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Gwasanaeth Casglu a Throsglwyddo Meddygol Brys
Emergency Medical Retrieval & Transfer Service

EMRTS Cymru SOPS

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Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Approach to pre-hospital critical care

Reference Number	CSOP 001
Original Author(s)	
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Introduction & Objectives

The purpose of this CSOP is to provide an outline of the approach to managing critically ill and injured patients in the pre-hospital environment. It is designed to provide an overview and therefore should be read in conjunction with other CSOPs which provide further details of specific conditions and interventions.

Pre-hospital Activation

The EMRTS team will be tasked to pre-hospital incidents against Operating SOP 008 and will consist of immediate activation or activation by interrogation or crew request. The response will either be by helicopter (see OSOP 014) or car (see OSOP 015). After receiving information on the tasking the crew should make their way immediately to scene. En route, they will consider:

- Specific interventions that may be required
- Drug doses and equipment sizes for paediatric cases
- Likely destination hospital and transport modality

The primary and secondary bags should be transported to the patient on all missions. In addition the following equipment should be considered:

- Oxygen cylinder if first on scene (kept in primary response bag).
- Automated chest compression system for cardiac arrests.
- Blood box carried to the scene where information suggests need (or can be brought to the patient by the pilot or member of the emergency services after assessment).
- Hamilton T1 Ventilator if high likelihood of need for RSI/Non-invasive ventilation
- Additional PPE (e.g. RTC helmet/Hi-vis jacket) if there is a risk of personal injury.

Scene Safety and Approach

On arrival the team should approach at a brisk walk or make use of a vehicle (RRV/police). Whilst approaching a job, scene safety is paramount importance. (See OSOP 002). Identify potential safety issues

and communicate to other team members to keep the team safe. On approach it is helpful to consider patient extrication from the incident and the resources required. It is important for extrication planning and clinical assessment/management to occur in parallel.

Introduction and Handover

The EMRTS team should make initial contact with the treating clinicians on scene and introduce themselves. A clear handover should then be received. In the case of an RTC, initial contact should be made with the Emergency Service Clinical Team Leader. The roles of the EMRTS doctor and CCP will then be defined. This will depend on:

1. The clinical condition of the patient(s)
2. The level of experience of team members
3. The presence of multiple patients. In this case it will be essential to establish who is responsible for the scene and who is responsible for clinical care
4. Other resources available on scene

Clinical Assessment and Management – Non-trauma patients

Clinical management of patients will occur in line with specific CSOPs. A structured ABCDE approach will be required for assessment and initial resuscitation as outlined below. **Not all interventions are relevant to all clinical situations.** A brief history may be obtainable from bystanders, relatives or the Emergency Services. This includes drug history and allergies.

Airway	Airway assessment and suctioning, maintenance with airway manoeuvres/adjuncts and application of high flow oxygen titrated to clinical need Early decision and preparation for RSI if indicated – see CSOP 004a and 004b
Breathing	Rapid respiratory assessment and application of SpO_2 probe (switching to EMRTS monitoring as soon as practical) Ventilatory support with BVM or Mapleson C (Water's circuit) if required Interventions targeted to clinical findings
Circulation	Assessment of radial pulse and peripheral perfusion EMRTS monitoring: obtain 3 lead ECG and NIBP (set at 2 minute intervals) IV/IO access X 2 (as appropriate) and targeted fluid resuscitation Vasopressor or inotropic support as required (see CSOP 034) 12 lead ECG as indicated Targeted use of USS and blood gas analysis – not delaying transfer

Disability	Assessment and breakdown of GCS, pupil responses and limb movements (particularly pre RSI) Check glucose level Sedate and paralyse patient (if intubated) Ensure adequate analgesia
Exposure	Temperature and complete physical examination

Clinical Assessment and Management – Trauma patients

Clinical management of patients is covered by specific CSOPS. A structured CABCDE approach guides simultaneous assessment and initial resuscitation as below. **Not all interventions are relevant to all clinical situations.** Damage Control Resuscitation is adopted in these patients.

Catastrophic haemorrhage control (see CSOP 006)	Application of tourniquets / haemostatic agents Anatomical realignment of limbs / pelvic binder application Limb splinting with traction devices and vacuum splints (peripheral limb injuries in the elderly and risk of hypovolaemia)
Airway and c-spine control	Airway assessment and suctioning, maintenance with airway manoeuvres/adjuncts Application of high flow oxygen Early decision and preparation for RSI if indicated – (CSOP 004a and 004b) Appropriate C-spine control (CSOP 012)
Breathing	Rapid respiratory assessment and application of SpO_2 probe (switching to EMRTS monitoring when practical) Ventilatory support with BVM if required Placement of thoracostomies after intubation (Consider USS/clinical assessment to detect pneumothorax pre-RSI) – (CSOP 007) Resuscitative thoracotomy if indicated – (CSOP 021)
Circulation	Assess radial pulse and peripheral perfusion Obtain 3 lead ECG and NIBP (set at 2 minute intervals) IV/IO access X 2 (as appropriate) – (CSOP 017) Warm blood and blood product resuscitation using Fluid Warmer – target presence

	of radial pulse – (CSOP 019) Emergency reversal of anticoagulation – (CSOP 018) Assess haemorrhage source (consider chest, abdomen, pelvis/retro peritoneum, extremities and scalp) Targeted use of FAST / blood gas analysis – carried out *en route* to avoid delays on scene
Disability	Assessment and breakdown of GCS, pupil responses and limb movements (particularly pre-RSI), check blood glucose Sedate patient and ensure muscle relaxation if intubated. Ensure adequate analgesia Neuroprotection – (CSOP 010)
Exposure	Remove clothing ('Skin to scoop') to expose injuries whilst preventing hypothermia Minimal handling / movement with packaging onto scoop stretcher Temperature monitoring and active/passive warming using a warming device

Disposition of Patients and Mode of Transport

Patient disposition is outlined within each CSOP. Choice of transport is dependent upon multiple factors including:

1. Clinical condition and requirement for time-critical specialist care
2. Availability of an air or road ambulance assets
3. Distance to receiving centre by air and road
4. Weather and geographical factors
5. The need for a secondary transfer to the helipad at the referring and/or receiving centre

Decision making can be complex and the EMRTS App has been developed to assist (see OSOP 050). It is essential that early decisions are made on disposition / choice of transport in order for preparations to be made (e.g. additional resources to the scene, pilot to refuel), so that transfer is not delayed. It is essential that the EMRTS team create momentum to minimise on-scene times. Consider an antiemetic prior to air transfer.

Transfer of Patients

EMRTS team should check that no equipment has been left at the scene prior to departure. Careful consideration to which bags should travel with the patient if transferring by road. The airway bag, BVM and suction unit should be immediately to hand for all air transfers.

Specific equipment should be immediately available for all intubated patients (see CSOP 004b). Intubated patients should be placed on a ventilator and pre-transfer checks undertaken. Certain interventions (e.g. USS and blood gas analysis) can be conducted *en route.*

When an estimated time of arrival (ETA) is available, a member of the EMRTS team should provide a succinct ATMISTER pre-alert to the receiving unit. Ideally this should be conveyed to the ED consultant or registrar or trauma team leader as appropriate. The ASD should conference this call for recording purposes.

A: ***A****ge and sex*

T: ***T****ime of incident*

M: **M**echanism of injury (or history of event/illness)

I: **I**njuries sustained (or working diagnosis)

S: **S**ymptoms and signs (including most recent Obs)

T: **T**reatment administered

E: **E**TA

R: **R**ecommendations on arrival (e.g. activation of major haemorrhage policy or specific clinical teams).

Consider direct to CT SOP (OSOP 021) if appropriate.

Where direct contact is not possible (due to poor phone reception) the ATMISTER should be communicated via the CCP in the ASD.

Hospital Handover and Documentation

These should follow the procedures outlined in OSOP 020 and OSOP 047. It is at this point that clinical responsibility passes to the receiving hospital, unless an urgent procedure needs to be performed that the receiving unit is unable to provide (e.g. resuscitative thoracotomy). The team accompanies the patient to the ED where handover takes place.

State to the receiving team on arrival whether any emergency life-saving procedures/treatments are immediately required. The EMRTS team should maintain clinical responsibility until formal handover. Documentation will be on the EPR app, a copy of which will be left with the receiving hospital to form part of the patient care record, either paper or electronic (PDF).

Clear at Hospital and Return to Base

After handover it is essential that all EMRTS equipment including bags, the RSI drug bag and monitoring are returned to the helicopter or car first to make the team immediately available. On returning to base the following need to be completed:

1. Replace kit and seal bags.

2. Replace drugs including pre-draws/prefilled syringes.
3. Record drug use as per appropriate OSOP.

4. Complete post mission debrief for significant jobs.

Summary

This SOP provides an overview of the management of critically ill and injured patients in the pre-hospital environment. It should be read in conjunction with other SOPs.

Audit Criteria

Clinical and Operational KPI's are described against specific SOPs.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Approach to Time Critical Adult and Paediatric Transfers

Reference Number	CSOP 002
Application	All EMRTS Teams
Related SOPS	Multiple

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Sign off	COB

Introduction

Critical care transfer is the transport of a critically ill or injured patient from one hospital to another. The transfer can be a time of significant risk. The patient is removed from a place of relative safety for transfer to a place that can provide ongoing care. To reduce risk and facilitate rapid and safe transfer the process requires careful co-ordination, communication, attention to detail and sound clinical decision making.

Time critical transfers are from secondary care sites which include Emergency Departments, Medical Assessment Units, Minor Injury Units and Intensive Care Units. They do not include non-time critical transfers from a hospitals with limited critical care facilities. It includes patients 16 years or over only. Time critical paediatric transfers will be considered in CSOP 046.

Definitions

In this CSOP the following definitions will be used:

1. Referring Hospital - Current location of the patient when transfer request received.
2. Receiving Hospital - Hospital that patient will be transferred to.

Activation of Time Critical Adult Transfer

An EMRTS team will be tasked to a time critical adult transfer by the Air Support Desk (ASD) – see OSOP 009. Calls will be received by the CCP at the ASD from the referring hospital and the following indications must be met to activate the team:

1. Patient must be critically ill or injured and requiring level 2 or 3 care.

2. The patient must be time critical and require intervention that can only be carried out at the receiving hospital OR the patient is not time critical but has a high risk of deterioration requiring care that is best carried out at the receiving hospital.

3. The patient must been referred and accepted by the receiving hospital. It is NOT the responsibility of the EMRTS team to make referrals.

The following are **absolute contraindications** to transfer with EMRTS:

1. The patient requires life saving time critical interventions that can be performed in the current hospital which have not been carried out and take priority over the transfer.

2. Not time critical or with no potential to deteriorate.

3. Transfer for non clinical reasons (e.g. lack of an ITU bed).

4. Flight transfer safety risk (combative, agitated, suicide risk, contamination etc). This is a **relative contraindication**. In these circumstances the patient may require intubation /ventilation or transfer by road.

The decision to transfer a patient for time critical intervention is usually straightforward. The decision making for patients with potential to deteriorate requiring care best delivered in a tertiary centre is not as clear cut.

When a call is received by the ASD from referring hospital, the 'top cover' consultant is called to join the conference call. At this stage basic details will be taken (according to a proforma) and if the above indications are met the 'top cover' consultant will decide on whether an EMRTS team should be tasked. The appropriate EMRTS team is then be activated.

The activated team then plan the transfer taking into account weather, primary/secondary hospital landing sites and how the patient will be transferred to the receiving hospital from the outset. This will include the following options:

1. Wales Air Ambulance (Helimed 57 and 59).
2. Emergency Services ambulance.
3. Search and Rescue.

After team deployment 'top cover' will, where necessary, continue conversations with the referring unit and receiving unit to determine what needs to be carried out clinically before EMRTS transfer and what is the expectation on arrival at the receiving unit. This information can be communicated to the EMRTS team whilst *en route* to the tasking by the ASD. Only information which changes patient care or logistical considerations should be communicated.

In exceptional circumstances where the patient may die without specialist care a transfer can be passed directly to the most appropriate EMRTS team without 'top cover' consultation. ASD should then contact the 'top cover' consultant to inform them. The 'top cover' consultant should then speak to the referring unit to support the coordination of preparing the patient for transfer.

The initial response of the EMRTS will then be either by helicopter (see OSOP 014) or car (see OSOP 015). For time critical helicopters activation a HEMS response is required.

At the referring hospital the following should ALWAYS be carried:

1. Primary bag and retrieval bag.
2. Monitoring bag.
3. Oxygen.

If indicated the following should also be carried by the team:

1. Automated chest compression system for post cardiac arrest patients.
2. Blood box for all bleeding patients.
3. Scoop with gel pads.

Transfer Personnel

Only trained EMRTS teams can carry out a transfer. Hospital staff will be not escort a patient unless there has been a prior agreement for training purposes or in exceptional circumstances. This must be confirmed checked with 'top cover' .

Teams can consider carrying a parent or care giver for children or adults with special needs if this is in their best interests.

Handover Location

Clinical responsibility for the patient transfers to the EMRTS team at handover location which will usually be in the referring hospital. Handover at the helipad site can often introduce risks which can outweigh the benefits in time saved. It should ONLY be used where the helipad is a considerable distance away from the helipad or weather factors dictate that the aircraft needs to lift quickly. The handover site should be agreed between the referring and EMRTS teams before departure. Helipad handovers occurring at the helipad should be with rotors stopped. A suitable Emergency Services vehicle will organized by the ASD so that delays in transferring the patient to the helicopter are minimised. This is especially important if an expedited immediate transfer is required.

Team Limitations and Alternative Transfer Teams

There may be situations where EMRTS are not immediately available to carry out a transfer. The team may be on a primary mission or the time required get to the requesting hospital is excessive (e.g. where aircraft

not available and road transport time prolonged).

In these situations alterative arrangements are made. This may involve the requesting team and the ambulance service (or a Search and Rescue aircraft) performing the transfer. The CCP at the ASD will document on the database why the team wasn't available.

Clinical Interventions and Checks Prior to Transfer

All clinical interventions prior to transfer must be completed in line with CSOPS. Only essential clinical interventions and checks completed prior to transfer (i.e. those of immediate clinical benefit or to ensure safety in transfer).

