Guideline 11.7 – Post-resuscitation Therapy in Adult Advanced Life Support

Summary

This guideline provides advice on post-resuscitation care because a comprehensive treatment protocol including multiple interventions provided in a structured way may improve survival after cardiac arrest.

Who does this guideline apply to?

This guideline applies to adults who require advanced life support

Who is the audience for this guideline?

This guideline is for health professionals and those who provide healthcare in environments where equipment and drugs are available.

Summary of Recommendations

This guideline has been updated based on evidence reviews including the 2018-2023[1-7] International Liaison Committee on Resuscitation (ILCOR) Advanced Life Support (ALS) Taskforce evidence reviews. The Australian and New Zealand Committee on Resuscitation (ANZCOR) makes the following recommendations:

1. ANZCOR suggests hemodynamic goals (e.g. mean arterial pressure (MAP), systolic blood pressure (SBP), be considered during post-resuscitation care and as part of any bundle of post-resuscitation interventions.
2. ANZCOR recommends avoiding hypoxemia in adults with return of spontaneous circulation (ROSC) after cardiac arrest in any setting.
3. ANZCOR suggests avoiding hyperoxemia in adults with ROSC after cardiac arrest in any setting.
4. ANZCOR suggests the use of 100% inspired oxygen until the arterial oxygen saturation, or the partial pressure of arterial oxygen can be measured reliably in adults with ROSC after cardiac arrest in any setting.
5. ANZCOR suggests once ROSC has been established and the oxygen saturation of arterial blood can be monitored reliably by pulse oximetry (SpO_2) and/or arterial blood gas analysis (SaO_2), it is reasonable to titrate the inspired oxygen to achieve an initial target saturation

between 94 to 98%.

6. ANZCOR suggests maintaining partial pressure of carbon dioxide ($PaCO_2$) within a normal physiological range as part of a post-ROSC bundle of care.
7. ANZCOR suggests providers monitor blood glucose frequently after cardiac arrest, aim for normoglycaemia and treat hyperglycemia (>10 mmol/l) with insulin while avoiding hypoglycemia.
8. ANZCOR suggests it may be reasonable to continue an infusion of an antiarrhythmic drug that successfully restored a stable rhythm during resuscitation (e.g. amiodarone 0.6 mg/kg/hour or lignocaine 2 to 4 mg/min for 12 to 24 hours).
9. ANZCOR suggests if no antiarrhythmic drug was used during resuscitation from a shockable rhythm, an antiarrhythmic drug may be considered to prevent recurrent ventricular fibrillation (VF).
10. ANZCOR suggests against the use of prophylactic antibiotics in patients after ROSC.
11. ANZCOR recommends Temperature Control for adult victims of cardiac arrest who remain unresponsive after ROSC (Refer to ANZCOR Guideline 11.9 for details).
12. ANZCOR suggests against routine seizure prophylaxis in post–cardiac arrest patients.
13. ANZCOR recommends the treatment of seizures in post–cardiac arrest patients.
14. Maintenance therapy for seizures should be started after the first seizure event and potential precipitating causes (e.g. intracranial haemorrhage, electrolyte imbalance, etc.) should be excluded.
15. ANZCOR suggests that when coronary angiography is considered for comatose post-arrest patients without ST-segment elevation, either an early (within 2 to 6 hours) or a delayed (within 24 hours) approach for coronary angiography is reasonable.
16. ANZCOR suggests early coronary angiography in comatose post–cardiac arrest patients with ST-segment elevation.
17. After resuscitation all patients should be reassessed and re-evaluated for resuscitation-related injuries. The extent of injuries is often underestimated by standard investigations (e.g. chest radiograph). Other complications of resuscitation (e.g. incorrect placement of tubes) should be identified and treated. Intravascular lines inserted under emergency conditions may need to be replaced.
18. ANZCOR suggests adult non-traumatic out-of-hospital cardiac arrest (OHCA) patients be cared for in cardiac arrest centres, where available, rather than non-cardiac arrest centres.
19. For patients with in-hospital cardiac arrest, we suggest they are considered for transfer to a cardiac arrest centre.

Prognostication and cardiac arrest

20. ANZCOR recommends against relying on the neurologic exam during or immediately after cardiac arrest to predict outcome.

21. ANZCOR recommends that neuroprognostication always be undertaken by using a multimodal approach as no single test has sufficient specificity to eliminate false positives.

22. ANZCOR suggests assessing the GCS motor score in the first 4 days after cardiac arrest to identify patients with a score of >3, which may indicate an increased likelihood of favourable outcome.

23. ANZCOR suggests using pupillary light reflex at 72 hours or more after ROSC for predicting neurological outcome of adults who are comatose after cardiac arrest.

24. ANZCOR suggests using quantitative pupillometry at 72 hours or more after ROSC for predicting neurological outcome of adults who are comatose after cardiac arrest.

25. ANZCOR suggests using bilateral absence of corneal reflex at 72 hours or more after ROSC for predicting poor neurological outcome in adults who are comatose after cardiac arrest.

26. ANZCOR suggests using presence of myoclonus or status myoclonus within 7 days after ROSC, in combination with other tests, for predicting poor neurological outcome in adults who are comatose after cardiac arrest. We also suggest recording electroencephalogram (EEG) in the presence of myoclonic jerks to detect any associated epileptiform activity.

27. ANZCOR suggests prolonging the observation of clinical signs when interference from residual sedation or paralysis is suspected, so that the possibility of obtaining false-positive results is minimized.

