



## CG027 Post-cardiac arrest (adults)

1. Key Recommendations for operational use		
1	Airway	<ul style="list-style-type: none"> <li>Consider general anaesthesia, intubation and ventilation in any patient with reduced consciousness.</li> </ul>
2	Breathing	<ul style="list-style-type: none"> <li>Use 100% oxygen until SpO<sub>2</sub> can be measured and then titrate oxygen to SpO<sub>2</sub> 94-98%.</li> <li>Use waveform capnography.               <ul style="list-style-type: none"> <li>ventilate to normocapnia: ET/CO<sub>2</sub> 4.0 to 5.0kPa.</li> </ul> </li> <li>Measure arterial PaCO<sub>2</sub> if feasible with a target of 4.5 to 6.0kPa.</li> <li>Use protective lung ventilation strategies (6-8ml/kg tidal volume).</li> <li>Insert OG/NG tube.</li> </ul>
3a	Circulation	<ul style="list-style-type: none"> <li>Site IV/IO access x 2.</li> <li>Consider intra-arterial blood pressure monitoring.               <ul style="list-style-type: none"> <li>avoid the right radial artery if coronary angiography is a possibility.</li> </ul> </li> <li>Tolerate bradycardia (HR 30 to 40/min) as long as blood pressure and cerebral/renal perfusion are maintained.</li> <li>Aim for systolic BP ≥100 mmHg or mean arterial pressure (MAP) ≥65 mmHg.               <ul style="list-style-type: none"> <li>consider IV crystalloid to restore normovolaemia.</li> </ul> </li> <li>Consider vasopressor use to maintain BP:               <ul style="list-style-type: none"> <li>first line: noradrenaline infusion.</li> <li>if giving peripherally then use the 4mg/50ml dilution and monitor the infusion site.</li> <li>consider giving boluses of 50 to 100micrograms (0.5-1ml of 1:10,000) adrenaline to treat critical hypotension in the first instance.</li> </ul> </li> <li>If a syringe driver is not available consider 10-20microgram boluses of IV adrenaline.               <ul style="list-style-type: none"> <li>dilute 1ml of 1:10,000 adrenaline with saline or dextrose up to 10ml total volume.</li> <li>1ml of this 1:100,000 adrenaline dilution is 10micrograms</li> </ul> </li> </ul>
3b		<ul style="list-style-type: none"> <li>Obtain 12-lead ECG.</li> <li>With ST elevation or left bundle branch block on ECG:               <ul style="list-style-type: none"> <li>Discuss with interventional cardiology centre.</li> <li>Consider thrombolysis if &gt;120 minutes to primary PCI.</li> <li>See <b>CG008 Acute Coronary Syndromes</b>.</li> </ul> </li> </ul>
3c		<ul style="list-style-type: none"> <li>For guidance on dysrhythmias (either tachy- or bradycardia) with life threatening features, use <b>CG016 Peri-arrest arrhythmias (adult)</b></li> </ul>
4	Disability	<ul style="list-style-type: none"> <li>Measure Glucose and target 7.8 to 10 mmol/L.               <ul style="list-style-type: none"> <li>avoid hypoglycaemia.</li> </ul> </li> <li>Treat seizures (<b>CG004 Status Epilepticus</b>).</li> <li>Do not use anticonvulsants prophylactically.</li> <li>Ensure adequate sedation in patients who are ventilated.</li> </ul>



