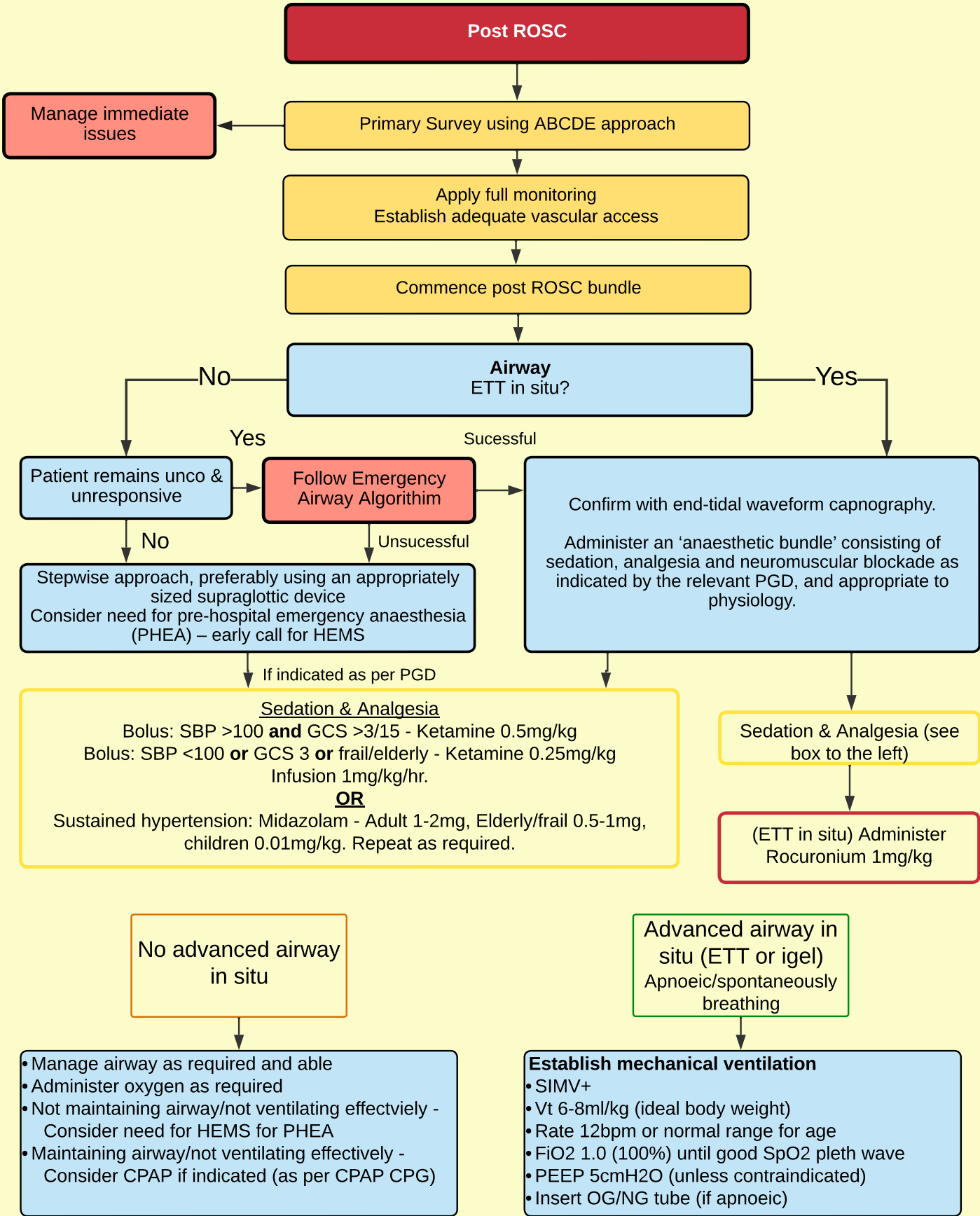




Critical Care

Clinical Practice Guideline

POST ROSC MANAGEMENT





Critical Care Clinical Practice Guideline

POST ROSC MANAGEMENT

- **Avoid hypoxia & hyperoxia**
target SpO₂ of 94-98%. Adjust FiO₂ to titrate oxygen - do not go below 0.4 (40%).
- **Avoid hyper/hypocapnoea**
target EtCO₂ of 4.0-5.0kPa.
- Deliver 5cmH₂O PEEP as standard unless contraindicated (bronchospasm, profound hypotension)

Difficulty oxygenating?