Airway	Airway assessment and intubate/ventilate using criteria in CSOP 004b (Also consider if flying an agitated patient) Check and note position of existing TT (Approx 22cm at lips – male, 20cm at lips - female) Ensure presence in-line capnography after HME filter in circuit Secure TT with Thomas Tube Holder
Breathing	Note RR and ausculate chest Ensure adequate oxygenation / ventilation Switch to EMRTS monitoring Check and switch to EMRTS ventilator and check settings against patient's current ventilator settings, check airway pressures Consider CPAP/BIPAP as indicated in CSOP 031 Ensure adequate muscle relaxation (CSOP 004b) if ventilated Decompress pneumothoraces (if not already done) with finger thoracostomies in a ventilated patient AND placement of chest drain with Heimlich valve in a non-ventilated patient. Ensure chest drains adequately secured and position checked on CXR if time allows. Check ABG using hospital blood gas analyser or EPOC. Target ventilation against result. Review CXR if conducted (this may not be relevant in all cases) Ensure adequate oxygen for transfer See notes below on NG/OG tubes
Circulation	Check radial pulse/peripheral perfusion Switch to EMRTS monitoring for 3 lead ECG and NIBP (set to cycle at 3-5 minute intervals)/transducer arterial line (if already inserted), if using arterial line leave

	NIBP *in situ* IV access X 2 (as appropriate) and targeted fluid resuscitation Lines should be checked for patency, accessibility and reinforced with a large translucent 'tegaderm' to avoid dislodgement. Attach infusion line to the IV line via one way valve. Plastic back slab can be used to prevent movement at the wrist. Prevent snag of the line by double looping the IV line around hand. Vasopressor or inotropic support as required (see CSOP 034) 12 lead ECG (as appropriate) Targeted use of USS (ESOP 019) and blood gas analysis (ESOP 016) Lucas 2 chest compression system in situ for post cardiac arrest patients See notes below on arterial lines, central lines and urinary catheters If urinary catheter already placed ensure that it is draining, note urine output and empty bag
Disability	Assessment and breakdown of GCS, pupil responses and limb movements (particularly pre-RSI) Check glucose level Sedate and provide muscle relaxation (if intubated). Ensure adequate analgesia. Check syringe drivers for adequate battery. Ensure appropriate neuroprotection in place
Exposure	Oesophageal temperature monitoring in ventilated patients Place patient in Blizzard blanket with Ready Heat if cold Package onto scoop stretcher with gel pads for transfer onto road vehicle or air ambulance stretcher EMRTS helicopter or Emergency Services ambulance transfer – secure fluids, monitoring, ventilator and transducer using appropriate brackets or bridge system Tape shut eyes and ear protection
Others	Copy of patient notes and contact receiving unit with ETA just prior to leaving Awake patients should be given an antiemetic prior to air transfer

Other procedures may required on a case by case basis. Place NG/OG tubes in an intubated patients if

presence of gastric distension a concern. Urinary catheters can be placed if doing so alters immediate management but should not delay transfer.

Arterial lines are useful for continuously monitoring BP during transfer in patients with TBI, where BP is (or expected to be) unstable or where inotropes are being administered. The benefit of inserting an arterial line must outweigh any transfer delay. If a patient has an arterial line it must be transduced and NIBP left *in situ*.

Time should not be wasted placing a central line unless there is a clear benefit (e.g. the patient requires infusions of vasoconstrictors/inotropes). However, if central access has already been placed by the hospital team or the decision has been made by EMRTS to place one, the position must be confirmed on CXR.

A simplified pre-transfer checklist is provided at the end of this CSOP which should be used in all transfer cases. NOTE: a number of checks will have already been done as part of the base routine (e.g. checking battery on ventilator). These will not necessarily have to be repeated at the time of transfer unless indicated by the device.

Decision Making Prior to Transfer

Some patients may be unstable prior to transfer as the reason they are being transferred to specialist care is to achieve haemodynamic stability. If the EMRTS team arrive and find a patient is *in extremis* and on further assessment do not believe that it is in the patients best interests to be transferred then discussion must proceed with the referring and receiving centres. A decision must be made and communicated to the patient (as appropriate) and relatives. It is essential that the EMRTS team carefully documents decisions made. A similar scenario may arise where a patient is in a worse state or with more co morbidity than expected. Changes in the plan must be discussed with 'top cover'.

During Transfer

Observations should be clearly documented prior to transfer and at least at 5 minute intervals during transfer. This is facilitated by setting the Tempus Pro monitor set to record observations at the stated interval.

Observations must include:

- SpO_2 and RR (spontaneous or set on ventilator)
- $ETCO_2$ (vent circuit or nasal)
- Ventilation Pressures (inspiratory and PEEP or CPAP)
- Pulse
- Blood Pressure (invasive or non invasive) – invasive should include MAP
- Pupil's reaction and size
- GCS (if not sedated and ventilated)

Times must be clearly documented including:

- Initial contact time
- Lift from base
- At requesting hospital
- At patient
- Handover from requesting hospital team (including location of handover)

Lift from requesting hospital
Arrival at destination hospital
Handover to destination hospital team (including location of handover)

The EMRTS database will allow the team to continuously record the above information electronically in real time. It is essential that a member of the team maintains visualisation of the patient, monitor and ventilator during transfer.

Clinical deterioration during transfer should be managed according to CSOPs. If possible clinical deterioration should be communicated to the destination hospital.

If the aircraft needs to be diverted for weather or technical issues then the hub must be contacted and alternative transport arranged. Destination hospital must be informed of delay.

Hospital Handover and Documentation

These should follow the procedures outlined in OSOP 020 and OSOP 047. It is at this point that clinical responsibility passes to the receiving hospital.

Clear at Hospital and Return to Base

After handover EMRTS equipment including bags, the critical care drug bag and monitoring are returned to the helicopter or car. On returning to base:

1. Replace kit and seal bags.
2. Replace drugs including pre-draws/prefilled syringes.
3. Record drug use as per ESOP 023
4. Complete database
5. Complete RSI audit form (if indicated)
6. Complete hot debrief for significant missions

Time Critical Paediatric Transfers

Paediatric Considerations

Activation and approach to paediatric transfer is usually should be the same as for adult transfer.

EMRTS will not usually undertake paediatric intensive care retrieval only time critical retrievals usually undertaken by the referring hospitals (e.g. the transfer of a head injured child requiring immediate neurosurgical intervention).

Currently WATCh and the North West and North Wales Paediatric Transfer Service (NWTS) undertake non-time critical transfers

Time critical transfers require careful consideration. The geographical location, distances involved and time to intervention may result in a delay in life saving interventions. In this situation NWTS/WATCh may advise the local team to carry out the transfer to save life and reduce morbidity. EMRTS may be in a position to rapidly facilitate the transfer instead of the local team. The status of the paediatric transfer team and the advice given to the local unit should be ascertained.

Involvement of the top cover consultant and discussion with NWTS/WATCh is essential.

Clinical Management

Clinical management is tailored to clinical need and age of the child. Appropriately sized emergency kit is available at all times.

Check and note position of existing TT (Approx (age / 2) + 12) cm at the lips. Ideally a pre transfer chest x-ray should be performed to confirm the TT position in small children.

A cuffed or micro-cuffed tube should be used with the exception of neonates. If the child has already been intubated with an un-cuffed tube by the local team then it should ideally be changed. This will depend on the difficulties of the first intubation and the stability of the child. If the risks of changing the tube are high then it should be left.

Select the correct settings on the ventilator before connecting to the child. Ideally a pressure controlled mode should be used. If a volume controlled mode is used ensure that the tidal volumes are set correctly for the size of the child.

When assessing circulatory status in a baby use the brachial pulse.

Automated chest compression devices are not used in children.

Both Epinephrine and Noradrenaline infusions dose ranges are 0.05 – 2 mcg/kg/min.

Modified paediatric GCS scoring are used.

Propofol should be avoided in paediatric critical care sedation. Use morphine and midazolam. Ketamine and fentanyl can also be considered:

Morphine 5 – 60 mcg/kg/hr.

Midazolam 60 – 300 mcg/kg/hr (do not use if under 3 kg).

Ketamine 5 – 45 mcg/kg/min.

Fentanyl 1 – 10 mcg/kg/hr.

See EMRTS APP for drug calculator.

Avoid hypothermia and over warming.

Carrying a Parent

Teams can consider carrying a parent or care giver for a children or an adult with special needs if this is a benefit to the patient in terms of psychological support and control on the aircraft and in their best interest.

Retrieval from Midwifery Units

Teams will be involved in the retrieval of sick neonates from midwifery led units. When undertaking a neonatal retrieval the incubator or babypod must be positioned on the aircraft or car prior to departing. Neonatal care and transfer should be performed within the guidance set out by the appropriate SOPs in

neonatal care. Close liaison with neonatal and midwifery services is essential when performing this type of transfer.

Audit Criteria

Time from time critical transfer allocation to being airborne <6mins – 90%

Time from call received by 'top' cover consultant and decision to allocate an EMRTS asset <15mins – 80%

Total at hospital time <60mins for all time critical transfers – 80%

Welsh guidelines for the transfer of the critically ill adult (continuous ECG monitoring, oesophageal temp monitoring, $ETCO_2$, Sats, NIBP or IABP, airway pressures) – 100%

Pre-transfer checklist completed – 100%

Missions with no monitoring failure during transport – 98%

Missions with no ventilator failure during transport – 98%

Any death in EMRTS care from a retrieval tasking reviewed as significant incident – 100%

References and Further Reading

Designed for life: Welsh Guidelines for the Transfer of the Critically Ill Adult, 2009.

AAGBI Safety Guideline. Inter-hospital Transfer. Anaesthetics Association of Great Britain and Ireland. 2009.

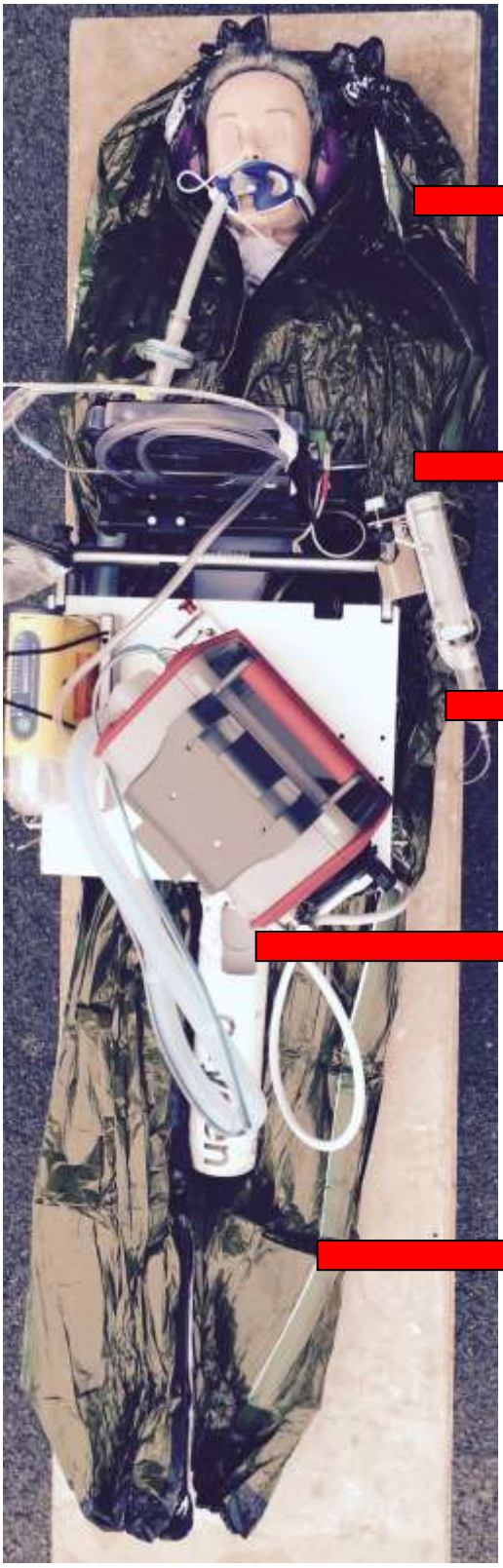
AAGBI Safety Guideline. Recommendations for Safe Transfer of Patients with Brain Injury. AAGBI Safety Guideline. 2006

Guidelines for the Transport of the Critically Ill Adult. (3rd Edition). Intensive Care Society 2011.

EMRTS PRE-TRANSFER CHECKLIST	
TICK	**ALL PATIENTS**

	Ear protection
	Anti-emetic given
	Arterial line and transducer accessible (as appropriate)
	NIBP in situ
	Vascular access – all flushed, secured and accessible
	Ensure chest decompression, secure chest drain and check position (as appropriate)
	Snag risk minimised (lines and fluids)
	Catheter checked and bag emptied (as appropriate)
	Monitor/syringe drivers/ventilator secured on patients leg or shelf
	Patient placed in scoop stretcher with gel pads
	Patient warming as appropriate with Blizzard blanket & Redi Heat
TICK	**VENTILATED PATIENTS**
	Check ETT position and secure with Thomas Tube Holder
	$ETCO_2$ after HME filter in circuit
	NG tube (as appropriate)
	Oesophageal temperature probe in situ
	Eye protection
	Patient ID wristband
	Neuroprotection (if applicable) as per CSOP
TICK	**EQUIPMENT**
	Primary response, monitoring and retrieval bags
	Vacuum mattress or scoop stretcher with straps (as appropriate)
	Visually check battery on all equipment being used
	Blood box and Buddy Lite (if applicable)
	Sufficient oxygen (double predicted amount)
	Muscle relaxant (double predicted amount drawn up)
	Sedation (double predicted amount drawn up)
	Patients belongings and documentation gathered – notes/imaging
	Room checked for anything left
TICK	**ACCESIBLE EQUIPMENT**
	Emergency Anaesthesia Drug Bag
	Intubation pack
	BVM
TICK	**COMMUNICATION**
	Air or road crew – discuss transport plans
	Receiving hospital informed
	Relatives briefed/information given
	Referring team briefed and thanked

Acknowledgments to EMRTS Scotland for above which has been modified



Eyes taped shut

Ear protection (air transfer)

ETT secured tightly (Thomas Tube Holder in most cases)

Oesophageal temperature probe inserted

Ventilator tubing secured under bridge

Monitoring device clearly visible on front of bridge

Ventilator, syringe driver and suction unit on bridge

Lines to emerge from one side of blizzard heat blanket, avoid snagging of lines, secure chest drains

Oxygen cylinder between legs OR attached to bridge holder

Package onto scoop with gel pads into blizzard blanket & redi heat (cover patient in sheet or blanket to avoid direct skin contact) – avoid heating in post cardiac arrest

Strap onto transferring stretcher

EMRTS TIME CRITICAL TRANSFER ACTIVATION CHECKLIST (use of every call)	
TICK	**CALL RECEIVED FOR POTENTIAL TIME CRITICAL TRANSFER BY ASD**
	CCP/ALLOCATORS at ASD contacts Top Cover Consultant (TCC) to join a conference call at the earliest chance
ACTIONS FOR CCP/ALLOCATOR AND TCC AT THE ASD	

