally be stopped 12 hours prior to obtaining the EEG
- If a reduction in sedation cannot be tolerated then as a minimum, propofol must be stopped 2 hours and remifentanil 30 minutes prior to EEG. Propofol has an impact on the amplitude and continuity of the recording
- EEG can often be equivocal - A repeat EEC can be considered 24 hours after optimising treatment if there is no clear clinical improvement.

- Consider using neuromuscular blocker (with sedation) if muscle artefact is causing interference.

Post-Anoxic Myoclonus[14]

- Myoclonus can be focal, multi-focal or generalised.
- Post-anoxic myoclonus occurs in 20% of cardiac arrest patients, usually beginning within 24 hours; 55-89% with concomitant EEG changes, and the remainder are likely subcortical in origin. Around 10% of patients with post-anoxic myoclonus may have a favourable outcome.
- It is recommended to perform EEG in the presence of myoclonic jerks to detect any associated epileptiform activity or identify EEG signs, such as background reactivity or continuity, suggesting a potential for neurological recovery.
- Status myoclonus: continuous and generalised myoclonus lasting for 30 minutes or more; associated with poor neurological outcome (specificity 99-100%).

Lance Adams syndrome (Action myoclonus with more favourable prognosis)

- Action myoclonus on waking from anoxic injury.
- Mainly affects the limbs, and is induced by actions or sensory stimulation.
- Can be masked by sedatives and anti-epileptic drugs.
- Thought to represent selective death of Purkinje cells in the cerebellum (which are highly sensitive to anoxia), leading to loss of GABAergic tone, disinhibition of the reticular formation and synchronous firing of thalamic cells. There is an absence of diffuse cortical damage.
- Continuous EEG background with superimposed epileptiform discharges and clinical myoclonus.
- Tends to be midline or parasagittal spikes.
- More favourable prognosis, and more likely to respond to anti-epileptic medication

Neuroprognostication of the comatose adult patient after resuscitation from cardiac arrest:

ROSC after cardiorespiratory arrest

- Maintain targeted temperature <36ºC for 24 hours
- Allow passive rewarming if actively cooled
- Stop sedation if clinically able

- Progressive multi-organ failure
- Evidence of poor pre-morbid state
- Evidence of brainstem herniation
- Evidence of advanced directive / DNAR stating not for resuscitation
- Myoclonic status epilepticus PLUS absence of bilateral N20 SSEPs

→ **Withdrawal of life sustaining therapy**

Clinical assessment 72hrs:
Exclude residual sedation
Unconscious Patient with GMS ≤3?

No → **Continue active treatment**

Yes

Two or more of following:

- No pupillary or corneal reflexes at >72hrs
- Bilaterally absent N20 SSEP wave
- Status myoclonus <72hrs after ROSC
- Highly malignant EEG at >24hrs
- CT or MRI evidence of diffuse anoxic injury

Yes → **Poor outcome likely.**
Consider withdrawal of life sustaining therapy

No

- **Indeterminate outcome**.
- Continue support and reassess daily.
- Repeat EEG

If remains unconscious with GMS ≤3 at day 5 post ROSC then poor outcome likely:

Second Consultant opinion → **Poor outcome likely.**
Consider withdrawal of life sustaining therapy

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Appendix A: Guideline for median somatosensory (SEP) evoked potential ICU.

Appendix A for SSEPs.doc

Appendix B: Guideline for EEG for Neuroprognostication in ICU

Guideline for Portable EEG +SSEP.