- Consider increasing PEEP. Caution with PEEP >10cmH₂O
- Consider Pressure Support (PS).
Start at 5cmH₂O - max 20cmH₂O
- Bronchospasm - see Asthma CPG
- Spontaneously breathing - consider CPAP as per CPG
- Consider patient habitus/position - sit up

- **Avoid hypotension**
target a systolic blood pressure of >100mmHg
- Use 250 ml boluses of fluid to restore systolic BP >100mmHg
- Use vasoactive drugs as per the vasoactive CPG
- Ensure a 12 lead ECG is performed - at least 10 minutes post ROSC
- Treat arrhythmias as per the 'Tachycardia' and 'Bradycardia' CPGs
- If in cardiogenic shock with ECG confirmed STEMI consider thrombolysis as per CPG

In the paralysed patient with persistent tachycardia and/or hypotension, despite adequate sedation, consider anaphylaxis if there is bronchospasm or urticaria

- Control seizures as per the Seizures CPG
- Record temperature (ideally oesophageal) - maintain normothermia - avoid temperature >37.7°C
- Ensure BGL >4.0mmol

Triage

- ECG meeting PPCI criteria - follow PPCI pathway
- Likely cardiac without PPCI criteria ECG - consider PPCI centre - do not bypass without discussion
- Trauma - follow major trauma decision tool
- Children - nearest paed receiving ED
- All others - nearest ED

ROSC Care Bundle Clinical Performance Indicator

- Airway secured
- Paralysed if ETT in situ
- Appropriate sedation/analgesia
- Establish ventilation - Vt 6-8ml/kg, PEEP 5cmH₂O
- Oxygen administered & SpO₂ maintained 94-98%
- EtCO₂ maintained 4.0-5.0kPa
- SBP recorded & maintained >100mmHg
- Fluid bolus administered
- 12 lead ECG performed
- BGL recorded & maintained >4.0mmol
- Appropriate triage
- Record condition code - A00

For full detail see CPI guide



Critical Care

Clinical Practice Guideline

POST ROSC MANAGEMENT

Preparation

Bolus and Infusion:

Draw 200mg (20ml) of ketamine 10mg/ml into a labelled 20ml syringe

For bolus doses below 20mg (2ml volume) the appropriate volume of 10mg/ml solution should be drawn/decanted into a 1ml or 2ml syringe to facilitate safe administration of smaller volumes.

Dose

Bolus:

Systolic BP >100 **AND** GCS >3/15 - 0.5mg/kg. Repeat as required.

Systolic BP <100 **OR** GCS 3/15 - 0.25mg/kg. Repeat as required.

Infusion: Start at rate of 0.1ml/kg/hr (1mg/kg/hr).

Titrate in increments of 0.05ml/kg/hr (0.5mg/kg/hr)