## CG027 Post-cardiac arrest (adults)

5	Environment	<ul style="list-style-type: none"> <li>• Insert temperature probe and continuously monitor temperature.</li> <li>• Intervene to avoid temperature &gt;37.5°C.</li> <li>• Do not actively rewarm mild hypothermia.</li> <li>• Do not use rapid infusion of large volumes of cold IV fluids in the pre-hospital phase.</li> </ul>
6	Further management	<ul style="list-style-type: none"> <li>• Catheterise and monitor urine output:             <ul style="list-style-type: none"> <li>- target &gt;0.5 ml/kg/hour.</li> </ul> </li> <li>• Where available the following are useful:             <ul style="list-style-type: none"> <li>- Bloods: arterial gases, FBC, U&amp;Es, calcium, magnesium, troponin.</li> <li>- Echocardiography.</li> <li>- Chest X-ray.</li> <li>- CT brain and / or CTPA if non-cardiac cause of arrest is suspected.</li> </ul> </li> <li>• If feasible, target serum potassium of 4.0 to 4.5 mmol/L.</li> <li>• Consider a higher target blood pressure if known hypertension, not achieving urine output or persistently raised lactate.</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Do not give steroids routinely.</li> <li>• Do not give antibiotics routinely.</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• If available, consider using a dobutamine infusion (in additional to noradrenaline) for myocardial dysfunction.</li> </ul>
7	Triage	<ul style="list-style-type: none"> <li>• Ensure early discussion with retrieval service where their assistance will be needed.</li> <li>• Discuss with the appropriate interventional cardiology centre:             <ul style="list-style-type: none"> <li>- patients with other suspicion / evidence of acute coronary artery occlusion.</li> <li>- haemodynamic and/or electrical instability.</li> </ul> </li> <li>• For other patients use usual triage pathways to the nearest hospital with an ICU.</li> </ul>



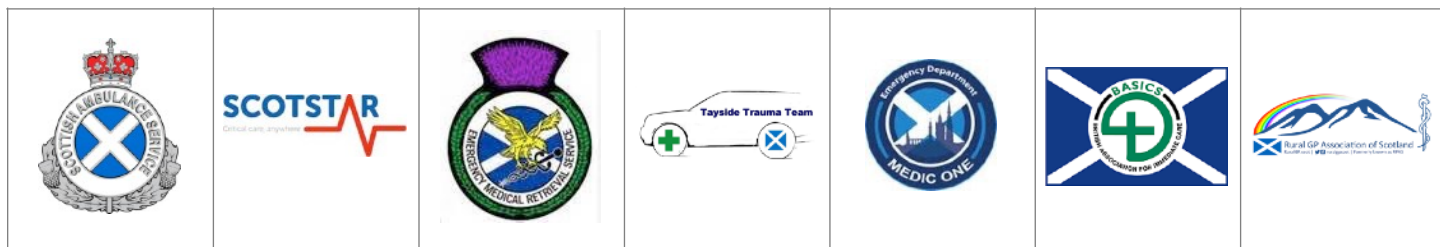
## CG027 Post-cardiac arrest (adults)

Physiology checklist			
8	Physiological Targets	• SpO <sub>2</sub>	94 - 98%
		• ETCO <sub>2</sub>	4 - 5kPa / 35 - 45mmHg (with waveform capnography)
		• SBP	>100mmHg
		• MAP	≥65mmHg (consider higher target if known hypertension, not achieving urine output or persistently raised lactate)
		• Temperature	target below 37.5°C
		• Glucose	7.8-10 mmol/L (normoglycaemia)
		• Potassium	4.0 to 4.5 mmol/L
		• Urine output	>0.5 ml/kg/hour



## CG027 Post-cardiac arrest (adults)

2. Document History			
Reference Number	CG027		
Version	1		
Writing group (Lead author in bold)	David Campbell	Retrieval Practitioner	EMRS North
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Date issued	15th April 2022		
Date for review	April 2025		
Distribution	BASICS Scotland		✓
	Medic 1		✓
	Referring centres via service websites		✓
	Rural GPs Association of Scotland		✓
	SAS	Air Ambulance	for information
		Specialist Services Desk	X
	ScotSTAR	EMRS West	✓
		EMRS North	✓
		Paediatric	X
		Neonatal	X
Tayside Trauma Team		✓	





## CG027 Post-cardiac arrest (adults)

### 3. Scope and purpose

- Overall objectives:

The aim of this guideline is to inform patient management decisions for patients with return of spontaneous circulation (ROSC) following a cardiac arrest.