28. ANZCOR suggests using bilateral absent N20 somatosensory evoked potentials (SSEP) in combination with other indices to predict poor outcome in adult patients who are comatose after cardiac arrest.

29. ANZCOR suggests against using the amplitude of the N20 SSEP wave to predict good neurological outcome of adults who are comatose after cardiac arrest.

30. ANZCOR suggests against using the absence of EEG background reactivity alone to predict poor outcome in adult patients who are comatose after cardiac arrest.

31. ANZCOR suggests using a continuous or nearly continuous normal voltage EEG background without periodic discharges or seizures within 72h from ROSC in combination with other indices to predict good outcome in patients who are comatose after cardiac arrest.

32. ANZCOR suggests that the American Clinical Neurophysiological Society (ACNS) terminology be used to classify the EEG patterns used for prognostication in patients who are comatose after cardiac arrest.

33. ANZCOR suggests against using heterogeneous, non–ACNS defined favourable EEG patterns to predict good neurological outcome after cardiac arrest

34. ANZCOR suggests using the presence of seizure activity on EEG in combination with other indices to predict poor outcome in adult patients who are comatose after cardiac arrest.

35. ANZCOR suggests against the use of other EEG metrics, including reduced montage or amplitude-integrated EEG, Bispectral Index (BIS), or EEG derived indices, to predict good outcome in patients who are comatose after cardiac arrest.

36. ANZCOR suggests using burst suppression on EEG in combination with other indices to predict poor outcome in adult patients who are comatose and who are off sedation after cardiac arrest.

37. ANZCOR suggests using normal neuron specific-enolase (NSE) (<17 µg/L) within 72 hours after ROSC, in combination with other tests, for predicting good neurological outcome of adults who are comatose after cardiac arrest.

38. ANZCOR suggests against using serum levels of glial fibrillary acidic protein, serum tau

protein, or neurofilament light chain (NfL) in clinical practice for predicting good neurological outcome of adults who are comatose after cardiac arrest.

39. ANZCOR suggests using brain-imaging studies for prognostication only in centres where specific experience is available.

40. ANZCOR suggests using the presence of a marked reduction of the grey matter/white matter (GM/WM) ratio on brain computed tomography (CT) within 48 hours after ROSC or the presence of extensive diffusion restriction on brain magnetic resonance imaging (MRI) at 2 to 6 days after ROSC in combination with other predictors for prognosticating a poor neurologic outcome in patients who are comatose after cardiac arrest.

41. ANZCOR suggests against using grey-white matter ratio (GWR), quantitative regional abnormality (QRA), or Alberta Stroke Program (ASPECTS-b) on brain CT to predict good neurological outcome in patients who are comatose after cardiac arrest.

42. ANZCOR suggests against using apparent diffusion coefficient or gradient-recalled echo on brain MRI to predict good neurological outcome in patients who are comatose after cardiac arrest.

43. ANZCOR suggests using the absence of diffusion restriction on MRI between 72 hours and 7 days after ROSC, in combination with other tests, for predicting good neurological outcome of adults who are comatose after cardiac arrest.

44. Cardiac arrest survivors may experience post-arrest problems including anxiety, depression, post-traumatic stress, and difficulties with cognitive function. Clinicians should be aware of these potential problems, screen for them and, if found, treat them.

45. ANZCOR recommends that all patients who have restoration of circulation after cardiopulmonary resuscitation (CPR) and who subsequently progress to death be evaluated for organ and tissue donation.

1.0 | Guideline

Introduction

After the return of spontaneous circulation (ROSC), resuscitation DOES NOT STOP. It is essential to continue maintenance of airway, breathing and circulation. ROSC is just the first step toward the goal of complete recovery from cardiac arrest. Interventions in the post-resuscitation period are likely to significantly influence the final outcome. A comprehensive treatment protocol including multiple interventions provided in a structured way may improve survival after cardiac arrest.[8]

Hypoxic brain injury, myocardial injury or subsequent organ failure are the predominant causes of morbidity and mortality after cardiac arrests.[9]

The aims of therapy after initial resuscitation are to:

- Continue respiratory support.
- Maintain cerebral perfusion.
- Treat and prevent cardiac arrhythmias.
- Determine and treat the cause of the arrest.
    - In addition treatable causes of cardiac arrest need to be addressed. These include:
- Hypoxaemia
- Hypovolaemia
- Hypo/Hyperkalaemia and other metabolic disorders including acidosis and disturbances of magnesium and calcium
- Hypo/Hyperthermia
- Tension pneumothorax
- Tamponade: pericardial
- Toxins/poisons/drugs including carbon monoxide, and cyclic antidepressants
- Thrombosis: pulmonary embolus /acute myocardial infarction.

A full history and examination will guide the possible investigations. Electrolyte disorders such as hyponatraemia and hypernatraemia may cause continuing cerebral damage. Serum electrolytes, arterial blood gases and electrocardiogram (ECG) should be performed to guide further treatment.[4]

1.1 | Post-resuscitation Hemodynamic Support

It is imperative to ensure an adequate systemic arterial blood pressure as soon as practicable after ROSC. Despite limited clinical data, the known pathophysiology of post-cardiac arrest syndrome provides a rationale for titrating hemodynamics to optimize organ perfusion.[8]

An evidence update was included in the ILCOR 2020 review process and a 2023-2024 update is in progress. Two randomized control trials (RCTs) completed since 2015 did not find that targeting a specific MAP affected outcome, although the studies were not powered for clinical outcomes of survival or neurologic outcome.[10,11] The previous treatment recommendation based on CoSTR 2015 has been modified.[12]

Recommendations

The treatment recommendation now includes an initial target mean arterial blood pressure.