**only one syringe driver to be used per point of IV/IO access.*

AGE	WEIGHT	BP<100 MMHG (0.25MG/KG)		BP>100 MMHG (0.5MG/KG)		INITIAL INFUSION RATE	INCREMENT RATE
		INITIAL BOLUS	VOLUME (not	INITIAL BOLUS	VOLUME (not		
Birth	3.5kg	1mg	0.1ml	1.5mg	0.15ml	N/A	N/A
3mths	6kg	1.5mg	0.15ml	3mg	0.3ml	N/A	N/A
6mths	8kg	2mg	0.2ml	4mg	0.4ml	N/A	N/A
12mths	10kg	2.5mg	0.25ml	5mg	0.5ml	N/A	N/A
18mths	11kg	2.5mg	0.25ml	5.5mg	0.55ml	N/A	N/A
2yrs	12kg	3mg	0.3ml	6mg	0.6ml	N/A	N/A
3yrs	14kg	3.5mg	0.35ml	7mg	0.7ml	N/A	N/A
4yrs	16kg	4mg	0.4ml	8mg	0.8ml	N/A	N/A
5yrs	19kg	5mg	0.5ml	9mg	0.9ml	N/A	N/A
6yrs	21kg	5.5mg	0.55ml	11mg	1.1ml	N/A	N/A
7yrs	23kg	6mg	0.6ml	12mg	1.2ml	N/A	N/A
8yrs	26kg	6.5mg	0.65ml	13mg	1.3ml	N/A	N/A
9yrs	29kg	7mg	0.7ml	14mg	1.4ml	N/A	N/A
10yrs	32kg	8mg	0.8ml	16mg	1.6ml	3.2ml/hr	1.6ml/hr
11yrs	35kg	9mg	0.9ml	18mg	1.8ml	3.5ml/hr	1.8ml/hr
40kg		10mg	1ml	20mg	2mls	4ml/hr	2ml/hr
45kg		11mg	1.1ml	22.5mg	2.25mls	4.5ml/hr	2.3ml/hr
50kg		12.5mg	1.25ml	25mg	2.5mls	5ml/hr	2.5ml/hr
60kg		15mg	1.5ml	30mg	3mls	6ml/hr	3ml/hr
70kg		17.5mg	1.75ml	35mg	3.5mls	7ml/hr	3.5ml/hr
80kg		20mg	2mls	40mg	4mls	8ml/hr	4ml/hr
90kg		22.5mg	2.25mls	45mg	4.5mls	9ml/hr	4.5ml/hr
100kg+		25mg	2.5mls	50mg	5mls	10ml/hr	5ml/hr



Critical Care

Clinical Practice Guideline

POST ROSC MANAGEMENT

Preparation

Bolus:

Morphine - prepare in the standard method for a 1mg/ml solution
Midazolam - draw 5mg/5ml into a labelled 5ml syringe for a 1mg/ml solution.

For bolus doses below 1mg (1ml volume) decant into a 1ml syringe to facilitate safe administration of smaller volumes

Dose

Bolus:

Morphine and Midazolam:
Adult 1-2mg
Elderly/frail 0.5-1mg
Children 0.01mg/kg.
Repeat as required to a maximum of 0.1mg/kg.

AGE	WEIGHT	MORPHINE BOLUS DOSE 0.01MG/KG	VOLUME	MIDAZOLAM BOLUS DOSE 0.01MG/KG	VOLUME
6mths	8kg	0.08mg	0.08ml	0.08mg	0.08ml
12mths	10kg	0.1mg	0.1ml	0.1mg	0.1ml
18mths	11kg	0.11mg	0.11ml	0.11mg	0.11ml
2yrs	12kg	0.12mg	0.12ml	0.12mg	0.12ml
3yrs	14kg	0.14mg	0.14ml	0.14mg	0.14ml
4yrs	16kg	0.16mg	0.16ml	0.16mg	0.16ml
5yrs	19kg	0.19mg	0.19ml	0.19mg	0.19ml
6yrs	21kg	0.21mg	0.21ml	0.21mg	0.21ml
7yrs	23kg	0.23mg	0.23ml	0.23mg	0.23ml
8yrs	26kg	0.26mg	0.26ml	0.26mg	0.26ml
9yrs	29kg	0.29mg	0.29ml	0.29mg	0.29ml
10yrs	32kg	0.32mg	0.32ml	0.32mg	0.32ml
11yrs	35kg	0.35mg	0.32ml	0.35mg	0.35ml
40kg		0.5mg	0.5ml	0.5mg	0.5ml
45kg		0.5mg	0.5ml	0.5mg	0.5ml
50kg		0.5mg	0.5ml	0.5mg	0.5ml
60kg		1.0mg	1.0ml	1.0mg	1.0ml
70kg		1.5mg	1.5ml	1.5mg	1.5ml
80kg		2.0mg	2.0mls	2.0mg	2.0ml
90kg		2.0mg	2.0mls	2.0mg	2.0ml
100kg+		2.5mg	2.5mls	2.5mg	2.5ml



Critical Care

Clinical Practice Guideline

POST ROSC MANAGEMENT

Background

Critical Care Paramedics are frequently tasked to patients who have a return of spontaneous circulation (ROSC) following an out-of-hospital cardiac arrest (OHCA). Attendance can be during the cardiac arrest phase, or once ROSC has been achieved.