	Referrer name and grade Referring hospital and exact location Direct contact number	
	Patient name, DOB, Hospital number Approx. weight (kg) & height (ft/inches)	
	Provisional diagnosis & reason for transfer	
	Latest Obs (HR, RR, BP, SpO_2, GCS, pupils)	
	Brief past medical history (if appropriate)	
	Interventions and investigations so far	
	Receiving hospital and exact location Receiving consultant's name and specialty Direct contact number	
	Referring hospital planned handover site	
ACTIONS FOR 'TOP COVER'CONSULTANT		
	Check if 'YES' to all of the following: • Critically ill or injured and requiring level 2 or 3 care? • Time critical and requires intervention that can only be carried out at the receiving hospital OR not time critical but has a high risk of deterioration requiring care that is best carried out at the receiving hospital? • Referred and accepted by the receiving hospital? (BUT if *in extremis* appropriate team should be immediately deployed without patient being referred and accepted).	
	IF YES TCC to inform referring hospital that tasking has been provisionally accepted but final confirmation will come from the ASD once duty crew have been informed (check operational logistics) If YES to above instruct CCP/ALLOCATOR at ASD to contact most appropriate team, with TCC in conference to troubleshoot any issues with transport platform. NOTE final decision to accept transfer lies with the TCC. Duty teams should NOT negotiate the requirement to accept the tasking from a clinical perspective.	
	If NO (or undecided) further questions asked to determine decision and reasons given if declined: • Contact receiving centre to update.	
FURTHER ACTIONS FOR CCP/ALLOCATOR AT THE ASD		
	Allocates most appropriate EMRTS team passing details given above as well as passing/establishing: • Job number • Weather issues • HLS site	
	Informs referring unit that the tasking has been formally accepted and informs them of the ETA of the team by air or road and exact handover location. Receives update on patient condition.	
	Informs duty team of updated patient condition, and expands on history if appropriate.	
	Organises appropriate resources for secondary transfer at referring and receiving hospital(s) as appropriate.	
	Informs TCC if expedited immediate transfer (i.e. call gone direct to the team).	
	Record all information on EMRTS database and MIS Cad inc. any unattended calls and TCC advice.	
	Carry out actions as listed in Job Cycle section of ASD SOP.	
FURTHER ACTIONS FOR TCC		
	If aircraft unavailable, decide on most appropriate transport platform and take steps to activate it via CCP/ALLOCATOR at the ASD.	
	Discuss any patient management issues with referring hospital prior to arrival of the EMRTS team inc. clinical issues and enhancing speed of turnaround of patient (e.g. if possible packaging patient against EMRTS SOP's)	
	Discuss patient management issues with receiving hospital (if appropriate).	
	Record all information on EMRTS database and MIS Cad inc. any unattended calls and TCC advice.	

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Analgesia and Procedural Sedation

Reference Number	CSOP 003
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 004a and 004b, CSOP 009

Author(s)	Tracy Phipps
Internal reviewer(s)	Jonathan Whelan
External reviewer(s)	Daniel Greenwell - SBU Pharmacy
Sign off	EMRTS Clinical and Operational Board

Ready Reference Guide

Procedural sedation:

1. Always use the procedural sedation checklist.
2. Full AAGBI monitoring, including the use of nasal waveform capnography, NIBP 3mins, with high-flow O2.
3. Designate one person/sub-team to sedate, one to perform procedure.
4. Titrate sedative agent to effect, wide interpatient variability in response.

Introduction & Objectives

This SOP describes analgesic and sedative drugs that are available to EMRTS and their indications. Key principles are that all patients have their analgesic needs assessed and addressed. Sedation should also be offered where the patient is subjected to a painful or noxious procedure. All drugs are handled in accordance with drug SOPs.

The following drugs are used for analgesia and procedural sedation:

Ketamine - 200mg/20ml or 500mg/10ml (IM administration)

Fentanyl - 500mcg/10ml

Midazolam – 5mg/5ml

Propofol 200mg/20ml

Morphine – 10mg/1ml

Lidocaine 1% 5ml

Bupivicaine 0.5% 10ml

A number of drugs come in pre-filled syringes to reduce drugs error and wastage (e.g. ketamine and fentanyl). Others will either be drawn up at the start of the shift or on scene.

Procedural Sedation

Procedural sedation is administration of a sedative with analgesic to allow a painful or noxious procedure to be tolerated whilst maintaining the airway and cardiorespiratory function. There are a number of circumstances in which it can be used.

1. To facilitate painful procedures and for humanitarian reasons.
2. To facilitate patient safety, extrication and management.
3. To facilitate emergency anaesthesia.
4. Sedation following anaesthesia – see CSOP 004b.

In the majority of cases procedural sedation will be undertaken with ketamine, with the addition of midazolam as indicated. Procedural sedation does not equate to analgesia although ketamine does provide both. Analgesia should be provided where indicated (e.g. addition of fentanyl to propofol if sedating a patient following intubation).

If pain is constant (e.g. in a patient with a fracture that doesn't require manipulation or chest/abdominal pain) then morphine is the analgesic of choice as sedation is not usually indicated. However where the patient requires a painful or noxious procedure (e.g. joint reduction, extrication with long bone injuries) then procedural sedation with ketamine and midazolam more suitable.

Preparation for Procedural Sedation

Preparation should proceed in line with the College of Emergency Medicine/Royal College of Anaesthetists guidance 2013 and the accompanying checklist. The pre-sedation checklist is used in all cases.

Procedural sedation is only administered by appropriately trained personnel. CCPs are able to administer procedural sedation once qualified to do so in accordance with the Advanced Clinical Intervention Policy. This is guided by a PGD and 'top cover' consultant advice.

Patients must have full monitoring in place including NIBP (cycling at 3 minute intervals), SpO_2, 3 lead ECG and nasal $ETCO_2$. High flow oxygen should be provided in all cases and appropriate IV access. Patient access should be optimised and advanced airway equipment and resuscitation equipment immediately available. Flumazenil and naloxone are available in the critical care drug bag. Where administered in the context of procedural sedation this is reported as an adverse clinical incident.

Finally roles are clearly defined between the EMRTS doctor and CCP including who will administer sedation and monitor the patient whilst the other is performing the procedure. Any airway issues resulting from procedural sedation should be managed by the EMRTS team.

The EMRTS team usually travel with the patient to the receiving hospital after procedural sedation, unless the patient has been *fully* recovered from the sedation for at least 15mins, and there are no ongoing critical care needs.

The above scenarios will now be considered in turn:

1. Procedural Sedation To Facilitate Painful Procedures

Patients who require a painful procedure, but not full anaesthesia, receive ketamine with the addition of midazolam unless either drug is contra-indicated. If midazolam is contra-indicated ketamine alone is used. If ketamine is contra-indicated a combination of fentanyl and midazolam should be used. Examples of painful procedures include reduction of a fracture or dislocated joint or chest drain insertion.

Low dose midazolam is given before ketamine to minimise emergence phenomena. In the frail or elderly patient increments as small as 0.5 mg may be sufficient, increasing to increments of 1 to 2 mg in young and fit adults. Ketamine is then slowly injected in bolus doses of 10 to 20 mg until the desired state is achieved. Ketamine at doses of up to 0.5mg/kg usually provides profound analgesia, with a state of dissociation. Once this state is reached verbal contact is lost, and the patient may stare or salivate. This usually occurs after 1-2 minutes. Nystagmus is often present. This is a good point at which to perform the painful procedure, topping up the ketamine with further bolus doses of 10 to 20 mg as required. Rapid injection of ketamine can cause an increased risk of complications e.g. apnoea, airway obstruction or laryngospasm.

Caution is required in patients who are trapped or partially inaccessible, where loss of the airway may be very difficult to recover. Consider omitting midazolam and give ketamine in small, slow bolus doses with as much monitoring as is practical and a clear plan (with all the required equipment to hand) should the patient deteriorate. Midazolam should also be omitted in patients with severe hypovolaemia (because of the risk of cardiovascular collapse) or children under 10 years old. Consider regional anaesthesia in the trapped patient if trained and competent see CSOP 055.

Once the painful procedure has been completed the ketamine sedation should be allowed to wear off, with analgesia provided by other means (e.g. splinting, nerve block, morphine, fentanyl etc.). This facilitates handover and further assessment on hospital arrival. Occasionally a patient will experience significant distress and agitation as ketamine wears off. In this case, midazolam is poorly effective and risks respiratory depression. In extreme cases re-sedation with ketamine may be required pending hospital arrival.

Where ketamine is contraindicated incremental doses of fentanyl (up to 1mcg/kg, usual total dose 50-100mcg) 3-4 minutes before procedure is followed by a conscious sedation dose of midazolam. A reduced dose of fentanyl and midazolam should also be used for cardioversion of a patient in an unstable tachyarrhythmia. Ketamine should be avoided in this context.

The IM route for children is outlined in a protocol at the end of this document. The dose is up to 4mg/kg to achieve a state of dissociation and it takes 2-5 minutes to work. The Intra-nasal route has not been

adequately validated in the paediatric population and there is considerable dose variation. At the present time it should be avoided.

2. Procedural Sedation to Facilitate Patient Safety, Extrication and Management

Very occasionally a patient may be entirely unmanageable or a danger to themselves or others. In these circumstances the goal is to achieve reliable intravenous or intraosseous access, followed by sedation with midazolam and/or ketamine following the above guidance. Full monitoring should be applied as soon as possible.

In extreme circumstances, the IM ketamine route should be considered using the 50mg/ml concentration. This should ALWAYS be stored in a sealed pouch within the RSI drug bag to avoid risk of drug error. The dose is up to 4mg/kg to achieve a state of dissociation and it takes 2-5 minutes to work.

Once sedation has been achieved in agitated or uncooperative patient, it may be necessary to proceed to emergency anaesthesia.

If a patient becomes agitated or uncooperative whilst in the helicopter they must be immediately sedated with intravenous ketamine to ensure the safety of the aircraft and its crew. All non-intubated patients transported by air must have a fully functioning intravenous line in immediate reach of the crew and a pre-drawn syringe of ketamine ready.

3. Procedural Sedation To Facilitate RSI

Some patients who require emergency anaesthesia in the pre-hospital or transfer environment may be agitated and uncooperative. This is often due to hypoxia and hypovolaemia. In these cases incremental doses of sedation may be given to facilitate patient preparation, monitoring and pre-oxygenation. This sedation should be given IV unless it proves impossible to gain either IV or IO access (see above). In this case the IM route should be considered as above. After the patient is sedated IV or IO should be secured.

In most adult patient's incremental 10-20mg boluses of ketamine titrated to provide a dissociative effect are sufficient. Alternatively 1-2mg of midazolam can be used instead, but caution must be exercised due to the risk of respiratory depression and apnoea. Always be prepared to control the airway and the necessary equipment should be immediately accessible to achieve this.

4. Sedation following intubation to maintain anaesthesia – see CSOP 004b.

Third party administration of Procedural Sedation

In exceptional circumstances it may be necessary for personnel working with the EMRTS team to administer procedural sedation under the direct supervision of EMRTS team (e.g. when access to the patient is restricted or in multiple patient scenarios). In these circumstances errors are more likely to occur due to the use of unfamiliar drugs, dilutions and equipment. Where possible this practice should be avoided, and under no circumstances should a person external to the team give critical care drugs in the absence of direct supervision by a EMRTS team member. The following process should be used to minimise errors:

1. Ensure personnel are happy to administer drugs
2. Ensure all syringes are correctly labelled.
3. If wishing to give 2mg (2mls) of midazolam, for example, state "I would like you to give 2mls of this."

4. Get personnel to repeat the instructions back to you. If there is any misunderstanding, try re-phrasing rather than repeating, e.g. “There are 10mls in the syringe, give 2mls, so there are 8mls left.”
5. Monitor the amount being given.
6. If possible give instructions for, and pass over, only one drug syringe at a time.
7. If you feel your instructions are not comprehended an alternative is to use a smaller syringe to draw up only the exact amount you wish to give, and hand that over.

Analgesia

Morphine

Morphine remains the mainstay for provided ongoing analgesia for patients not requiring procedural sedation.

Presentation is as a 1ml vial (10mg/ml).

The 10mg/ml vial is diluted in 9ml of saline to give 10mls (1mg/ml).

Titrate in 2mg aliquots to effect.

(10mg/ml is suitable for IM use).

Fentanyl

Is used:

1. As analgesic agent in major trauma patients – 25-50mcg boluses titrated to effect, be cautious in hypovolaemic states, can be used in this situation as part of Damage Control Resuscitation
2. As analgesic agent at induction of Emergency Anaesthesia – see CSOP 004b
3. Maintenance of anaesthesia with propofol or midazolam – see CSOP 004b
4. Analgesia for conscious sedation with midazolam if ketamine is contraindicated
5. Intranasal fentanyl in children in severe pain and no IV access – protocol provided below

Presentation is an ampoule of 500mcg in 10ml (50mcg/ml).

Lidocaine 1% (10mg/ml) 5ml – short acting local anaesthetic

Used for nerve blocks, maximum dose 3mg/kg.

Bupivacaine 0.5% (5mg/ml) 10ml – long acting local anaesthetic

Used for nerve blocks, maximum dose 2mg/kg.

NB – Local anaesthetic toxic doses are cumulative.

Disposition

Patients administered drugs outside JRCALC guidelines will be accompanied by a member of the EMRTS team. Rarely this is not required:

Fentanyl

If EMRTS do not need to accompany for clinical reasons and the fentanyl was administered at least 15 minutes prior to leaving the scene with no adverse effects, then it is acceptable for a WAST paramedic to convey the patient to hospital. Paramedics should be advised that should opiate related side effects (such as respiratory depression) occur, these can be managed supportively or with the administration of naloxone, as for morphine.

Ketamine

Patients who have received ketamine will generally be conveyed by, or accompanied by a member of the EMRTS team. This is both due to the nature of the injuries they have likely suffered, and also the effects of ketamine on conscious level (both sedation, and occasionally agitation as the effects wear off).

Exceptions to this might be:

1. Patients in whom the effects of ketamine have fully worn off (i.e. fully alert & oriented, GCS 15).

2. Patients who would be cared for by a WAST paramedic currently trained in the use of ketamine for analgesia under the WAST Patient Group Directive and who has access to further ketamine and midazolam to manage complications should they occur. Both the WAST paramedic and EMRTS team must be in agreement before handing over care.