- Statement of intent:

This guideline is not intended to be construed or to serve as a standard of care. Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan. Clinicians using this guideline should work within their skill sets and usual scope of practice.

- Feedback:

Comments on this guideline can be sent to: [sas.cpg@nhs.scot](mailto:sas.cpg@nhs.scot)

- Equality Impact Assessment:

Applied to the ScotSTAR Clinical Standards group processes.

- Guideline process endorsed by the Scottish Trauma Network Prehospital, Transfer and Retrieval group.





## CG027 Post-cardiac arrest (adults)

4. Explanatory Statements		
4.1 Airway	Authors' recommendation	Level [Reference]
<ul style="list-style-type: none"> <li>Consider general anaesthesia, intubation and ventilation in any patient with reduced consciousness.</li> </ul> <p>Patients who have had a brief period of cardiac arrest and have immediate return of normal cerebral function do not require intubation and ventilation.</p>	Conditional	Guideline [1]
<p><b>4.2 Breathing</b></p> <ul style="list-style-type: none"> <li>Use 100% oxygen until SpO<sub>2</sub> can be measured and then titrate oxygen to SpO<sub>2</sub> 94-98%.</li> </ul> <p>Hypoxaemia may contribute to secondary brain injury. There is mixed evidence surrounding hyperoxia and neurological injury: normal levels of oxygenation are advised.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>Use waveform capnography.               <ul style="list-style-type: none"> <li>ventilate to normocapnia: ET/CO<sub>2</sub> 4.0 to 5.0kPa.</li> </ul> </li> <li>Measure arterial PaCO<sub>2</sub> if feasible with a target of 4.5 to 6.0kPa.</li> </ul> <p>It is advised to avoid hypocapnia since this can be associated with worse outcomes. The evidence for targeting mild hypercapnia is uncertain.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>Use protective lung ventilation strategies (6-8ml/kg tidal volume).</li> </ul> <p>The ERC [1] recommendation is extrapolated from the general ICU population. A propensity adjusted retrospective cohort analysis suggested better outcomes with low tidal volume ventilation during the initial 48hrs in the ICU.</p>	Conditional	Guideline [1] 2++ [7]
<ul style="list-style-type: none"> <li>Insert OG/NG tube.</li> </ul> <p>Decompressing the stomach with an NG/OG tube may improve ventilation.</p>	Conditional	Guideline [1]
<p><b>4.3a Circulation</b></p>		
<ul style="list-style-type: none"> <li>Site IV/IO access x 2.</li> </ul>	GPP	Guideline [4]
<ul style="list-style-type: none"> <li>Consider intra-arterial blood pressure monitoring.</li> </ul> <p>Post-resuscitation myocardial dysfunction and low cardiac index may occur in up to 60% of post cardiac arrest patients. This can manifest as hypotension and arrhythmias. Arterial line monitoring is suggested as a best practice statement.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>avoid the right radial artery if coronary angiography is a possibility.</li> </ul> <p>The right radial artery is the preferred cannulation site for angiography [2] due to reduced adverse events including all cause mortality reduction [3].</p>	Strong	Guideline [2] 1++ [3]