ANZCOR suggest that hemodynamic goals (e.g. MAP, SBP) be considered during post-resuscitation care and as part of any bundle of post-resuscitation interventions [CoSTR 2015, weak recommendation, low-certainty evidence].

There is insufficient scientific evidence to recommend a specific blood pressure target for all patients after cardiac arrest. We suggest an initial target mean arterial blood pressure (MAP) of at least 60 to 65 mm Hg, or a systolic pressure greater than 100 mmHg in patients after out-of-

hospital and in-hospital cardiac arrest that may be adjusted according to post–cardiac arrest status and pre-existing comorbidities [Good Practice Statement].

Justification

In making these recommendations, we place a higher value on the recognition that while hemodynamic goals are likely important to optimize outcome, specific targets remain unknown and likely vary depending on individual physiology and comorbid status.[12]

Aim for a blood pressure equal to the patient's usual blood pressure or mean arterial blood pressure (MAP) of at least 60 to 65 mm Hg, or a systolic blood pressure (SBP) greater than 100 mmHg. If the blood pressure falls, a vasopressor may be given by small intravenous increments (e.g. adrenaline 50 to 100 mcg) or infusion until fluid status and the need for intravascular volume expansion can be assessed [Good Practice Statement].

There is insufficient evidence to support or refute the routine use of intravenous fluids following sustained ROSC after cardiac arrest. Based on the pathophysiology of post-cardiac arrest syndrome,[9] it is reasonable to use intravenous fluids as part of a package of post-cardiac arrest care[8] [Good Practice Statement].

There is insufficient evidence to support or refute the routine use of vasopressors and/ or inotropes for improving survival in adult patients with cardiovascular dysfunction after resuscitation from cardiac arrest.[6] If vasoactive drugs are used, as soon as possible, any vasoconstricting drugs should be given by a dedicated central venous line [Good Practice Statement].

There is insufficient evidence to support or refute the use of mechanical circulatory support (e.g. an intra-aortic balloon pump) in post-cardiac arrest patients who have cardiovascular dysfunction.[8]

Intubation and ventilation are continued in the immediate post-arrest period guided by appropriate monitoring.

1.2 | Ventilation Strategy After ROSC-Oxygenation

Both hypoxemia and hyperoxemia during post-resuscitation care have been associated with worse outcomes. Hypoxemia may worsen ischemic brain injury and injury to other organs, and hyperoxemia may lead to increased oxidative stress and organ damage after reperfusion. A systematic review was conducted to inform the 2020 CoSTR.[13]

Recommendations

ANZCOR suggests the use of 100% inspired oxygen until the arterial oxygen saturation or the partial pressure of arterial oxygen can be measured reliably in adults with ROSC after cardiac arrest in any setting [CoSTR 2020, weak recommendation, very low-certainty evidence].

ANZCOR recommends avoiding hypoxaemia in adults with ROSC after cardiac arrest in any setting [CoSTR 2020, strong recommendation, very low-certainty evidence].

ANZCOR suggests avoiding hyperoxaemia in adults with ROSC after cardiac arrest in any setting [CoSTR 2020, weak recommendation, low-certainty evidence].

Once ROSC has been established and the oxygen saturation of arterial blood can be monitored reliably by pulse oximetry (SpO_2) and/or arterial blood gas analysis (SaO_2), it is reasonable to titrate the inspired oxygen to achieve an initial target saturation between 94 to 98% [Good Practice Statement] (Refer to ANZCOR Guideline 11.6.1).

1.3 | Ventilation Strategy After ROSC-control of arterial carbon dioxide

Hypocapnia causes cerebral vasoconstriction and hypercapnia leads to cerebral vasodilation. Exactly how variations in CO_2 affect intracranial pressure and perfusion in the brains of post-arrest patients, and whether this affects outcome, remains unclear.

A systematic review was conducted to inform the 2020 CoSTR.[13]

Recommendations

There is insufficient evidence to suggest for or against targeting mild hypercapnia compared with normocapnia in adults with ROSC after cardiac arrest.

ANZCOR suggests against routinely targeting hypocapnia in adults with ROSC after cardiac arrest [CoSTR 2020, weak recommendation, low-certainty evidence].

ANZCOR suggests maintaining $PaCO_2$ within a normal physiological range as part of a post-ROSC bundle of care [CoSTR 2015, weak recommendation, very low certainty evidence].

1.4 | Blood glucose control

Several human studies have documented a strong association between high blood glucose after resuscitation from cardiac arrest and poor neurologic outcome. There is good evidence that persistent hyperglycemia after stroke is associated with a worse neurologic outcome.

The optimal blood glucose target in critically ill patients has not been determined. Comatose patients are at particular risk from unrecognized hypoglycemia, and the risk of this complication occurring increases as the target blood glucose concentration is lowered.[8]

Recommendation

ANZCOR suggests no modification of standard glucose management protocols for adults with ROSC after cardiac arrest [CoSTR 2015, weak recommendation, moderate-certainty evidence].[12]

ANZCOR suggests monitoring blood glucose frequently after cardiac arrest, aim for normoglycaemia and treat hyperglycemia (>10 mmol/l) with insulin while avoiding hypoglycemia.