References and Further Reading

Royal College of Anaesthetists (RCoA) and College of Emergency Medicine (CEM) Report and recommendations. October 2013.

https://www.rcoa.ac.uk/system/files/PUB-SafeSedPrac2013.pdf

Godwin SA, Caro DA, Wolf SJ *et al*. Clinical policy: procedural sedation and analgesia in the emergency department. *Annals Emerg Med* 2005: 45(2): 177-96.

Green SM, Roback MG, Kennedy RM *et al*. Clinical practice guidelines for emergency department ketamine dissociative sedation: 2011 update. *Annals Emerg Med* 2011; 57(5); 449-61.

Green SM, Hummel CB, Wittlake WA *et al*. What is the optimal dose of IM ketamine in paediatric sedation? *Acad Emerg Med* 1999; 6(1): 21-26.

PROCEDURAL SEDATION CHECKLIST		
	START OF CHECKLIST	*Expected response*
→	Top cover call made	.....check
→	Access to patient optimised	.....check
→	Post sedation plan	.....will be to [x]
→	Monitorring attached and visible	BP is [x] mmhg, sats are [x], pulse is [x]
	Nasal capnography on and reading	.....resp rate is [x]
→	Oxygen on at 15 litres	.....15 litres, check
	Spare oxygen cylinder	.....check
	BVM connected to spare oxygen	.....check
→	Suction checked and positioned	.....check
→	Intubation pack to hand	.....check
	RSI drugs accessible	.....check
→	Drug giver & leading	.....[x] check
	Monitorring and airway management	.....[y] check
→	Ketamine dose will be [x] mg	.....[x]mg check
	Midazolam dose will be [x] mg	.....[x]mg check
→	IV / IO access flushed	.....check
→	Patient briefed	.....check
	Bystanders quiet	.....check
END OF CHECKLIST		

IM KETAMINE DOSING (50MG/ML)		
KG	**DOSE (4mg/kg)**	**VOLUME (ml)**
10	40	0.80
11	44	0.88
12	48	0.96
13	52	1.04
14	56	1.12
15	60	1.2
16	64	1.28
17	68	1.36
18	72	1.44
19	76	1.52
20	80	1.6
21	84	1.68
22	88	1.76
23	92	1.84
24	96	1.92
25	100	2.00
26	104	2.08
27	108	2.16
28	112	2.24
29	116	2.32
30	120	2.4
Estimate weight and draw up appropriate dose in a 1ml graduated syringe		

INTRANASAL FENTANYL DOSING (USE 50MCG/ML) First dose 1.5mcg/kg dose Second dose 0.75-1.5mcg/kg dose 10mins after first dose if required				
Weight estimate(kg)	**Initial dose (1.5mcg/kg)**	**Volume - initial dose (ml)**	**Top-up dose (0.75 - 1.5mcg/kg)**	**Volume - top up dose (ml)**
10	15 mcg	0.3 ml	7.5 - 15 mcg	0.15 - 0.3 ml
12	18 mcg	0.35 ml	9 - 18 mcg	0.2 - 0.35 ml
14	20 mcg	0.4 ml	10 - 20 mcg	0.2 - 0.4 ml
16	24 mcg	0.5 ml	12 - 24 mcg	0.25 - 0.5 ml
18	27 mcg	0.55 ml	13.5 - 27 mcg	0.25 - 0.55 ml
20 - 24	30 mcg	0.6 ml	15 - 30 mcg	0.3 - 0.6 ml
25 - 29	37.5 mcg	0.75 ml	18.75 - 37.5 mcg	0.35 - 0.75 ml
30 - 34	40 mcg	0.8 ml	20 - 40 mcg	0.4 - 0.8 ml
35 - 39	52.5 mcg	1.05 ml	26.5 - 52.5 mcg	0.5 - 1.05 ml
40 - 44	60 mcg	1.2 ml	30 - 60 mcg	0.6 - 1.2 ml
45 - 49	67.5 mcg	1.35 ml	67.5 mcg	0.65 - 1.35 ml
> 50	75 mcg	1.5 ml	37.5 - 75 mcg	0.75 - 1.5 ml
Volumes have been rounded to the nearest 0.05ml Draw up appropriate dose for weight (see table above) plus 0.1ml extra to the first dose (to account for the dead space in the device) into 1ml graduated syringe Attach Mucosal Atomiser Device (MAD300) on to the end of the syringe Insert the device loosely into the nostril and press the plunger quickly *Dose should be divided* between nostrils Do **NOT** draw up 0.1ml extra for second dose when re-using the delivery device (MAD) (Source: Royal Childrens Hospital Melbourne Guideline)				

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Governance for Emergency Anaesthesia

Reference Number	CSOP 004a
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 003, CSOP 004b, CSOP 005

Author(s)	Stuart Gill
Internal reviewer(s)	Dindi Gill
External reviewer(s)	
Sign off	EMRTS Clinical and Operational Board

Introduction

The delivery of emergency anaesthesia is a key EMRTS pre-hospital intervention. RSI is a high risk but potentially lifesaving procedure that may improve patient outcome and facilitate safe transfer and rapid transition of patients to definitive care.

> National guidelines already exist (e.g. AAGBI pre-hospital anaesthesia safety guideline) and rather than replicate guidelines this SOP is designed to adapt guidelines and ensure high quality practice in EMRTS.

Airway Group

The Airway Group quality assure RSI provision within EMRTS.

The Airway group consists of:

- Airway Group chair, (usually Airway lead or deputised to another group member)
- One Doctor from each base
- National Director or base lead

- One CCP from each base
- There must be representation from consultants in Emergency Medicine and Anaesthesia/ICM
- Secretarial support from Admin Assistant

In addition the following should normally be invited but their attendance not mandated;

- Service manager
- Pharmaceutical advisor
- WAST representative (for discussion of items related to WAST/BASICS)

Where a meeting is not fully quorate it is acceptable that minutes are circulated to the membership of the airway group and decisions ratified one week after circulation where no objections are raised.

The core remit of the Airway Group is to ensure high quality, safe RSI is performed on EMRTS patients. The Airway Group reports directly to National Clinical Director through the EMRTS Clinical and Operational Board, with who decision-making will stand. The group can seek advice from the ECAG on issues that require either a second opinion or resolution.

The group will meet every quarter with the following standing agenda items;

1. Review of previous audit data with comparison to "all time" data
2. Review of all significant RSI or Airway related cases, namely;
    a. Difficult of failed airway
    b. Paediatric RSI
    c. Critical incidents
    d. Complaints
    e. Any case where equipment issues are noted
    f. All cases where top cover advice was mandated
    g. All cases where on scene time exceeds one hour (other than where extenuating circumstances exist).
3. Review the list of clinicians authorised to undertake unsupervised RSI and "sign off" new personnel.
4. Discuss and agree any changes to SOP 004a, 004b, 004c and 005

Emergency Anaesthesia – CSOP 004b

A working party drawn from the Airway Group has developed this CSOP. Subsequently it will ratify and review its content.

The Emergency Anaesthesia SOP will include:

- Indications for RSI.
- Standardised kit layout
- Checklists for pre and post RSI

- Algorithm for difficult/failed airways
- Algorithm for surgical airways (CSOP 005)

General principles around practitioners delivering RSI within EMRTS

The doctor-paramedic team delivering RSI must be trained and experienced in providing RSI on critically ill and injured patients in the emergency setting and have training and experience in pre-hospital care.

EMRTS must have clinical and governance oversight of all doctors providing RSI to EMRTS patients.

Which Doctors can perform RSI?

RSI within the EMRTS should only be performed by those doctors deemed competent. To be deemed competent the following criteria must be fulfilled:

1. All doctors should hold a contract of employment with the EMRTS host organisation.

2. RSI of critically unwell patients must be part of their "day job". This is to ensure adequate exposure to critically unwell patients as well as RSI competency.

3. Each doctor performing pre-hospital RSI must be approved by EMRTS via the EMRTS Airway Group. The group will hold list of qualified practitioners.

4. Recognised training and experience in pre-hospital care, fulfilling the job description for an EMRTS doctor.

5. Adherence to the Emergency Anaesthesia CSOP.

Consultants:
- Consultants in Anaesthesia/Intensive Care Medicine who regularly perform Emergency RSI.
- Consultants in Emergency Medicine with training and **recent** competency in RSI.

Critical Care Practitioners (CCP's):
- Both trainee and trained CCP's will participate in RSI as part of the consultant/CCP team. The roles will be interchangeable as described below. CCP's are not permitted to undertake RSI on their own or as part of a double CCP crew.

Trainees:
- Trainees in Anaesthesia, Intensive Care Medicine or Emergency Medicine (of ST5 level and above) who have been specifically approved by the EMRTS Airway Group.
- PHEM trainees in an approved Deanery post who have been approved by the EMRTS Airway Group.

Good practice in the safe delivery of pre-hospital emergency anaesthesia or RSI requires the presence of a minimum of one doctor meeting the above criteria and a trained assistant, as set out in the AAGBI Safer Pre-hospital Anaesthesia 2017 Guideline. On the extremely rare occasions

that where this does not occur the case will be subject to scrutiny and full review at Governance Day and M&M meeting to establish justification.

It is expected that all members of the EMRTS team demonstrate competence in airway skills, particularly intubation.

Those who do not, as part of their work intubate patients on a regular basis, or have not undergone a full anaesthetic training programme must provide evidence of ongoing competence. For CCPs this should include both intubations performed during hospital training shifts and pre-hospital work (see CSOP 004c).

A logbook outlining intubation experience should be submitted by these practitioners on an annual basis. It is expected that, on average 15-20 intubations be achieved every 6 months (see CSOP 004c)

'Top Cover' Consultant support

In the following situations a discussion with the 'top cover' consultant is usually required prior to performing RSI:

- RSIs in children under 12 years
- Doctors who not approved to act independently by the Airway Group.
- Trainees (including PHEM trainees).
- Cases where the EMRTS team thinks a second opinion is warranted.

Exception to 'top cover' authorisation is where the patient's condition necessitates an immediate RSI AND it would be detrimental to delay to make an advice call. (This should be a rare event and subject to review the Airway Group).

Paediatric patients

The AAGBI Prehospital Anaesthesia Safety Guideline highlights the fact that seriously injured young children present practitioners with a significant challenge, "Anaesthesia for children under the age of 8 years is increasingly recognised as a sub-specialist area of anaesthesia". This document also points out the need for a "careful risk: benefit analysis" in this group. In recognition of the range of specialties and individual experience within EMRTS the age for paediatric patients is 12 years old. For consistency this applies to all EMRTS consultants, irrespective of background or experience.

Neonates

Please see neonatal intubation CSOP 047b.

RSI team member role allocation

When performing an RSI several specific roles are allocated. Only EMRTS team members should perform intubation and give RSI drugs.

The default primary intubator will be the EMRTS doctor. Where delegated to the EMRTS CCP the doctor will continue to take responsibility for the intervention. Ensuring the maintenance of CCP

skills in intubation is of vital importance in maintaining team cohesion. The decision as to who will be the primary intubator involves all RSI team members; however the final decision will rest with the senior RSI competent doctor at scene.

Emergency Anaesthesia – see CSOP 004b

Audit and Governance

RSI is one of the highest risk interventions that the service performs and it requires a rigorous and robust governance process. Following each RSI (whether pre-hospital or in-hospital) full documentation is completed on the ePCR including an RSI tab. This is made available to key personnel on a weekly basis.

RSI's are evaluated against a pre-defined set of standards and this data will be reviewed monthly at the clinical governance days. This is the responsibility of the Airway Lead.

- The Airway Group will review in depth any cases where:
    - A serious complication occurred (e.g. cardiac arrest /failed intubation).
    - The clinician's actions were outside the SOP.
    - Concerns raised by any party (either internal / external to EMRTS).
    - At the request of the EMRTS team.
    - In circumstances outlined above under "**Airway Group**"

Feedback is provided by the chairperson to the Clinical and Operational Board.

Individual case feedback is provided to clinicians involved through monthly CG presentations and more detailed feedback forms (see appendix).

The current audit criteria are:

- Discuss with 'top cover' consultant first if;
    - Not signed off for solo RSI.
    - PHEM trainee.
    - All paediatric RSI's under the age of 12 years – 100% (see CSOP 4a and 4b).

- 80% of cases total pre-hospital on scene time ≤45mins for the non-trapped patient.[1]
- 80% of cases from RSI to leaving pre-hospital scene in ≤15mins.[3]
- Apnoeic oxygenation used - >80%.
- Intubated on first attempt - >90% and three or less attempts – 100%.
- Bougie used in all cases except if using difficult blade on video laryngoscope (where stylet should be used).
- Pre-RSI checklist used in all cases, with clear justification it "Immediate" checklist used.
    - Indications for immediate checklist;
        - Loss of airway not responding to or amenable to simple interventions.
        - Massive airway soiling.
        - "B" problem not responding to usual interventions.
        - Need for rapid and immediate surgical intervention (thoracostomy/thoracotomy).

- Transient complications (hypotension or desaturation) in traumatic/non traumatic brain injury – 10%.[4,5]
- $ETCO_2$ maintained within 3.0-4.5kPa for all patients with suspected brain injury (or $PaCO_2$ 4.5-5kPa where documented).
- All RSI relevant sections of PCR completed.
- Full case review of all cardiac arrests post RSI at governance days.

The sign ≥ denotes equal to or greater than and the sign ≤ denotes equal to or less than.
[1]Non-trapped patient – where 360 degree access to the patient is readily possible. (Entrapment including domestic entrapment – in doors, particularly upstairs etc.)
[2]Time from arrival at patient to leaving scene by air or road.
[3]Time from securing definitive airway to leaving scene by air or road. (See note below for time definitions)
[4] Hypotension – SBP ≤90mmHg within 5mins of induction.
[5] Desaturation – SpO2 ≤92% within 5mins of induction.

Time "stamp" definitions

The most important timings to be recorded around RSI are;

- Time RSI complete (this should be taken as time ETT confirmed in trachea, often best judged by first reliable $ETCO_2$ trace on monitor print out after drugs given)
- Time leaving scene – this should be the point at which movement towards the aircraft (or conveying vehicle) is commenced following RSI/packaging
- Time mobile from scene . Somewhat self explanatory - the time the aircraft is airborne, available from the pilot/ASD

Recording these times (in addition to time at scene etc.) gives the best breakdown of where time is spent during a case requiring RSI and may help guide improvement.

References and Further Reading

Lockey DJ *et al*. AAGBI: Safer pre-hospital anaesthesia 2017. Anaesthesia, 72, pp 379-390.

Appendix

EMRTS RSI Clinician Feedback Form

Job Number	Date	Crew	Dr	
			CCP	

Tasking

Location	
Indication for RSI	

Suspected clinical picture (based on PRF notes)

Full clinical picture on follow up (scan results etc.)