## CG027 Post-cardiac arrest (adults)

<ul style="list-style-type: none"> <li>• <i>Tolerate bradycardia (HR 30 to 40/min) as long as blood pressure and cerebral/renal perfusion are maintained.</i></li> </ul> <p>As long as blood pressure, lactate and urine output are sufficient, a bradycardia of <math>\leq 40</math>/min may be left untreated.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>• <i>Aim for systolic BP <math>\geq 100</math> mmHg / MAP <math>\geq 65</math> mmHg.</i> <ul style="list-style-type: none"> <li>- Hypotension (MAP <math>&lt; 65</math> mmHg) is associated with poor outcomes. MAP is a main determinant of cerebral perfusion pressure (CPP). Ischaemic brain injuries post ROSC are associated with hypotension, pyrexia, hypoglycaemia, hyperglycaemia and seizures.</li> <li>- Cerebral blood flow (CBF) regulation is impaired post-ROSC and is likely to be MAP dependant. Lower MAP risks reduced CBF and secondary brain injury.</li> <li>- Specific blood pressure targets and their influence on clinical outcome is not firmly established and optimal targets for mean arterial pressure and/or systolic arterial pressure remain unknown.</li> </ul> </li> </ul>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>- <i>consider IV crystalloid to restore normovolaemia.</i></li> <li>• <i>Consider vasopressor to maintain BP:</i> <ul style="list-style-type: none"> <li>- <i>first line: noradrenaline infusion.</i></li> <li>- <i>if giving peripherally then use the 4mg/50ml dilution and monitor the infusion site.</i></li> </ul> </li> </ul> <p>There is limited evidence to guide either optimal fluid therapy or vasoactive drug use in post-ROSC patients. Post-resuscitation myocardial dysfunction often requires inotropic support, at least transiently. The systematic inflammatory response that occurs frequently in post-cardiac arrest patients may cause vasoplegia and severe vasodilation. Thus, noradrenaline, with or without dobutamine, and fluid is usually the most effective treatment. Noradrenaline is well tolerated in the post-cardiac arrest patient.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>- <i>consider giving boluses of 50 to 100micrograms (0.5-1ml of 1:10,000) adrenaline to treat critical hypotension in the first instance.</i></li> </ul>	Conditional	Guidelines [4,8]
<ul style="list-style-type: none"> <li>• <i>If a syringe driver is not available consider 10-20microgram boluses of IV adrenaline.</i> <ul style="list-style-type: none"> <li>- <i>dilute 1ml of 1:10,000 adrenaline with saline or dextrose up to 10ml total volume.</i></li> <li>- <i>1ml of this 1:100,000 adrenaline dilution is 10micrograms</i></li> </ul> </li> </ul>	GPP	



## CG027 Post-cardiac arrest (adults)

4.3b Circulation	Authors' recommendation	Level [Reference]
<ul style="list-style-type: none"> <li>• Obtain 12-lead ECG.</li> <li>• With ST elevation or left bundle branch block on ECG:               <ul style="list-style-type: none"> <li>- Discuss with interventional cardiology centre.</li> <li>- Consider thrombolysis if &gt;120 minutes to primary PCI.</li> <li>- See <b>CG008 Acute Coronary Syndromes</b>.</li> </ul> </li> </ul> <p>A 12-lead ECG will identify acute ST segment elevation or left bundle branch block. This is an indication for primary PCI. Aim for a 'call to balloon time' of &lt;120 mins. In patients with ST segment elevation or left bundle branch block on the post-ROSC ECG more than 80% will have an acute coronary lesion. Immediate angiography and PCI when indicated should be performed in resuscitated OHCA patients whose initial ECG shows ST elevation, even if they remain comatose and ventilated.</p>	Strong	Guidelines [1,2]
<h3>4.4 Disability</h3>		
<ul style="list-style-type: none"> <li>• Glucose – target 7.8 to 10 mmol/L.               <ul style="list-style-type: none"> <li>- avoid hypoglycaemia (&lt;4.0 mmol/l)</li> </ul> </li> </ul> <p>There is a strong association between high blood glucose after resuscitation from cardiac arrest and poor neurological outcome. Severe hypoglycaemia is associated with increased mortality in critically ill patients. Following ROSC maintain the blood glucose at ≤10 mmol/l and avoid hypoglycaemia. Do not implement strict glucose control in adult patients with ROSC after cardiac arrest as it increases the risk of hypoglycaemia.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>• Treat seizures with anticonvulsants (<b>CG004 Status Epilepticus</b>).</li> <li>• Do not use anticonvulsants prophylactically.</li> </ul> <p>Seizures are common after cardiac arrest and occur in approximately one-third of patients who remain comatose after ROSC. Routine seizure prophylaxis in post-cardiac arrest patients is not recommended.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>• Ensure adequate sedation in patients who are ventilated.</li> </ul> <p>Consistent with standard ICU management. Short acting sedatives and opioids are preferred.</p>	Conditional	Guideline [1]