1.5 | Prophylactic anti-arrhythmic agents

No studies specifically and directly addressed the prophylactic use of antiarrhythmic therapy started immediately after resuscitation from cardiac arrest. Observational studies document inconsistent improvement in long-term survival when prophylactic antiarrhythmics were given to survivors of cardiac arrest from all causes.[12]

Recommendation

ANZCOR suggests it may be reasonable to continue an infusion of an antiarrhythmic drug that successfully restored a stable rhythm during resuscitation (e.g. amiodarone 0.6 mg/kg/hour or lignocaine 2 to 4 mg/min for 12 to 24 hours) [Good Practice Statement].

If no antiarrhythmic drug was used during resuscitation from a shockable rhythm, an antiarrhythmic drug may be considered to prevent recurrent VF [Good Practice Statement].

1.6 | Prophylactic Antibiotics After Cardiac Arrest

This topic was prioritized by the ILCOR 2020 ALS Task Force following the publication of a systematic review in 2019.[14] Infective complications are common in patients admitted to intensive care units (ICUs). After cardiac arrest, pneumonia has been reported in >50% of patients. In these patients, early and accurate identification of infection is challenging. Standard criteria for identifying infection are affected by patient treatment (e.g. drugs and hypothermia) and the pathophysiology of the post–cardiac arrest syndrome. The decision to treat a possible infection needs to be balanced to avoid antibiotic resistance. The ILCOR 2020 review process updated the systematic review by using the ADOLOPMENT process.[15]

Recommendation

ANZCOR suggests against the use of prophylactic antibiotics in patients after ROSC [CoSTR 2020, weak recommendation, low-certainty evidence].

1.7 | Temperature Control

Temperature control after ROSC was reviewed in detail during the 2021 CoSTR process[5] and is covered in more detail in ANZCOR Guideline 11.8 Temperature Control.

Recommendations

ANZCOR suggests actively preventing fever by targeting a temperature 37.5 °C for patients who remain comatose after ROSC from cardiac arrest.

Whether subpopulations of cardiac arrest patients may benefit from targeting hypothermia at 32-34°C remains uncertain.

ANZCOR suggests that comatose patients with mild hypothermia after ROSC should not be actively warmed to achieve normothermia.

ANZCOR recommends against the routine use of pre-hospital cooling with rapid infusion of large volumes of cold intravenous (IV) fluid immediately after ROSC.

ANZCOR suggests surface or endovascular temperature control techniques when temperature control is used in comatose patients after ROSC.

ANZCOR suggests that if used, cooling devices include a feedback system based on continuous temperature monitoring to maintain the target temperature.

ANZCOR suggests that rapid infusion of ice-cold IV fluid, up to 30 ml/kg or ice packs are feasible, safe and simple methods for initially lowering core temperature to up to 1.5 °C. When intravenous fluids are used to induce hypothermia, additional cooling strategies will be required to maintain hypothermia.

ANZCOR suggests active prevention of fever for at least 72 hours in post-cardiac arrest patients who remain comatose. ANZCOR suggests that percutaneous coronary intervention during temperature control is feasible and safe and may be associated with improved outcome.

ANZCOR suggests institutions implementing complex guidelines, such as temperature control, should consider using a comprehensive approach, including clinical champions; consensus-building processes; multidisciplinary involvement; written protocols; detailed process description; practical logistic support; multi-modality, multi-level education; and rapid cycle improvement methods.

1.8 | Sedation and paralysis

Apart from the data related to induced hypothermia, there were no data to support or refute the use of a defined period of ventilation, sedation, and neuromuscular blockade after cardiac arrest. One observational study in adults documents increased incidence of pneumonia when sedation is prolonged beyond 48 hours after pre-hospital or in-hospital cardiac arrest.[16]

There is insufficient data to recommend for or against the use of neuroprotective drugs (such as thiopental, glucocorticoids, nimodipine, lidoflazine, or diazepam) in comatose patients with return of spontaneous circulation post cardiac arrest, not treated with hypothermia or as an adjunct to temperature control management in the post-arrest treatment of adult cardiac arrest.[8]

1.9 | Post–Cardiac Arrest Seizure Prophylaxis and Treatment

Hypoxic-ischemic brain injury is a common cause of death in comatose cardiac arrest survivors. Clinical convulsions and epileptiform activity in the EEG are common. The prognosis for patients with clinical and electrographic seizures is usually poor but some patients recover and may ultimately have a good neurologic outcome. ILCOR CoSTR 2020 updated the 2015 CoSTR for seizure prophylaxis and treatment in cardiac arrest survivors.[3]

Recommendations

ANZCOR suggests against seizure prophylaxis in adult post-cardiac arrest survivors [CoSTR 2020, weak recommendation, very low-certainty evidence].

ANZCOR suggests treatment of seizures in adult post-cardiac arrest survivors [CoSTR 2020, weak recommendation, very low-certainty evidence].

Maintenance therapy for seizures should be started after the first event and potential precipitating causes (e.g. intracranial haemorrhage, electrolyte imbalance) should be excluded [Good Practice Statement].

Post-resuscitation Steroids

The 2010 CoSTR addressed steroid use both intra-arrest and post-resuscitation.[8] The

2015 CoSTR included only intra-arrest steroid use.[12] An Evidence Update for post-resuscitation steroid use was included in the 2023 CoSTR process.[7]

Recommendations

This recommendation is unchanged.