Audit criteria	

Timings	On scene	Arrival: Decision	Decision: RSI	RSI: Left scene

Other comments	

Grading	Paperwork		Clinical	

Paperwork	
Excellent	Clear understanding of job from notes, both PCR and audit paperwork 100% complete, signed by both crew
Good	Minor questions, some minor omissions
Adequate	Able to get general overview of case, using combination of audit form and PCR some (1 or 2) significant omissions (clinical info, GCS/BGL where indicated, ECG where indicated).
Sub-optimal	Unable to get a proper understanding of the job, >2 significant omissions, not signed by both crew, no continuous monitoring provided (<5min observations).
Poor	Very difficult to elicit full rationale, multiple major omissions, not singed by either crew.

Clinical						
Excellent	No audit issues, all treatment options covered, scene time minimised.					
Good	Minor issues only, maximum 1 audit "issue."					
Adequate	>1 audit/SOP issues without clear rationale/mitigating issues. Missed interventions/investigations/pertinent history.					
Sub-optimal	Significant deviation from SOP without clear rationale, major audit criteria issues. "Wrong" disposal, but without significant delay/harm.					
Poor	As above, plus patient harm or near miss. Wrong disposal resulting in delay or treatment.					

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Emergency Anaesthesia

Reference Number	CSOP 004b
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 004a, CSOP 003, CSOP 005

Author(s)	1. Matt O'Meara (checklists) 2. Michael Greenway 3. Tracy Phipps
Internal reviewer(s)	1. Stuart Gill
External reviewer(s)	
Sign off	COB

Summary Guide

- Always use the RSI checklists, Full or Immediate, Post-RSI & Pre-transfer
- Standardise 'kit dump' and personnel layout
- Use the same approach for prehospital and in-hospital RSI
- Optimise location/patient position before induction.
- Assess the patient thoroughly gcs pre-induction
- Fentanyl/Ketamine/Rocuronium is standard but modifications may be necessary (see special circumstances outlined below)

Introduction

Emergency Anaesthesia is an intervention that involves risk but also considerable benefits to patients. This CSOP provides a standardised, consistent approach to Emergency Anaesthesia, both in the pre-hospital and retrieval settings. They comply with published national recommendations

(AAGBI pre-hospital anaesthesia guideline). This CSOP is produced in conjunction with the overarching governance document on Emergency Anaesthesia (CSOP 004a).

Indications

The decision to anaesthetise patients should be made on the basis of an 'on-scene risk-benefit assessment' in every case i.e. in each specific situation, do the potential benefits of RSI outweigh the potential risks?

The indications are similar to those for immediate RSI in the ED.

The main indications for RSI are:

1. Actual or impending airway compromise
2. Ventilatory failure
3. Reduced LOC
4. Humanitarian need
5. Injured patients who are unmanageable or severely agitated after head injury
6. Anticipated clinical course

Choice of drugs

The EMRTS carry the following prefilled syringes / pre-drawn drugs for RSI and maintenance of anaesthesia. These are prepared at the start of each shift and after each RSI. Drugs are handled in accordance with drug SOPS:

- Ketamine 200mg (10mg/ml) X 1

- Fentanyl 500mcg (50mcg/ml) X 1

- Rocuronium 100mg (10mg/ml) X 1

- Midazolam 5mg (1mg/ml) X 1

-Epinephrine 100mcg (10mcg/ml) X 1

Other drugs for RSI carried but not pre-drawn will include propofol (10mg/ml), thiopentone (500mg powder vial), morphine (10mg/ml) and metaraminol (10mg/ml).

Drug selection for induction of anaesthesia is at the clinician's discretion. All drugs for induction, paralysis and maintenance of anaesthesia are drawn up and labelled prior to the RSI being performed. Pre-drawn syringes speed up this process and reduce error.

For trauma patients ketamine is strongly recommended for induction (at a dose of 1-2 mg/kg), with or without fentanyl depending on the haemodynamic status of the patient. In patients with significant haemodynamic compromise the dose of ketamine is usually be 1mg/kg or less.

Although a dose of 3mcg/kg of fentanyl may be used in haemodynamically stable patients witout co-morbidity a reduced dose is used when either are present.

Rocuronium is always be dosed at 1mg/kg. EMRTS does not carry suxamethonium.

Post intubation sedation and analgesia

Bolus Dosing:

(only suitable for short-term transfers)

- Midazolam and fentanyl boluses

- Ketamine boluses

Infusions:

(for journeys from scene to hospital > 20 minutes)

- Propofol 1% **OR**

- Mixture of ketamine and midazolam in a single syringe

    - Ketamine 200mg & Midazolam 5mg (see appendix for full recipe)

    - recommended for polytrauma patients

    - **DOSE (ml per hour)** = (**Patient weight)/4**.

Pre-RSI Checklist

A standardised pre-RSI checklist is used with a challenge and response format. It has been developed for standard RSI and the core elements essential for *immediate* induction are indicated in a separate but shorter checklist. Immediate induction is uncommon and standard RSI is the norm.

STANDARD PRE-RSI CHECKLIST

	START OF CHECKLIST	Expected Response
SET UP	Anticipated difficult?	Yes/No
	Position optimal?	Check
	C-spine control?	Yes/Not required
	Cricoid required?	Yes/No
	Roles allocated?	Intub1 =..... Intub 2 =..... MILS=..... Cricoid=.....
	Nasal oxgen?	Yes/No
	Oxygen?	2 cylinders, full & on
	Suction?	Working,check
	Pre oxygenation with full assembly?	Check
	IV access x2	Check
Monitoring	ECG	Rate/Rhythm
	Sats	%
	BP value & Interval	x/ymmHg, set to 2min, adult/paeds/neonate
	Capnography connected	Check
Airway	Laryngoscope (blade/size), (Spare/size)	1st[blade], 2nd[blade]
	Bougie (size)	Check
	ETT	1st [Size], 2nd[Size]
	Syringe	Check
Drugs	Induction	[Drug(s)], [Dose, mg,mls]
	Roc	[Dose, mg/mls]
	Maintenance available?	[Intended agent] Check
Drills	Plan B	Check
	Plan C	Check
	Thoracostomies required?	Yes/No.....[Side]

END OF CHECKLIST - PROCEED TO GIVE DRUGS

See EMRTS App for latest version

IMMEDIATE INTUBATION CHECKLIST

START OF CHECKLIST	Expected Response
Position optimal ?	check
Oxygen Cylinders x 2	check
Cylinder turned on and oxygen flowing	check
[BVM] or [Water's Circuit] connected	check
End tidal CO2 connected	check
Suction unit working and positioned	check
Laryngoscope ready and working	check
Tube ready	size [x] check
Bougie ready	check
Induction drugs	[drug 1], [drug 2], [drug 3] check
Vascular access	[location where drugs to be given]

END OF CHECKLIST - PROCEED TO GIVE DRUGS

See EMRTS App for latest version

Pre-RSI procedural sedation

Some patients who require emergency anaesthesia are agitated and uncooperative. This may be due to hypoxia and hypovolaemia. Incremental doses of IV sedation are given to facilitate patient preparation, monitoring and pre-oxygenation

Sedation can be achieved with boluses of the planned induction drug (increments of 5 to 10% of proposed induction dose). In adult patients incremental 10-20mg boluses of ketamine titrated to effect are sufficient. Alternatively 1-2mg of midazolam can be used, but caution is required due to the risk of respiratory depression and apnoea. Always be prepared with immediately available equipment to control the airway. See CSOP 003 for further details.

Preparation for RSI

Preparation and procedures for an RSI are the same whether it is being performed in the pre-hospital setting or within a healthcare facility. The checklist above is used to prepare in all cases.

Team

RSI should only be undertaken with a full EMRTS team (Doctor & EMRTS CCP). For further guidance see CSOP 004a.

Environmental considerations

Wherever possible the patient is placed supine on an ambulance stretcher set to knee height, with360 degree access. A dynamic assessment is made if this approach is not possible, taking into account weather conditions, lighting and patient privacy. On occasion the RSI may need to be undertaken in an ambulance. Sunlight should be from behind the intubator and sheets may sometimes need to be used to provide shade during laryngoscopy. Patient positioning is optimised before intubation.

It is inadvisable to undertake RSI in a confined space or on an trapped patient –other methods of airway management (e.g. placement of a supraglottic airway device) should be considered.

Kit layout

The kit layout is contained in the primary bag airway section – there are adult and paediatric sections with following equipment:

- **Appropriate size tracheal tube – opened, cuff checked and lubricated. Alternative sizes available**
- **Videolaryngoscope blade, videolaryngoscope, stylet if difficult intubation blade used**
- **Back-up laryngoscope with handle – checked**
- **20ml syringe**
- **Catheter mount and HME filter**
- **Bougie (Frova Intubating catheter)**
- **Thomas tube holder**

The layout of the kit is shown below:

The kit bag is placed Eon the patient's right . The external laryngeal manipulation (ELM) and stabilisation of spine (MILS) assistant (if required) is positioned to be effective without hindering the role of RSI team members. Monitoring is to either the patient's left or on his/her legs with an unobstructed eye line to operators intubator and assistant. Sufficient oxygen (3 full cylinders) and a working suction unit are prepared.

Monitoring

Every RSI requires full monitoring including $ETCO_2$ waveform capnography.
The BP cuff is applied to the contralateral arm to the SpO_2 probe and the IV (induction drugs) line. The BP is cycled every 2 minutes. For retrieval taskings it may be preferable to insert an arterial line prior to RSI.

Ideally patient temperature should be checked and documented pre-RSI and a temperature probe inserted post-RSI, to facilitate temperature monitoring.

Pre-oxygenation

Pre-oxygenation is essential to minimise the risk of hypoxaemia occurring during RSI. In some patients, high saturations may not be possible (e.g. because of severe chest injury or underlying lung pathology) and the risk of post-induction desaturation remains high. Poor perfusion can make it difficult to obtain an oxygen saturation.

Ideally 3 minutes of pre-oxygenation is delivered prior to induction. This can be achieved by three techniques:

1. Water's (Mapleson C) circuit
2. Tight fitting reservoir mask with high flow oxygen
3. Self-inflating bag with well-fitting facemask

The choice will depend on operator familiarity and availability of equipment. If using options 1 or 3, connect catheter mount, HME filter and $ETCO_2$ assembly to the facemask to confirm all functioning.

Apnoeic oxygenation is applied throughout induction using nasal cannulae for all RSI's unless immediate induction is required or is impractical e.g. due to nasal trauma. Apply nasal cannulae to the patient and deliver at 15 l/min. Remove after successful intubation.

Active BVM ventilation during RSI may be required where saturations fall below 90%.

Consider airway adjuncts to optimise airway patency during the pre-oxygenation phase. Patients with a high BMI will benefit from being pre-oxygenated 15-20 degrees head up.

Vascular / IO access

Ideally two points of IV access must be available prior to induction. Fluid is attached to one access point, to act as a flush when drugs are administered and to confirm line patency.

Patient assessment

Prior to the induction, the following are checked and recorded:

1. Respiratory rate
2. GCS (especially motor score)
3. Movements (and where applicable sensation)
4. Pupillary size and response
5. Abdominal tenderness and guarding
6. Neurological function distal to any significant limb injury
7. Blood glucose level (medical RSI)
8. Body temperature

Environment and Team preparation

Ensure a calm and quiet scene RSI. Minimise extraneous noise (e.g. radios turned down, engines switched off).

Give a concise team brief to ensure all present understand rationale and plan for RSI. Ensure roles are allocated (see below) and briefed.

Role Allocation

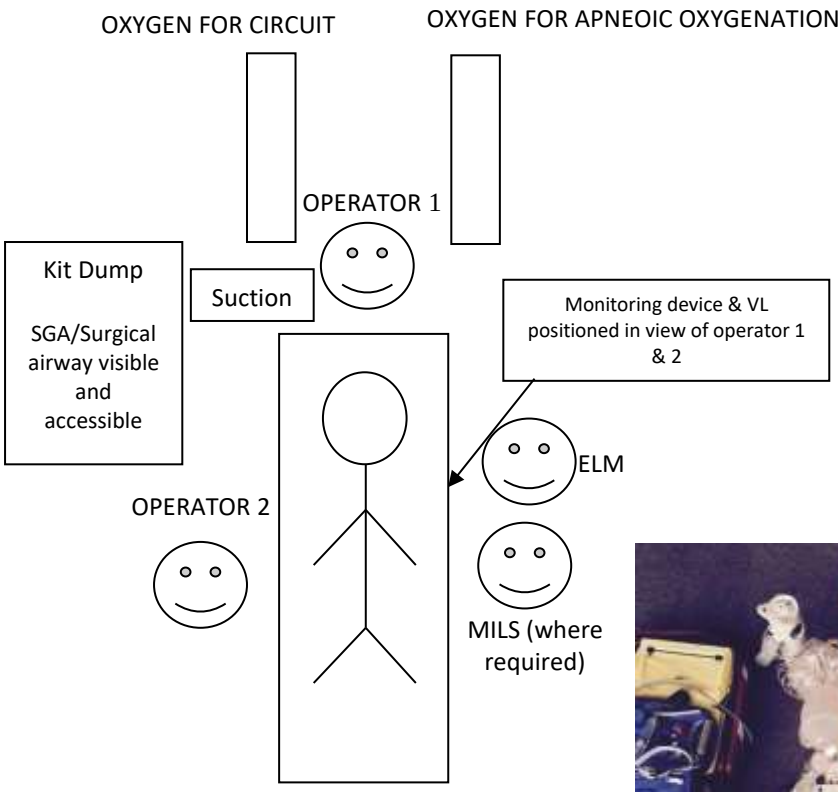
Operator 1	Intubating clinician.
Operator 2	Assisting clinician with overview of the whole procedure.
Stabilisation of neck (MILS)	Operator to maintain manual in-line cervical spine stabilisation ('MILS' - best done from ‘below’, i.e. facing the intubating clinician).
External Laryngeal manipulation (ELM)	Operator to assist with cricoid pressure / external laryngeal manipulation.

Cricoid pressure is not mandatory due to limited evidence of effect and potential for worsening laryngoscopic view. However, it should be considered in patients with high risk of regurgitation.

External Laryngeal Manipulation can be used with video laryngoscope view to improve the view without the need for additional commentary or movements from operator one.

Manual in line stabilisation of the cervical spine is applied if the risk of C-spine instability is considered likely. However, achieving an adequate airway and intubation success is paramount.

A standard configuration of team and equipment should be adopted, and is illustrated below:



Delivery of RSI

Induction phase

The challenge response pre-RSI checklist is completed prior to induction.