Successful return of spontaneous circulation (ROSC) following an out of hospital cardiac arrest is the first step towards the goal of complete recovery. The complex pathophysiological processes that occur following whole body ischaemia during cardiac arrest and the subsequent re-perfusion response during CPR and following successful resuscitation have been termed the post-cardiac arrest syndrome. The post-cardiac arrest syndrome comprises:

- post-cardiac arrest brain injury
- post-cardiac arrest myocardial dysfunction
- systemic ischaemia/reperfusion response
- persistent precipitating pathology.

Care of ROSC patients should follow a defined care bundle. This bundle of care aims to address the elements of the post cardiac arrest syndrome.

This Clinical Practice Guideline (CPG) applies to cardiac arrest in both adults and children, with the primary objective of standardising the optimal approach to the management of patients with return of spontaneous circulation following an out of hospital cardiac arrest.

This CPG introduces a standardised bundle of care for the post-ROSC patient and outlines the key points in post-ROSC care. It is not a substitute for a comprehensive understanding of the wider evidence base.

This CPG begins immediately cardiac output is restored to a patient who was previously in cardiac arrest. It is to be used in conjunction with other CPGs, as noted.

Assessment

A detailed primary survey should be undertaken with the priority of identifying immediate threat to life and initial treatment priorities.

Concurrently to the patient assessment, other activity should include supporting initial treatment priorities as identified in the primary survey and directing peripheral activity in order to initiate the ROSC care bundle, i.e. establishing monitoring, ensuring adequate vascular access.

Airway

Airway and ventilation support should continue after ROSC is achieved.

If an endo-tracheal tube (ETT) was not sited during the cardiac arrest phase, consider endo-tracheal intubation (ETI) in patients that remain comatose^[1], following the Emergency Airway Algorithm (Appendix 1). This must be confirmed with end-tidal waveform capnography.

If ETT insertion is not appropriate or possible, then the airway may be maintained in a stepwise approach, preferably using an appropriately sized supraglottic device.

Administer an ‘anaesthetic bundle’ consisting of sedation, analgesia and neuromuscular blockade as indicated by the relevant PGD, and appropriate to physiology (see page 6).

Consider need for pre-hospital emergency anaesthesia – early call for HEMS.



Critical Care Clinical Practice Guideline

POST ROSC MANAGEMENT

Breathing (oxygenation & ventilation)

Avoid hypoxia and hyperoxia. Once a reliable SpO₂ reading is obtained (illustrated by a good plethysmograph trace), titrate FiO₂ to target an oxygen saturation of 94-98%. An FiO₂ below 0.4 should be avoided until optimal oxygenation can be confirmed by blood gases.

Use EtCO₂ capnography in all patients requiring mechanical or manual ventilation and target a 'normal' value of 4.0-5.0kPa (30-40mmHg) by adjusting the minute volume as required (typically by adjusting respiratory rate).

An NG/OG tube should be placed unless contra-indicated or not clinically appropriate (see 'Gastric Decompression CPG').

Consideration should be given to positioning the patient head up in order to support optimal ventilation and improve cerebral perfusion.

Difficulty oxygenating?

PEEP - deliver 5cmH₂O PEEP as standard unless contra-indicated (bronchospasm, profound hypotension). Adjust to support recruitment & optimal ventilation. PEEP of above 10cm H₂O should be used with caution. PEEP should be returned to normal values at the earliest opportunity when clinically appropriate.

Consider pressure support (PS) - start at 5cmH₂O and increase slowly. Do not exceed IPAP of 20cmH₂O. Titrate as required.

Asthma/bronchospasm - see Asthma (adult) CPG.

Spontaneously breathing & conscious - consider non-invasive ventilation as per CPAP CPG.

Circulation

All patients should be monitored with non-invasive blood pressure (NIBP) set to cycle every 3 minutes and continuous ECG monitoring. If the patient remains unstable consideration should be given to remaining on defibrillation pads. Pad placement should also be considered based on the potential needs of the patient, i.e. for transcutaneous pacing AP positioning is preferred.