There is insufficient evidence to support or refute the use of corticosteroids for patients with ROSC after cardiac arrest.

1.10 | Treatment of underlying cause of the cardiac arrest

If not already undertaken, management should be directed toward the treatment of underlying causes that have been identified (e.g. management of myocardial infarction, correction of

electrolyte abnormalities, treatment of tension pneumothorax etc.).

Early coronary angiography after ROSC

In 2015, ILCOR recommended early coronary angiography for patients with ROSC after cardiac arrest and ST-segment elevation on ECG.[12] For select post-ROSC patients without ST-segment elevation but with suspected cardiac cause of cardiac arrest, early angiography was suggested. Because of the recent publication of additional evidence, including RCTs, on the question of coronary angiography after ROSC a systematic review[18] was undertaken to inform the 2021 CoSTR process. This was updated with inclusion of new RCT evidence in the 2022 CoSTR process.[6]

There is evidence of underlying ischemic heart disease in the majority of patients who have an OHCA. Acute coronary artery occlusion is known to be the precipitating factor in many of these patients. While coronary artery occlusion after cardiac arrest is associated with ECG ST-segment elevation or left bundle branch block (LBBB), it can also occur in the absence of these findings.[17]

Coma in patients prior to percutaneous coronary intervention (PCI) is commonly present in OHCA patients and should not be a contraindication to consider angiography and PCI.

Recommendations

ANZCOR suggests that when coronary angiography is considered for comatose post-arrest patients without ST-segment elevation, either an early (within 2 to 6 hours) or a delayed (within 24 hours) approach for coronary angiography is reasonable [CoSTR 2022, weak recommendation, low certainty evidence].[6]

ANZCOR suggests early coronary angiography in comatose post–cardiac arrest patients with ST-segment elevation [Good Practice Statement].[6]

Pulmonary embolism

Pulmonary embolism (PE) is a potentially reversible cause of cardiac arrest. There is limited research on the topic and hence it is not clear if the chances of ROSC and survival are better if a PE is present and can be treated. A systematic review of this topic was conducted by ILCOR to inform the 2020 COSTR.[3]

Recommendations

ANZCOR suggests administering fibrinolytic drugs for cardiac arrest when PE is the suspected cause of cardiac arrest [weak recommendation, very low-certainty evidence].

ANZCOR suggests the use of fibrinolytic drugs or surgical embolectomy or percutaneous mechanical thrombectomy for cardiac arrest when PE is the known cause of cardiac arrest [weak recommendation, very low-certainty evidence].

1.11 | Resuscitation related injuries

Rib fractures and other injuries are common but acceptable consequences of CPR given the alternative of death from cardiac arrest.

Recommendation

ANZCOR recommends that after resuscitation, all patients should be reassessed and re-evaluated for resuscitation-related injuries. The extent of injuries is often underestimated by standard investigations (e.g. chest radiograph).[19] Other complications of resuscitation (e.g. incorrect placement of tubes) should be identified and treated. Intravascular lines inserted under emergency conditions may need to be replaced [Good Practice Statement].

1.12 | Cardiac Arrest Centres

Cardiac arrest centres are considered to be hospitals providing evidence-based post-resuscitation treatments, with intensive care and cardiac intervention availability. A systematic review[20] informed the 2019 CoSTR process,[2] and an evidence update was included in 2023 CoSTR by the EIT taskforce. The recommendation is unchanged.

Recommendations

ANZCOR suggests adult non-traumatic OHCA cardiac arrest patients be cared for in cardiac arrest centres rather than in non-cardiac arrest centres [CoSTR 2019, weak recommendation, very low certainty of evidence].

ANZCOR suggests patients with in-hospital cardiac arrest are considered for transfer to a cardiac arrest centre [Good Practice Statement].

2.0 | Prognostication in Comatose Patients After Resuscitation from Cardiac Arrest

Many comatose post-cardiac arrest patients will not survive or will survive with an unfavourable neurologic outcome. Treating teams may limit or withdraw life-sustaining treatment when unfavourable neurologic outcomes are expected. Therefore, reliable strategies for timely prognostication are a critical component of any cardiac arrest care system. The 2015 CoSTR distinguished between studies of prognostication among patients treated with or without hypothermia. For the 2020 CoSTR, these treatment recommendations apply regardless of the temperature management strategy used and were based on updated systematic reviews related to clinical examination, neurophysiology, biomarkers, and imaging available at https://costr.ilcor.org. The reviews identified clinical signs, neurophysiological measurements, blood biomarkers, and imaging studies that had high specificity for poor neurologic outcome.[3] A systematic review on prognostication of favourable outcome was included in the 2023 CoSTR[7].

2.1 | Prognostication during a cardiac arrest

It is impossible to predict accurately the degree of neurological recovery during or immediately after a cardiac arrest. Sedation and pain medication may influence the assessment of the GCS motor score. Waiting time after stopping such medications to achieve a reliable test result varies. The probability of awakening decreases with each day of coma after cessation of sedatives and analgesics.

The assessment of the GCS motor score is an integral part of the identification of those unconscious patients who should undergo prognostication tests after cardiac arrest. Using the GCS motor score to identify those with a better motor response is not likely to have undesirable effects.

Recommendations

ANZCOR recommends against relying on the neurologic exam during or immediately after cardiac arrest to predict outcome [Good Practice Statement].

ANZCOR recommends that neuroprognostication always be undertaken by using a multimodal approach as no single test has sufficient specificity to eliminate false positives [CoSTR 2020, strong recommendation, very low-certainty evidence].