Induction drug(s) and rocuronium are given rapidly through a patent IV line. Induction and paralytic drugs should ONLY be administered by an EMRTS team member.

If the patient develops a SpO_2 of <94% then assisted ventilation should be commenced using gentle low tidal volume ventilation (apneoic oxygenation via nasal cannulae will help to mitigate against significant desaturation). The skilled application of cricoid pressure during ventilation may reduce the risk of gastric insufflation and regurgitation. If the SpO_2 remains above 94% then assisted ventilation is not required.

Laryngoscopy and intubation

A standardised approach to airway management is necessary advocated according to the in-hospital principles outlined by the Difficult Airway Society (DAS). A "wake up" option is rarely appropriate in a prehospital RSI patient.

A video-laryngoscope is used as first line for the majority of intubations. It has a Macintosh 4 and difficult intubation-blade (with increased anterior curvature). The videolaryngoscope can be used as a conventional laryngoscope (i.e. direct laryngoscopy) or, if difficulty is encountered, as a video laryngoscope with the operator using screen images to guide intubation. Where the Mac 4 blade does not provide a view the difficult intubation blade can be substituted. A back-up conventional Macintosh blade and handle is available. A conventional blade may be more effective in bright sunlight, or where there is airway soiling.

All intubations are performed with a bougie unless using the V/L difficult intubation blade where a stylet is used instead.

After intubation and cuff inflation a ventilation circuit (Water's circuit or BVM) and pre-prepared catheter mount, HME filter and ETCO2 waveform capnograph is attached. $ETCO_2$ waveform on the monitor is examined to confirm tube position in addition to chest inspection and auscultation. Tube length at teeth is recorded (approx 22-24cm in adult males and 20-22cm in adult females) and the tube secured in place with a Thomas tube holder. For younger children and infants consider taping the tube in place, in addition to a standard tube tie.

Proceed to the post-intubation checklist.

Plan B

No more than 3 attempts are made at intubation; 2 by operator one and one by operator two. In between attempts a change to optimise laryngoscopy should be made. 5 categories of change can be considered:

1. Manipulations: Adjusting patient or intubator position, or laryngeal manipulation.
2. Adjuncts: Stylet, Bougie, Magill forceps
3. Size/type: Smaller TT tube, different laryngoscope blade
4. Suction: Suction foreign material/blood
5. Muscle tone: Allow longer for muscle relaxant to fully work

If adequate oxygenation cannot be maintained at any point then this oxygenation becomes the priority. Perform two person BVM ventilation with using NP/OP airways OR by insertion of a supraglottic airway device.

A maximum of 2 attempts should be made with a supraglottic airway device before proceeding to Plan C, especially if the patient is failing to oxygenate adequately.

Plan C

If the patient cannot be oxygenated adequately using the measures in plan A and B then progress swiftly to a surgical airway as per CSOP 005. Needle cricothyroidotomy is only indicted in pre-pubertal paediatric patients.

Post-RSI Care

The immediate post-RSI period is used to reassess the patient, optimise stability and prepare to transport. Frequently post-RSI time is unnecessarily prolonged and use of the post-RSI checklist is designed to ensure patient safety and promote shorter scene times. This is found at the end of this document. A longer transfer checklist is provided in CSOP 002 for critical care transfers.

Ensure adequate sedation and analgesia. During the transfer assess for signs of awareness (lacrimation, tachycardia, sweating, dilated pupils and hypertension) and treat accordingly.

If the patient is connected to a mechanical ventilator then, in general, aim to keep peak pressures <30cmH_20, Tidal Volume at around 6-8 ml/kg and SpO_2 between 94-98%. Most patients benefit from a minimum of 5cmH_20 of Peak End Expiratory Pressure (PEEP). Certain patient groups may require higher peak pressures (for example acute asthmatics with severe bronchospasm) or higher levels of PEEP (pulmonary oedema, lung contusions with hypoxaemia).

In patients with potential for brain injury (TBI, suspected spontaneous intracranial event or post RoSC) an end tidal CO_2 of 3-4.5kPa is targeted (see CSOP 10). If time allows, blood gas analysis should be used to guide ventilation ($PaCO_2$ of 4.5-5kPa- 4.0-4.5kPa critically raised ICP suspected). In non brain injured patients should be maintained at normal EtCO2 with a lung protective strategy. Permissive hypercarbia may be allowed in some conditions (e.g. severe asthma/COPD).

Complications can occur following RSI as described below:

Hypotension

Hypotension can occur after RSI, particularly in the presence of hypovolaemia, and the cause may be multi-factorial. Potential causes include induction drug, vasodilatation and myocardial depression. This may require treatment with fluids and/or inotropic and vasopressor support. The major exception to this is haemodynamically compromised trauma patients where haemorrhage is highly likely. These patients should receive prompt blood products titrated to a radial pulse. Vasopressors without volume replacement should be avoided. See *CSOP 034 – Inotropic support*.

Tension pneumothorax

In the intubated patient this requires rapid diagnosis and treatment. Ideally thoracostomies should occur within 60 seconds of confirming correct TT position. The procedure needs to be pre-empted with preparation of equipment and roles prior to RSI.

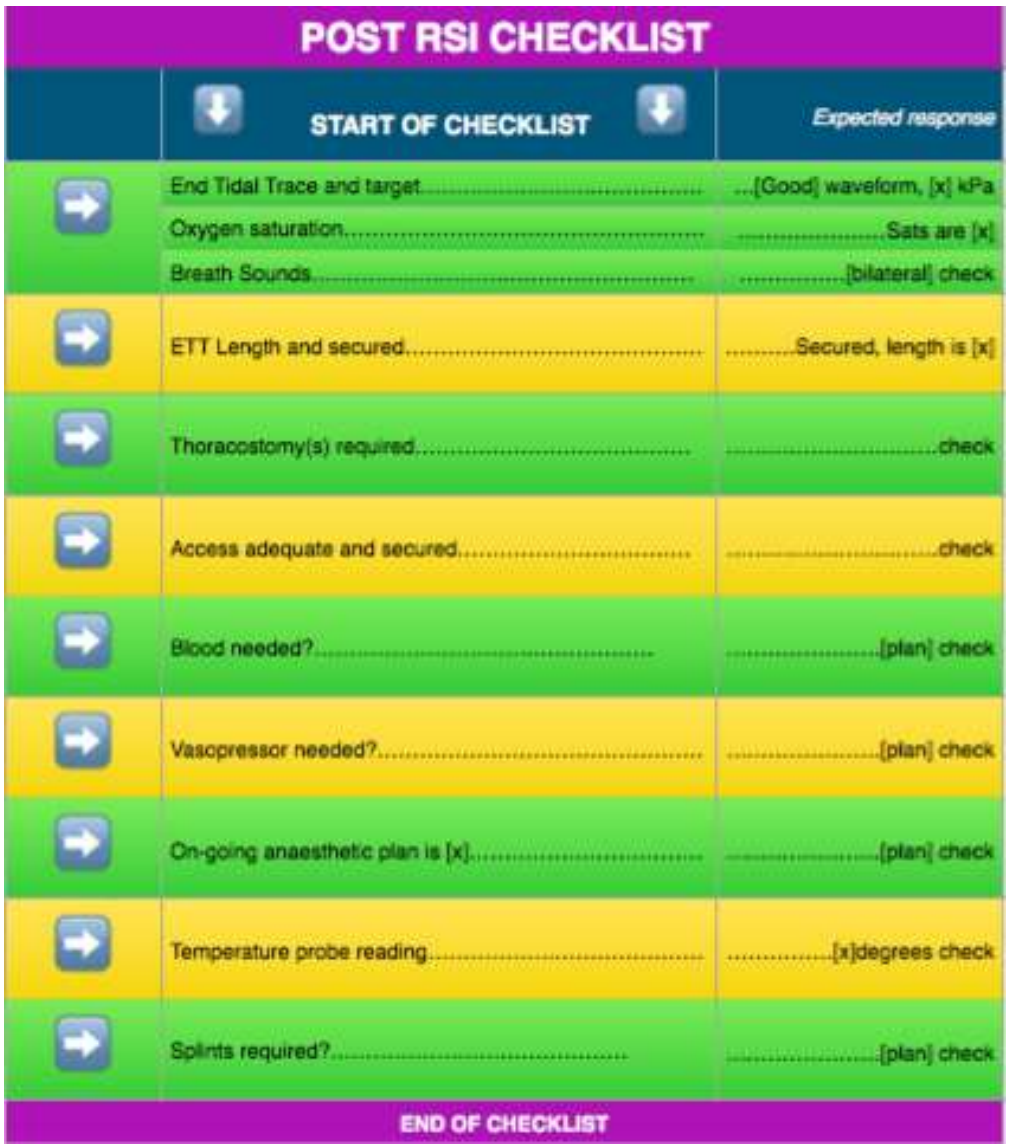
Hypoxia and increased airway pressure are the earliest signs with reduction in $ETCO_2$ and hypotension occurring. Tracheal deviation is a late, unreliable sign. A combination of transthoracic ultrasound and clinical assessment to diagnose pneumothorax may assist in ensuring thoracostomies are appropriate.

For patients with chest wall injuries, consider whether a thoracostomy is required before leaving scene as these are best done prior to departure.

Hyperventilation

Hyperventilation with air trapping can occur in the context of respiratory disease, particularly where aggressive ventilation has occurred to treat desaturation. High intra-thoracic pressure impairs venous return and cardiac output. Peak inspiratory pressure and chest hyperexpansion in a high risk patient should suggest the diagnosis. Disconnection from the ventilation circuit and forced expiration to release trapped alveolar gas may assist ventilation. Ventilation rates are reduced and expiration time increased to improve exhalation time and bronchodilators considered.
If these actions do not resolve the situation consider the possibility of tension pneumothorax.

An oesophageal temperature probe is inserted and warming or cooling provided if required.



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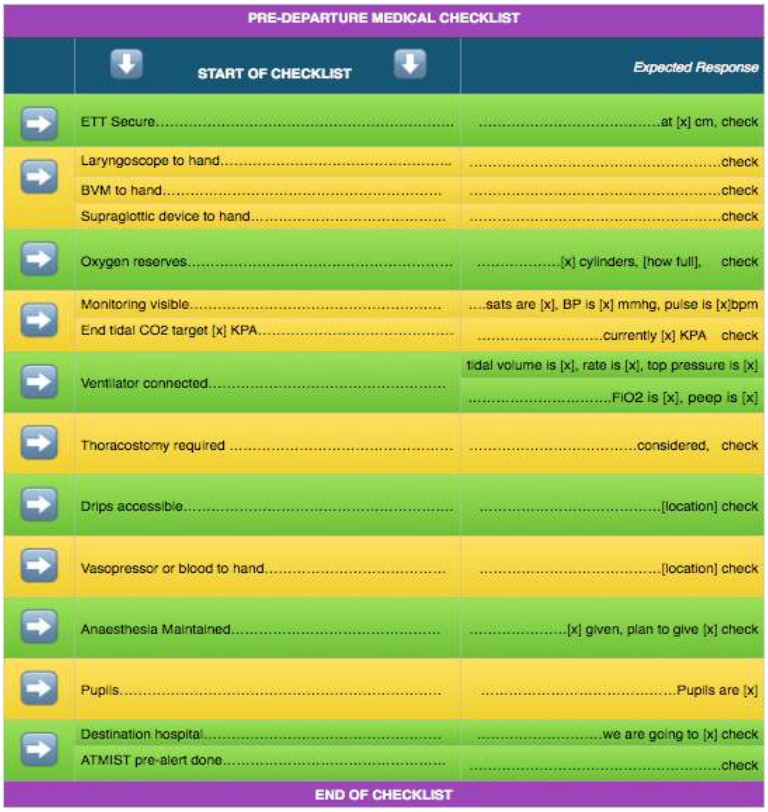


PRE-DEPARTURE MEDICAL CHECKLIST		
	START OF CHECKLIST	*Expected Response*
	ETT Secure	.....at [x] cm, check
	Laryngoscope to hand	.....check
	BVM to hand	.....check
	Supraglottic device to hand	.....check
	Oxygen reserves	.....[x] cylinders, [how full], check
	Monitoring visible	....sats are [x], BP is [x] mmhg, pulse is [x]bpm
	End tidal CO2 target [x] KPA	.....currently [x] KPA check
	Ventilator connected	tidal volume is [x], rate is [x], top pressure is [x]
		.....FiO2 is [x], peep is [x]
	Thoracostomy required	.....considered, check
	Drips accessible	.....[location] check
	Vasopressor or blood to hand	.....[location] check
	Anaesthesia Maintained	.....[x] given, plan to give [x] check
	Pupils	.....Pupils are [x]
	Destination hospital	.....we are going to [x] check
	ATMIST pre-alert done	.....check
END OF CHECKLIST		

See EMRTS App for latest version

Special Considerations

Paediatric patients

Children usually have more straightforward anatomy than adults, and airway management is frequently easier. The threshold for RSI is higher and should be (when not time critical) discussed with the Top Cover Consultant (TCC) for children under 12 years old.

RSI in paediatric patients is the same as for adults, with a few minor differences:

- A Mac 2 blade is carried. Alternatively a Miller blade can be used
- Care should be taken not to over-inflate the cuff
- Drugs and doses are checked and confirmed by both members of the EMRTS team
- Consider taping the tracheal tube with Elastoplast, in addition to securing with a tube tie

Appendix 1

Recipe for mixing Ketamine and Midazolam
Draw up 200mg of ketamine into 20ml syringe

- Add 5mg midazolam
- Total volume should be 25ml
- **Run the Infusion at (Patient weight) / 4**
- This will provide a dose of Ketamine 2mg/kg/hr and Midazolam and 50mcg/kg/hr

See Infusion table below:

Ketamine 200mg and 5mg Midazolam in 25ml

Age	Weight (Kg)	Recommended Rate (ml per Hour)
3 months	6	**1.5**
6 months	7	**1.75**
9 months	8	**2**
1	10	**2.5**
2	12	**3**
3	14	**3.5**
4	16	**4**
5	18	**4.5**
6	25	**6.25**
7	28	**7**
8	31	**7.75**
9	34	**8.5**
10	37	**9.25**
11	40	**10**
12	43	**10.75**
13	46	**11.5**
Small Adult	50	**12.5**
Standard Adult	70	**17.5**
Large Adult	100	**25**

References and Further Reading

Lockey DJ, Crewdson K, Davies G, Jenkins B, Klein J, Laird C, Mahoney PF,Nolan J, Pountney A, Shinde S, Tighe S, Russell MQ, Price J, Wright C. AAGBI:Safer pre-hospital anaesthesia 2017: Association of Anaesthetists of Great Britain and Ireland. Anaesthesia. 2017 Mar;72(3):379-390.