## CG027 Post-cardiac arrest (adults)

4.5 Environment	Authors' recommendation	Level [Reference]
<ul style="list-style-type: none"> <li>• <i>Insert temperature probe and continuously monitor temperature.</i></li> <li>• <i>Intervene to avoid temperature &gt;37.5°C.</i></li> <li>• <i>Do not actively rewarm mild hypothermia.</i></li> <li>• <i>Do not use rapid infusion of large volumes of cold IV fluids in the pre-hospital phase (maximum of 1 litre of crystalloids).</i></li> </ul> <p>A period of hyperthermia is common in the first 48 hours after cardiac arrest. Several studies document an association between post-cardiac arrest pyrexia and poor outcomes. Trials of targeted temperature management have given conflicting results. The most recent guideline [5] accounts for the findings of the TTM2 trial [6], which was ongoing at the time of publication of the ERC 2021 guideline [1].</p>	Strong	Guidelines [1,5] 1++ [6]
<b>4.6 Further Management</b>		
<ul style="list-style-type: none"> <li>• <i>Catheterise and monitor urine output.</i></li> </ul> <p>Desired urine output is &gt;0.5ml/kg/hr to guide MAP</p>		Guideline [1]
<ul style="list-style-type: none"> <li>• <i>Where possible the following are useful:</i> <ul style="list-style-type: none"> <li>- <i>Bloods: arterial gases, FBC, U&amp;Es, calcium, magnesium, troponin.</i></li> </ul> </li> </ul> <p>Arterial gases: to monitor and refine ventilation and resuscitation  FBC: avoid anaemia  Magnesium: replace if low to prevent arrhythmias and increase seizure threshold. Target 0.7-1.1mmol/l.  Calcium: replace if low to prevent arrhythmias  Troponin: baseline</p>	GPP	
<ul style="list-style-type: none"> <li>- <i>Echocardiography.</i></li> </ul> <p>Perform as soon as feasible to assess for cardiac pathology and myocardial dysfunction.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>- <i>Chest X-ray.</i></li> </ul> <p>Check position of ET tube, gastric tube and central venous lines; assess for pulmonary oedema; detect complications from CPR e.g., rib fractures and pneumothorax.</p>	Conditional	Guideline [9]
<ul style="list-style-type: none"> <li>- <i>CT brain and / or CTPA if non-cardiac cause of arrest is suspected.</i></li> </ul> <p>To diagnose cause of cardiac arrest and guide further management.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>• <i>If feasible, target serum potassium of 4.0 to 4.5 mmol/L.</i></li> </ul> <p>Immediately after a cardiac arrest there is typically a period of hyperkalaemia followed by hypokalaemia after endogenous correction of metabolic and respiratory acidosis. Hypokalaemia may predispose to ventricular arrhythmias. Give potassium to maintain the serum potassium concentration between 4.0 and 4.5 mmol/L.</p>	Conditional	Guideline [1]