2.2 | Clinical Examination for prognostication

ILCOR evidence review identified 4 categories of predictors of neurological outcome after cardiac arrest: clinical examination, biomarkers, electrophysiology, and imaging.

Recommendations

ANZCOR suggests assessing the GCS motor score in the first 4 days after cardiac arrest to identify patients with a score of >3, which may indicate an increased likelihood of favourable outcome [CoSTR 2023, weak recommendation, very low-certainty evidence].

ANZCOR suggests using pupillary light reflex at 72 hours or more after ROSC for predicting neurological outcome of adults who are comatose after cardiac arrest [CoSTR 2020, weak recommendation, very low-certainty evidence].

ANZCOR suggests using quantitative pupillometry at 72 hours or more after ROSC for predicting neurological outcome of adults who are comatose after cardiac arrest [CoSTR 2020, weak recommendation, low-certainty evidence].

ANZCOR suggests using bilateral absence of corneal reflex at 72 hours or more after ROSC for predicting poor neurological outcome in adults who are comatose after cardiac arrest [CoSTR 2020, weak recommendation, very low-certainty evidence].

ANZCOR suggests using presence of myoclonus or status myoclonus within 7 days after ROSC,

in combination with other tests, for predicting poor neurological outcome in adults who are comatose after cardiac arrest [CoSTR 2020, weak recommendation, very low-certainty evidence]. We also suggest recording EEG in the presence of myoclonic jerks to detect any associated epileptiform activity [CoSTR 2020, weak recommendation, very low-certainty evidence].

ANZCOR suggests prolonging the observation of clinical signs when interference from residual sedation or paralysis is suspected, so that the possibility of obtaining false-positive results is minimized [Good Practice Statement].

2.3 | Neurophysiological Tests for Prognostication

Recommendations

ANZCOR suggests using bilateral absent N20 somatosensory evoked potentials (SSEP) in combination with other indices to predict poor outcome in adult patients who are comatose after cardiac arrest [CoSTR 2020, weak recommendation, very low-certainty evidence].

ANZCOR suggests against using the amplitude of the N20 SSEP wave to predict good neurological outcome of adults who are comatose after cardiac arrest [CoSTR 2023, weak recommendation, very low-certainty evidence].

ANZCOR suggests against using the absence of EEG background reactivity alone to predict poor outcome in adult patients who are comatose after cardiac arrest [CoSTR 2020, weak recommendation, very low-quality evidence].

ANZCOR suggests using a continuous or nearly continuous normal voltage EEG background without periodic discharges or seizures within 72h from ROSC in combination with other indices to predict good outcome in patients who are comatose after cardiac arrest [CoSTR 2023, weak recommendation, very low-certainty evidence].

ANZCOR suggests that the American Clinical Neurophysiological Society (ACNS) terminology be used to classify the EEG patterns used for prognostication in patients who are comatose after cardiac arrest [Good Practice Statement].

ANZCOR suggests against using heterogeneous, non–ACNS defined favourable EEG patterns to predict good neurological outcome after cardiac arrest [CoSTR 2023, weak recommendation, very low-certainty evidence].

ANZCOR suggests using the presence of seizure activity on EEG in combination with other indices to predict poor outcome in adult patients who are comatose after cardiac arrest [CoSTR 2020, weak recommendation, very low-quality evidence].

ANZCOR suggests against the use of other EEG metrics, including reduced montage or amplitude-integrated EEG, BIS, or EEG derived indices, to predict good outcome in patients who are comatose after cardiac arrest [CoSTR 2023, weak recommendation, very low-certainty evidence].

ANZCOR suggests using burst suppression on EEG in combination with other indices to predict

poor outcome in adult patients who are comatose and who are off sedation after cardiac arrest [CoSTR 2020, weak recommendation, very low-quality evidence].

2.4 | Blood Biomarkers for Prognostication

Recommendations

ANZCOR suggests using normal NSE (<17 µg/L) within 72 hours after ROSC, in combination with other tests, for predicting good neurological outcome of adults who are comatose after cardiac arrest [CoSTR 2023, weak recommendation, very low-certainty evidence).

ANZCOR suggests against using serum levels of glial fibrillary acidic protein, serum tau protein, or neurofilament light chain (NfL) in clinical practice for predicting good neurological outcome of adults who are comatose after cardiac arrest [CoSTR 2023, weak recommendation, very low-certainty evidence].

2.5 | Imaging for Prognostication

Recommendations

ANZCOR suggests using brain imaging studies for prognostication only in centres where specific experience is available (CoSTR 2015, weak recommendation, very-low-quality evidence)

ANZCOR suggests using the presence of a marked reduction of the gray matter/white matter (GM/WM) ratio on brain CT within 48 hours after ROSC or the presence of extensive diffusion restriction on brain MRI at 2 to 6 days after ROSC in combination with other predictors for prognosticating a poor neurologic outcome in patients who are comatose after cardiac arrest and who are treated with targeted temperature management (TTM) [CoSTR 2015, weak recommendation, very-low-quality evidence].

ANZCOR suggests against using grey-white matter ratio (GWR), quantitative regional abnormality (QRA), or Alberta Stroke Program (ASPECTS-b) on brain CT to predict good neurological outcome in patients who are comatose after cardiac arrest [CoSTR 2023, weak recommendation, very low-certainty evidence].