Avoid hypotension. Aim for a systolic blood pressure of >100mmHg.

Fluid should be used as an initial means of resuscitation for low blood pressure, boluses of 250 ml should be used to restore systolic BP >100mmHg. However, in patients with a suspected cardiac aetiology fluid resuscitation should be avoided where possible unless there is suspected right ventricular involvement, in which case a 250ml fluid bolus should be administered.

Vasoactive drugs can be considered as a supportive therapy where fluid therapy is ineffective or not clinically appropriate, as per 'Vasoactive Support' CPG.

Ensure a 12 lead ECG is performed, allowing at least 10 minutes post ROSC for cardiac activity to normalise.

Treat arrhythmias as per the 'Tachycardia' and 'Bradycardia' CPGs.

If the patient is hypotensive due to cardiogenic shock secondary to a confirmed STEMI and is considered not stable for transfer, then reperfusion with thrombolysis should be considered, as per the 'Thrombolysis' CPG. All ROSC patients receiving thrombolysis should get a dose of heparin.



Critical Care

Clinical Practice Guideline

POST ROSC MANAGEMENT

Disability

Seizure control should be as per the ‘Seizures CPG’. Have a low threshold for using Levetirecetam in the paralysed patient where there is a persistent tachycardia, despite adequate sedation.

Patients should have their body temperature recorded preferably via an oesophageal temperature probe. Maintain a normal body temperature and avoid fever (>37.7oC).

Blood glucose measurement should be taken and addressed where appropriate to maintain a BGL >4.0.

In the paralysed patient with persistent tachycardia and/or hypotension, despite adequate sedation, consider anaphylaxis if there is bronchospasm or urticaria.

Triage

Where the pre-arrest or post-ROSC ECG meets PPCI criteria, the ECG should be transmitted, and the patient should be conveyed to the nearest pPCI centre with a pre-alert. If the patient not fully conscious or maintaining their own airway (i.e. has an airway in situ),these cases will need to be discussed with the centre first.

Where the ECG does not meet PPCI criteria, but the arrest aetiology is strongly suggestive of a cardiac origin, consideration should be given to conveying to a 24/7 pPCI capable hospital. Consult the Critical Care Desk or senior on-call clinician to discuss.

If the arrest in traumatic in aetiology the patient should be triaged as per the Major Trauma Decision Tool.

In paediatric patients triage to the nearest paediatric receiving Emergency Department.
For all other arrest aetiologies the patient should be conveyed to the nearest appropriate emergency department.

'Anaesthetic' bundle

An ‘anaesthetic’ bundle consists of three elements, (1) sedation, (2) analgesia and (3) neuromuscular blockade. All three elements have a specific clinical role and should be used for appropriate effect.

(1) Sedation should be used to render the patient in a state of controlled unconsciousness and to reduce awareness. Sedation is not the optimal means for maintaining ETT placement or achieving ventilator synchrony. Choice of sedation agent depends on physiology and the clinical scenario. Recognising the fragility of the post ROSC phase, ketamine is the preferred agent unless the patient is presenting with sustained hypertension, in which case midazolam should be used. For maintenance of sedation infusion is preferred over bolus to achieve continuance of consistant sedation and avoid swings in physiology.

(2) Analgesia should be used to relive pain, support the reduction of awareness. There is the secondary benefit or reducing tachycardia and myocardial oxygen demand. If using ketamine for sedation then no second agent is required.

(3) Neuromuscular blockade (paralysis) should be used to facilitate maintenance of ETT placement and support optimal conditions for ventilator synchrony.

The order in which drugs are given is dependant on the clinical scenario, the intended effect and the priority in which the effect is required. Typically sedation is given first +/- analgesia followed by neuromuscular blockade. There may be occasions in the unconscious, obtunded patient with signs of increased respiratory effort and airway reflexes, where neuromuscular blockade takes primacy, if these reflexes risk ETT placement. In these instances, sedation should follow with urgency to avoid awareness. Drug doses should follow the relevant PGD.



Critical Care

Clinical Practice Guideline

POST ROSC MANAGEMENT

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