## CG027 Post-cardiac arrest (adults)

<ul style="list-style-type: none"> <li>• <i>Consider a higher target blood pressure if known hypertension, not achieving urine output or if serum lactate is consistently elevated.</i></li> </ul> <p>Target the mean arterial blood pressure to achieve an adequate urine output and normal or decreasing plasma lactate values, taking into consideration the patient's normal blood pressure, the cause of the arrest and the severity of any myocardial dysfunction. Accordingly, this may require an individualised plan.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>• <i>Do not give steroids routinely.</i></li> </ul> <p>There is currently conflicting data in this regard, and routine use of steroids is not recommended.</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>• <i>Do not give prophylactic antibiotics routinely.</i></li> </ul>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>• <i>If available, consider using a dobutamine infusion (in addition to noradrenaline) for myocardial dysfunction.</i></li> </ul>	Conditional	Guideline [1]
<b>4.6 Triage</b>		
<ul style="list-style-type: none"> <li>• <i>Discuss with the appropriate interventional cardiology centre:</i> <ul style="list-style-type: none"> <li>- <i>patients with other suspicion / evidence of acute coronary artery occlusion.</i></li> <li>- <i>haemodynamic and / or electrical instability.</i></li> </ul> </li> </ul> <p>Emergent angiography can be considered if it is thought that there is a high probability of acute coronary occlusion. Otherwise immediate angiography does not confer benefit and should be delayed [10].</p>	Conditional	Guideline [1]
<ul style="list-style-type: none"> <li>• <i>For other patients use usual triage pathways, ideally conveying to the nearest hospital with an ICU.</i></li> </ul>	GPP	



## CG027 Post-cardiac arrest (adults)

### 5. References

1. Nolan, JP et al. European Resuscitation Council and European Society of Intensive Care Medicine Guidelines 2021: Post-resuscitation Care. *Resuscitation* 2021; 161: 220-269.
2. Ibanez B et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. *European Heart Journal* 2018; 39: 119-177.
3. Valgimigli M et al. Radial versus femoral access in patients with acute coronary syndromes undergoing invasive management: a randomised multicentre trial. *Lancet* 2015; 385: 2465.
4. Advanced Life Support. 8th Edition. May 2021. Resuscitation Council UK. (Page 194).
5. Sandroni C et al. ERC-ESICM guidelines on temperature control after cardiac arrest in adults. *Intensive Care Med* 2022; 48: 261-269.
6. Dankiewicz J et al. Hypothermia versus normothermia after out of hospital cardiac arrest. *N Engl J Med* 2021; 384: 2283-94.
7. Beitler JR et al. Favourable neurocognitive outcome with low tidal volume ventilation after cardiac arrest. *Am J Resp Crit Care Med* 2017; 195: 1198-1206.
8. <https://www.medicines.org.uk/emc/product/3675/smpc#gref>
9. Peberdy MA et al. 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation* 2010; 122: S768-S786.
10. Desch S et al. Angiography after out-of-hospital cardiac arrest without ST-segment elevation. *NEJM* 2021; 385: 2544-2553.



## CG027 Post-cardiac arrest (adults)

Quick reference guide: Post ROSC
<b>Airway</b>
<ul style="list-style-type: none"><li>• Consider intubation if reduced level of consciousness</li></ul>
<b>Breathing</b>
<ul style="list-style-type: none"><li>• Maintain SpO<sub>2</sub> 94-98%</li><li>• Use waveform capnography (target 4.0 to 5.0kPa)</li><li>• Consider measuring P<sub>a</sub>CO<sub>2</sub> (target 4.5 to 6.0kPa)</li><li>• Ventilate with 6-8ml/kg tidal volume</li><li>• Insert OG/NG tube</li></ul>
<b>Circulation</b>
<ul style="list-style-type: none"><li>• 12-lead ECG - discuss STEMI with PCI centre</li><li>• Consider arterial line (avoid the right radial)</li><li>• Aim systolic BP ≥100 mmHg or MAP ≥65 mmHg<ul style="list-style-type: none"><li>- Fluid challenge (maximum 1 litre),</li><li>- then Noradrenaline infusion <b>Or</b> 10mcg Adrenaline boluses</li></ul></li><li>• Serum potassium of 4.0 to 4.5 mmol/l</li></ul>
<b>Disability</b>
<ul style="list-style-type: none"><li>• Measure Glucose and target 7.8 to 10 mmol/l</li><li>• Insert temperature probe and avoid &gt;37.5°C</li></ul>