Difficult airway society guidelines for the management of the unanticipated difficult intubation, 2015.

Emergency Airway Management. Burtenshaw A, Benger J, Nolan J (2nd Ed). Cambridge University Press: Cambridge, 2015.

Henderson JJ, Popat MT, Latto IP, Pearse AC. Difficult Airway Society guidelines for management of the unanticipated difficult intubation. *Anaesthesia* 2004; 59: 675-694

Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Annals of Emergency Medicine*. 2011.

The Vortex Approach to airway management: http://vortexapproach.org

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (OSOP)

Governance Arrangements for Intubation by CCPs during PHEA

Reference Number	CSOP 004C

Author(s)	Stuart Gill (Hywel Dda UHB - Anaesthetics Consultant) Original Author - Stuart Gill
Internal reviewer(s)	Airway Group/Clinical & Operational Board

Aim

The aim of this document is to formalise the position that EMRTS holds in maintaining intubation as part of CCP's skill set, including during PHEA where supervised by an EMRTS doctor.

Background

EMRTS have undertaken to achieve first time intubation rates of >90% as an audit standard and as a KPI.

Guidance cites pre-hospital intubation following PHEA as more difficult than in hospital intubation and potentially high risk. It gives some stipulation as to the minimum experience for doctors undertaking this procedure (an average of one undertaking of PHEA per month to maintain competence)[AAGBI Safer Pre-hospital Anaesthesia] but goes on to say that in order to maintain competence most doctors should undertake emergency anaesthesia as part of their regular in hospital practice.

Rationale

Recent research has suggested that intubation is not of benefit over SGA device placement in paramedic practice when treating patient in cardiac arrest [AIRWAYS2]. The emphasis of intubation by mainstream paramedics is reducing.

Not all CCP's joining the service are from a Paramedic background and may have little or no previous experience in performing endotracheal intubation.

However, endotracheal intubation remains an accepted intervention for patients in cardiac arrest, is expected of our Doctor/CCP teams and is delivered by teams made up of CCP only crews. CCP's are authorised to provide post ROSC sedation and muscle relaxation in previously intubated patients through a PGD with the aim of maximising quality survival benefit. Maintaining the skill of intubation, including during PHEA is important to ensure this service can be delivered.

For these reasons, there is a need to provide assurance as to the training and experience of CCPs undertaking intubation as part of PHEA.

This SOP covers two aspects of this; Initial training & Sign off and Maintenance of Competence.

Initial Training & Sign Off

CCPs come to the service from a variety of backgrounds and have a variety of different levels of experience with intubation.
For this reason all CCPs must undergo a period of training prior and be formally signed off prior to undertaking any intubations during pre-hospital anaesthesia.

Training will be undertaken during hospital placements. Theatre is an ideal setting for fine-tuning the technique of intubation.

New CCPs are expected to undertake a minimum of 20 training intubations. The focus of sign off however is not absolute numbers, but assessed competency. Training must include;

- Use of standard and video laryngoscopes used by the service
- Use of bougie
- Direct and indirect techniques, including use of stylet
- Undertaking RSI – this can involve real in hospital RSI but must also include a simulated scenario adhering to the EMRTS Pre-Hospital Anaesthesia SOP (CSOP004b)

They must also have the **skill of intubation formally assessed by an EMRTS consultant** in a controlled setting prior to undertaking the role of intubator during pre-hospital PHEA.

At sign off the following must be used

- Video laryngoscope used by the service
- Bougie

Sign off should take the form of a DOPS assessment, this should be clearly marked as a formal summative assessment.

HTP's – Intubation During Cardiac Arrest

HTP's who do not already have intubation as part of their scope of practice must demonstrate competency prior to undertaking this intervention. In order to achieve this they must;

- Undertake a minimum of 20 training intubations during theatre lists
- Be signed off by an EMRTS consultant who has observed the skill directly

Maintenance of Competence

The AAGBI PHEA Guideline suggests an average of 1 undertaking of PHEA per month as a minimum to maintain competence.

CCPs must maintain a logbook of intubations to ensure there is documented evidence of currency. EMRTS provides a logbook which should be used; see appendix 1.

Logbooks will be reviewed as part of yearly performance reviews/PDR process. Following the PDR meeting the airway lead must be informed of any issues with meeting the competence standards in order to be able to maintain a log of recognised practitioners.

The minimum that will be accepted as evidence of currency maintenance is;

- **15 intubations per year** (minimum of 7 undertaken as part of anaesthesia, either prehospital or in hospital)
- Minimum of **one theatre-based training shift** with an EMRTS consultant per year
- Personal first-time intubation rate must be reported

Where these are not achieved at annual review, 3 months will be allowed to provide logbook evidence meeting the above stipulations. If this is not achieved within the 3-month period, the CCP should no longer undertake intubation as part of PHEA and will need to achieve a minimum of;

- Five in-hospital training intubations
- Formal sign off by an EMRTS consultant who has observed intubation

These will also be undertaken on return to practice after a period of extended leave.

A low first-time intubation rate of less than 80% will also trigger a period of re-training. It is however recognised that it would be unfair for a truly difficult intubation to adversely affect an individual CCP's logbook numbers. In mitigation for this;

- CCP's should request a review, by their respective base lead, of cases they believe should not be counted towards this total
- Where there is agreement the base lead will enter a note in the CCP's log book (in the notes/comments section to this effect – this will be taken into account at annual review.

Note; these stipulations do not apply to intubation by CCPs undertaken during cardiac arrest.

Service Oversight

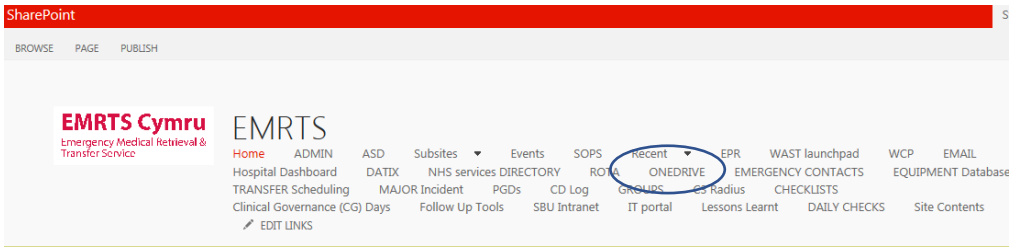
The Airway Committee will maintain a list of all intubation trained CCP's/HTP's. New CCP's joining the service must submit evidence – in the form of a logbook, evidence of simulated RSI and written confirmation of sign off by an EMRTS consultant (in the form of a summative DOPS assessment form).

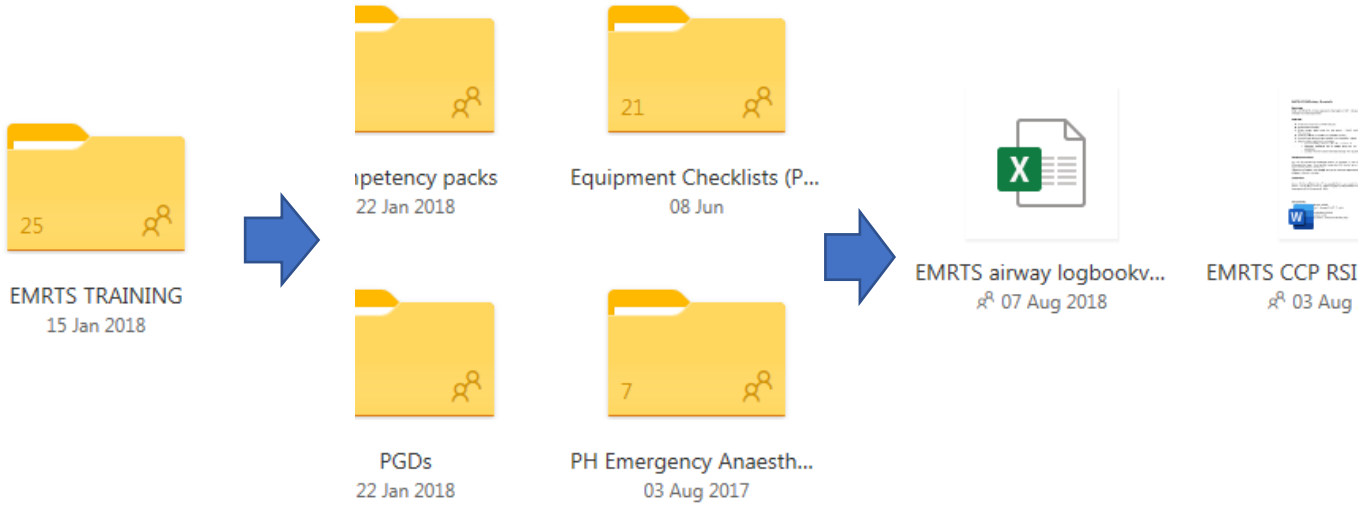
CCP's will automatically remain on the list of authorised intubators. Where review at PDR meetings shows an inability to meet the criteria in this document, the manager undertaking the PDR must inform the Airway Lead so that the list can be amended appropriately.

Appendix 1

Log book

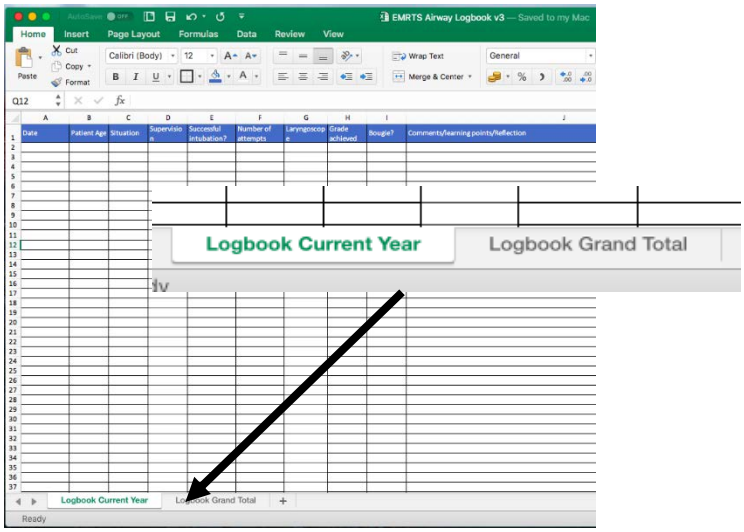
The EMRTS airway logbook is available on OneDrive (access through SharePoint) accessed via the following folders; EMRTS training →PH Emergency Anaesthesia.





Although individual separate logbooks may be maintained, for consistency of reporting clinicians should use this spreadsheet for reporting airway cases. This is in order to ensure consistency of reporting.

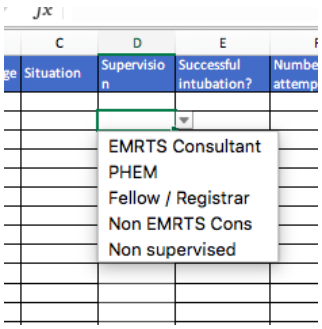
The spreadsheet contains two tabs;
"Logbook Current Year" and "Logbook Grand Total"

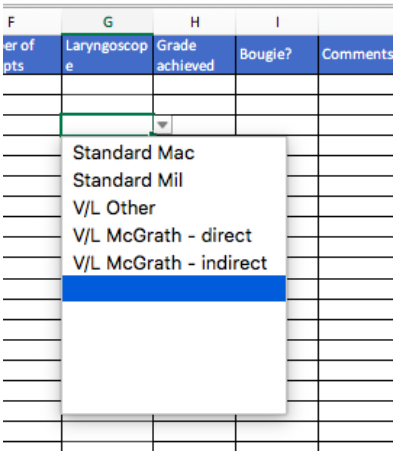


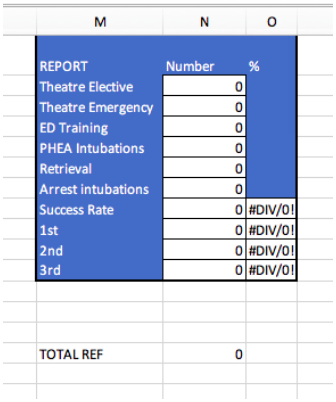
This allows reporting of a single year's experience for review of the criteria for currency set out in this SOP as well as ongoing log of career experience.

The "Current Year" should be used primarily for data entry, with data copy/pasted into the "Grand Total". Following presentation of data from the current year at PDR it should then be deleted from this page, ensuring it has been copied across.

Drop down lists are provided (contained within a hidden tab). Again this is for ease and consistency of reporting, which is automatically produced in a table to the right of the main data entry field.







REPORT	Number	%
Theatre Elective	0	
Theatre Emergency	0	
ED Training	0	
PHEA Intubations	0	
Retrieval	0	
Arrest intubations	0	
Success Rate	0	#DIV/0!
1st	0	#DIV/0!
2nd	0	#DIV/0!
3rd	0	#DIV/0!
TOTAL REF	0	

A final column provides space for free text allowing expansion on the details of the case and/or personal reflections, it is encouraged that this is used.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Surgical Airway

Kit in the Difficult Airway Pack in the Primary Bag

Reference Number	CSOP 005
Application	EMRTS Consultants and CCP's
Related SOPS	CSOP 004a, CSOP 004b

Author(s)	James Chinnery
Internal reviewer(s)	Bob Tipping
External reviewer(s)	
Sign off	COB

Introduction

Main indication: "can't intubate, can't oxygenate" scenario

Failure to intubate and failure to oxygenate the patient is rare , occurring most frequently in trauma patients. If a "rescue" device (such as supraglottic airway) fails to oxygenate the patient, then cricothyroidotomy may be required. This occurs after both plan A and plan B have failed – see CSOP 4b.

The two techniques are known collectively as **F**ront **O**f **N**eck **A**ccess (FONA):

- Surgical cricothyroidotomy (preferred technique).
- Needle cricothyroidotomy.

Human Factors:

Human factors issues can be more challenging than the procedure itself, in particular task fixation with intubation or Igel placement. When required urgently the procedure must be performed rapidly (within 30 seconds). All EMRTS practitioners carrying out RSI must be fully rehearsed with the FONA techniques (below). A specific person (i.e. Intubator 1) should be nominated to perform FONA as required prior to commencing RSI.

Plan A or primary FONA:

Moving directly to FONA without attempting to intubate may rarely be required with situations such as facial burns or severe maxillofacial trauma. If the risk-benefit decision is to proceed with RSI and it is predicted that intubation will be difficult, FONA equipment is available alongside standard RSI equipment.