ANZCOR suggests against using apparent diffusion coefficient or gradient-recalled echo on brain MRI to predict good neurological outcome in patients who are comatose after cardiac arrest [CoSTR 2023, weak recommendation, very low-certainty evidence].

ANZCOR suggests using the absence of diffusion restriction on MRI between 72 hours and 7

days after ROSC, in combination with other tests, for predicting good neurological outcome of adults who are comatose after cardiac arrest [CoSTR 2023, weak recommendation, very low-certainty evidence].

3.0 | Outcome of Resuscitation

Resuscitation after cardiac arrest produces a good quality of life in most long-term survivors. There is little evidence to suggest that resuscitation leads to a large pool of survivors with an unacceptable quality of life. Survivors may however suffer a variety of post-arrest problems that affect quality of life.

Recommendation

Cardiac arrest survivors may experience post-arrest problems including anxiety, depression, post-traumatic stress, and difficulties with cognitive function. ANZCOR suggests that clinicians should be aware of these potential problems, screen for them and, if found, treat them [Good Practice Statement].

3.1 | Organ donation

ANZCOR recommends that all patients who have restoration of circulation after CPR and who subsequently progress to death be evaluated for organ and tissue donation [CoSTR 2015, strong recommendation, low-quality evidence].

The Australian and New Zealand Intensive Care Society Death and Organ Donation Committee provides relevant advisory statements at: https://www.anzics.com.au/death-and-organ-donation/.

ILCOR published a scientific statement on organ donation after out of hospital cardiac arrest in 2023.[21]

Abbreviations

Abbreviation	Meaning/Phrase
ACNS	American Clinical Neurophysiological Society
ADC	apparent diffusion coefficient

ALS	advanced life support
ANZCOR	Australian and New Zealand Committee on Resuscitation
ASPECTS-b	Alberta Stroke Program
BIS	bispectral index
CoSTR	Consensus on Science with Treatment Recommendations
CPR	cardiopulmonary resuscitation
CT	computed tomography
ECG	electrocardiogram
EEG	electroencephalogram
GWR	grey matter-to-white matter ratio
ICU	Intensive care unit
ILCOR	International Liaison Committee on Resuscitation
IV	intravenous
LBBB	left bundle branch block
MAP	mean arterial pressure
MRI	magnetic resonance imaging
NfL	neurofilament light chain
N20	negative peak at 20ms
NSE	neuron-specific enolase
OHCA	out-of-hospital cardiac arrest
$PaCO_2$	partial pressure of carbon dioxide
PCI	percutaneous coronary intervention
PE	pulmonary embolism
QRA	quantitative regional abnormality
RCTs	randomised control trials

ROSC	return of spontaneous circulation
SaO_2	saturation of arterial oxygen
SBP	systolic blood pressure
SpO_2	pulse oximetry
SSEP	somatosensory evoked potentials
TTM	targeted temperature management
VF	ventricular fibrillation

References

1. Soar J, Donnino MW, Maconochie I, Aickin R, Atkins DL, Andersen LW, Berg KM, Bingham R, Bottiger BW, Callaway CW, et al; on behalf of the ILCOR Collaborators. 2018 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations summary. Resuscitation. 2018;133:194–206. doi:23 10.1016/j.resuscitation.2018.10.017
2. Soar J, Maconochie I, Wyckoff MH, et al. 2019 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces.Resuscitation2019; DOI:https://doi.org/10.1016/j.resuscitation.2019.10.016
3. Soar J, Berg KM, Wycoff MH et al. Adult Advanced Life Support 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation 2020;156:A80-A119.https://doi.org/10.1016/j.resuscitation.2020.09.012

4. Wycoff MH, Singletary EM, Soar J et al. 2021 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Resuscitation 2021;169:229-311.
5. Soar J, Nolan JP Andersen LW et al. Temperature Management in Adult Cardiac Arrest Consensus on Science with Treatment Recommendations. International Liaison Committee on Resuscitation (ILCOR) Advanced Life Support Task Force, 2021 August 30. Available from: http://ilcor.org
6. Wyckoff MH, Greif R, Morley PT et al. 2022 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Resuscitation 2022;181:208-2088. https://doi.org/10.1016/j.resuscitation.2022.10.005
7. Berg KM, Bray JE, Ng KC, Zideman DA, Nolan JP et al. 2023 International Consensus on

Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: Summary From the Basic Life Support; Advanced Life Support; Paediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Resuscitation 2023;194:109992. https://doi.org/10.1016/j.resuscitation.2023.109992

8. Deakin CD, Morrison LJ, Morley PT, Callaway CW, Kerber RE, Kronick SL, et al. Part 8: Advanced life support: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation. [doi: DOI: 10.1016/j.resuscitation.2010.08.027]. 2010;81(1, Supplement 1):e93-e174.
9. Nolan JP, Neumar RW, Adrie C, Aibiki M, Berg RA, Bottiger BW, et al. Post-cardiac arrest syndrome: epidemiology, pathophysiology, treatment, and prognostication. A Scientific Statement from the International Liaison Committee on Resuscitation; the American Heart Association Emergency Cardiovascular Care Committee; the Council on Cardiovascular Surgery and Anesthesia; the Council on Cardiopulmonary, Perioperative, and Critical Care; the Council on Clinical Cardiology; the Council on Stroke. Resuscitation. 2008 Dec;79(3):350-79.
10. Jakkula P, Reinikainen M, Hästbacka J, Loisa P, Tiainen M, Pettilä V, Toppila J, Lähde M, Bäcklund M, Okkonen M, et al; and the COMACARE study group. Targeting two different levels of both arterial carbon dioxide and arterial oxygen after cardiac arrest and resuscitation: a randomised pilot trial. Intensive Care Med. 2018;44:2112–2121. doi: 10.1007/s00134-018-5453-9
11. Ameloot K, De Deyne C, Eertmans W, Ferdinande 1 B, Dupont M, Palmers PJ, Petit T, Nuyens P, Maeremans J, Vundelinckx J, et al. Early goal-directed haemodynamic optimization of cerebral oxygenation in comatose survivors after cardiac arrest: the Neuroprotect post-cardiac arrest trial. Eur Heart J. 2019;40:1804–1814. doi: 10.1093/eurheartj/ehz120
12. Soar J, Callaway C, Aibiki M, Böttiger BW, Brooks SC, Deakin CD, Donnino MW, Drajer S, Kloeck W, Morley PT, Morrison LJ, Neumar RW, Nicholson TC, Nolan JP, Okada K, O'Neil BJ, Paiva EF, Parr MJ, Wang TL, Witt J, on behalf of the Advanced Life Support Chapter Collaborators. Part 4: Advanced life support. 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation 2015;95:e71–e1203
13. Holmberg M, Nicholson T, Nolan J, Schexnayder S, Reynolds J, Nation K, Welsford M, Morley P, Soar J, Berg K; on behalf of the Adult and Pediatric Advanced Life Support Task Forces at the International Liaison Committee on Resuscitation (ILCOR). Oxygenation and ventilation targets after cardiac arrest: a systematic review and meta-analysis. Resuscitation. 2020 Jul;152:107-115. doi: 10.1016/j.resuscitation.2020.04.031
14. Couper K, Laloo R, Field R, Perkins GD, Thomas M, Yeung J. Prophylactic antibiotic use following cardiac arrest: a systematic review and meta-analysis. Resuscitation. 2019;141:166–173. doi: 10.1016/j.resuscitation.2019.04.047
15. Schünemann HJ, Wiercioch W, Brozek J, Etxeandia-Ikobaltzeta I, Mustafa RA, Manja V, Brignardello-Petersen R, Neumann I, Falavigna M, Alhazzani W, et al. GRADE evidence to decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. J Clin Epidemiol. 2017;81:101–110. doi:10.1016/j.jclinepi.2016.09.009
16. Consensus on Science and Treatment Recommendations Part 4: Advanced life support. Resuscitation 2005;67(2-3):213-47.
17. Bossaert L, O'Connor RE, Arntz H-R, Brooks SC, Diercks D, Feitosa-Filho G, et al. Part 9: Acute coronary syndromes: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment

Recommendations. Resuscitation. [doi: DOI: 10.1016/j.resuscitation.2010.09.001]. 2010;81(1, Supplement 1):e175-e212.
18. Drennan IR, Nikolaou N, Netherton S, et al. International Liaison Committee on Resuscitation Advanced Life Support Task Force. Early coronary angiography post-ROSC: International Liaison Committee on Resuscitation. Accessed March 10, 2021.Available from: https://costr.ilcor.org/document/early-coronary-angiography-postrosc-als-costr-systematic-review, 2021.
19. Lederer W, Mair D, Rabl W, Baubin M. Frequency of rib and sternum fractures associated with out-of-hospital cardiopulmonary resuscitation is underestimated by conventional chest X-ray. Resuscitation. 2004;60(2):157-62.
20. Yeung J, Bray J, Reynolds J et al. Cardiac Arrest Centers versus Non-Cardiac Arrest Centers – Adults. Consensus on Science and Treatment Recommendations [Internet] Brussels, Belgium: International Liaison Committee on Resuscitation (ILCOR) EIT and ALS Task Forces, 2019 January 3023. Available from:http://ilcor.org
21. Morrison LJ, Sandroni C, Grunau B, Parr M, Macneil F, Perkins GD, Aibiki M, Censullo E, Lin S, Neumar RW, Brooks SC. Organ Donation After Out-of-Hospital Cardiac Arrest: A Scientific Statement from the International Liaison Committee on Resuscitation. Circulation 2023;147:e00–e00. DOI: 10.1161/CIR.0000000000001125 Online 9.8.2023.

About this Guideline

Search date/s	See ILCOR PICOs in CoSTR documents http://ilcor.org
Questions/PICOs:	See ILCOR PICOs in CoSTR documents http://ilcor.org
Method:	GRADE for ILCOR CoSTR reviews.
Main changes:	Updating of review evidence, references, and terminology to increase consistency with GRADE terminology. Describes initial blood pressure targets following ROSC. Modification of recommendation to emphasise temperature control and preventing fever (See Guideline 11.8 Temperature Control. Additional recommendations addressing prognostication for favourable neurological outcome
Primary reviewers:	Michael Parr, Tonia Nicholson, Margaret Nicholson, Sharon-Ann Shunker

Other consultation:	N/A
Worksheet:	N/A
Approved:	September 2024
Guideline Superseded:	January 2016

Referencing this guideline

When citing the ANZCOR Guidelines we recommend:

ANZCOR, 2025, Guideline 11.7 – Post-resuscitation Therapy in Adult Advanced Life Support, accessed 20 April 2025, https://www.anzcor.org/home/adult-advanced-life-support/guideline-11-7-post-resuscitation-therapy-in-adult-advanced-life-support/