If ventilated via Facemask or Igel, before undertaking FONA CONFIRM:

- Oxygen tubing connected?
- Cylinder has O2 in it?
- Cylinder turned on?

- Think – is oxygenation stable and survivable?
- Think – will FONA be easy/difficult?

A stable SpO_2 of 85% with no ventilation difficulty or impending airway problem is a situation which may allow more experienced help to be mobilised or transfer to the nearest trauma unit.

Ease/difficulty of FONA needs to be assessed prior to RSI (e.g. presence of a fat/short/goitre/ traumatised or immobile neck).

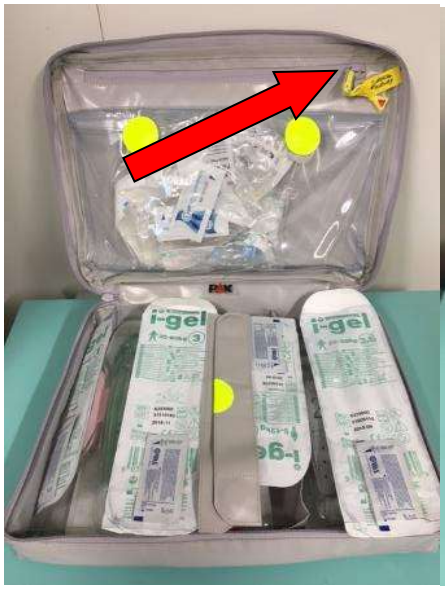
Surgical cricothyroidotomy

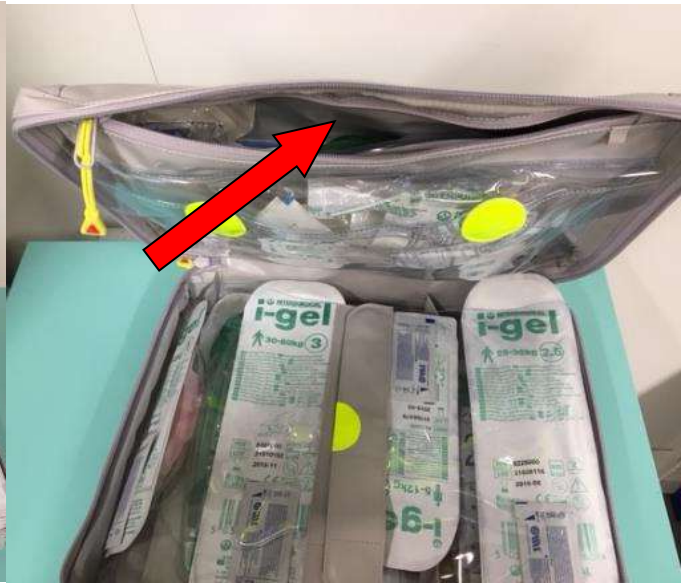
FONA kit is in Difficult Airway Pack in the Primary Bag

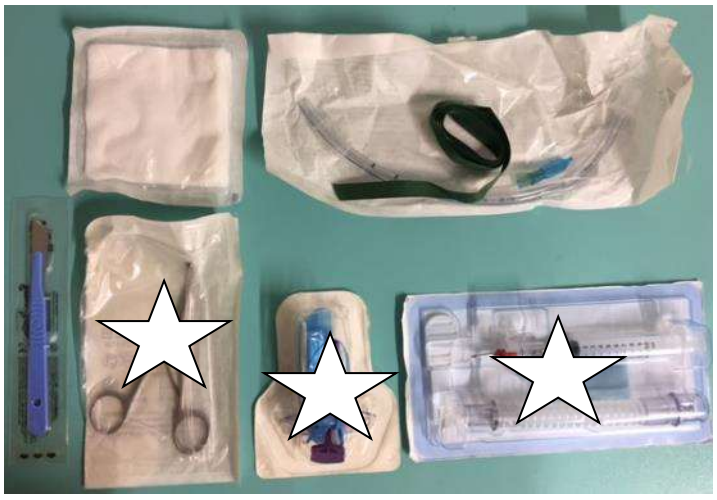
Equipment required: scalpel (ideally rounded 20 blade), gauze, forceps, bougie, a size 6.5 cuffed TT, and a tube tie.

Apart from the bougie, these items are stored in the difficult airway pack in the tagged zippered lid pocket (see red arrow in pictures below). The difficult airway pouch is in the primary bag.

The items marked with a white star are being removed and replaced by a LEROY or RAPID O2 needle cric kit.

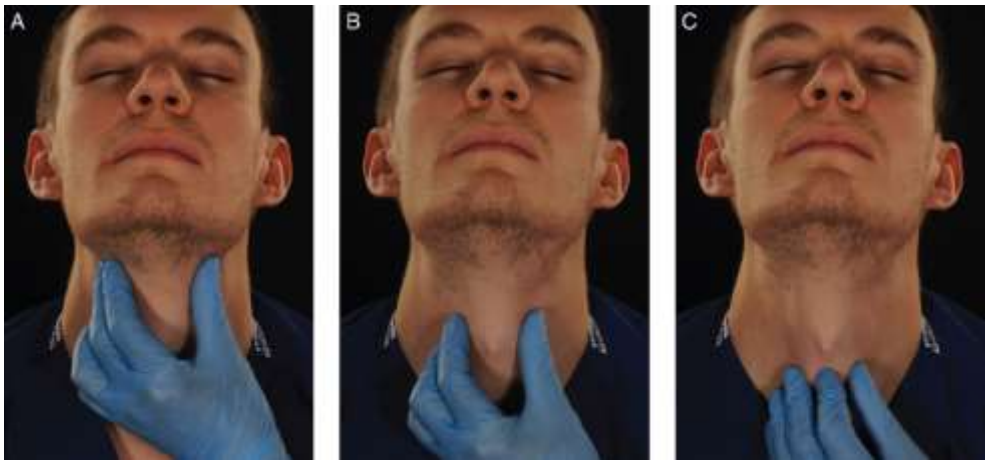






The laryngeal handshake:

The **'laryngeal handshake'** technique has been recommended by the Difficult Airway Society 2015 guidelines to aid the operator's recognition of the three dimensional anatomy of laryngeal structures.

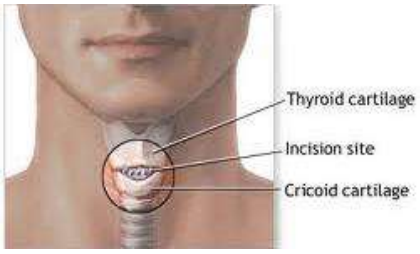


(A) The index finger and thumb grasp the top of the larynx (the greater cornu of the hyoid bone) and roll it from side to side. The bony and cartilaginous cage of the larynx is a cone, which connects to the trachea.
(B) The fingers and thumb slide down over the thyroid laminae.
(C) Middle finger and thumb rest on the cricoid cartilage, with the index finger palpating the cricothyroid membrane (CTM).

FONA technique:

The EMRTS technique is **surgical cricothyroidotomy** using a **scalpel-forceps-bougie** technique.

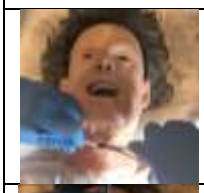
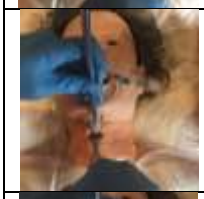
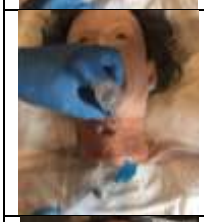
1. The CTM lies between the thyroid cartilage and cricoid cartilage.
2. It is identified with the laryngeal handshake and slight extension of the neck (if c-spine uninjured).
3. Continue oxygenation using a BVM (with NPAs & OPA) or I-gel from above.



4. Non-dominant hand should be used to stabilise the CTM.
5. The dominant hand using the scalpel makes a vertical midline incision (if the anatomy of the CTM is indistinct e.g. due to trauma, burns or high BMI).
6. This is followed by a horizontal incision once the CTM is identified.
7. The scalpel should be left *in situ* and the incision opened using forceps.
8. The scalpel should then be removed and a bougie passed through the stoma into the trachea with the forceps still in place.
9. Detection of clicks (as bougie slides over tracheal rings) may help confirm correct placement.
10. Care should be exercised to not damage the carina with the bougie.
11. The size 6.5 cuffed ETT is then “rail–roaded” over the bougie through the incision.
12. The forceps are removed as the TT is advanced into the trachea.
13. The bougie is removed, TT cuff inflated, and the position confirmed as per CSOP4b.
14. Initial ventilation should be gentle until $ETCO_2$ trace is obtained to guard against excessive surgical emphysema in the event of misplaced tube.
15. The tube is secured with a tie.

The surgical technique has the advantage of securing the airway definitively, with the ability to ventilate and oxygenate adequately. Potential complications include posterior tracheal wall damage, haemorrhage, false passage, surgical emphysema etc.

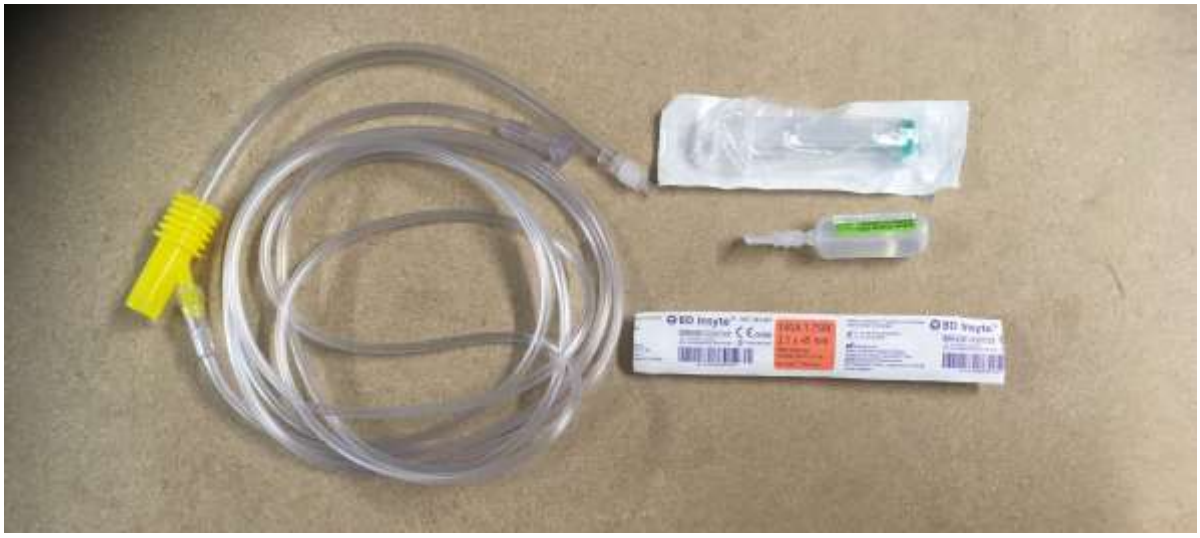
Illustration of steps to perform surgical cricothyroidotomy

	**Oxygenate from above** via BVM&OPA/NPA or Igel (not shown subsequently below)
	**Stabilise CTM** with Non-dominant hand **Horizontal incision through CTM** **(Vertical midline incision and** Blunt dissect if needed)
	Leave **scalpel *in situ*** **Open incision** with small mosquito forceps
	**Forceps *in situ*** (rotated clockwise) **scalpel removed** **Bougie passed** into trachea
	Railroad Size **6.5 Cuffed TT over bougie** **Remove forceps** as TT enters stoma
	**<u>Avoid</u> TT over-insertion** into right main bronchus
	**Bougie** out **Inflate** ETT cuff
	**Confirm** position with **ETCO2** and **Auscultation** **Secure** with ribbon tie (note depth in cm) Complete **post-RSI checklist**

Needle cricothyroidotomy with LEROY RAPID O2 kit

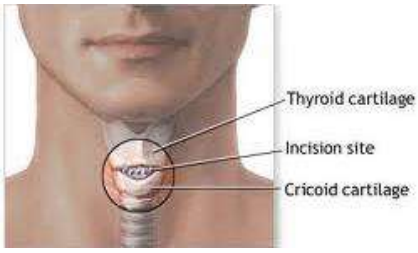
Kit is in the Difficult Airway Pack in the Primary Bag

The LEROY RAPID O2 kit includes tubing with a 'leur-screw' connector and female 'fir-tree' connector to connect to an oxygen cylinder. It is packed with a 10ml syringe, 10ml NaCl and 14G BD Insyte cannula.



This technique is simple, and may allow oxygenation to "buy time" before a more definitive airway intervention is achieved. It is useful in children under 10 years (in whom a surgical cricothyroidotomy may not be possible). However it does not provide ventilation of CO2 from the patient and does not protect the airway against aspiration. Furthermore the cannula can easily become blocked, kinked or may dislodge.

1. The CTM lies between the thyroid cartilage and cricoid cartilage.
2. It can usually be identified by use of the laryngeal handshake and slight extension of the neck.
3. Continue to attempt oxygenation using a BVM (with NPAs & OPA) or I-gel from above.



4. **Non-dominant hand** should be used to **stabilises** the CTM whilst
5. **Dominant hand cannulates CTM** at a **shallow angle** using a 14G insyte cannula and 10ml syringe with 2ml of NaCl.

6. Once air is aspirated, non-dominant hand stabilises cannula and syringe plunger is released
7. **Air should not be sucked back in to barrel of syringe**

8. Dominant hand now stabilises on chin to hold syringe and needle still whilst non-dominant hand slides cannula into trachea

9. Needle is disposed of in sharps bin, and syringe reconnected to cannula

10. Air should be aspirated easily and syringe removed

11. Flow rate is set at L/min corresponding to AGE of patient in YEARS in children <15

12. Connect LEROY RAPID O2 device to oxygen supply and insyte cannula

13. Occlude the wide open limb of the 'Y' for 4 SECONDS to give a jet of O2 and check for signs of chest movement

14. **Wait for minimum of 20 seconds for response in SpO2 value**
15. **If NO improvement in SpO2 seen, give a 2 SECOND jet**

16. Following rise in Spo2 do not jet again until Spo2 has dropped by >5% from the maximum response achieved.
17. **Subsequent jets should be for 2 SECONDS.**

18. If the cannula becomes blocked or kinked then manual pressure is felt on the 'Y' limb when the device is occluded.

19. If needle cricothyroidotomy is not effective in achieving oxygenation there must be a clear plan to proceed to surgical cricothyroidotomy using an appropriately sized cuffed TT and bougie.

References and Further Reading

Heard AM, Green RJ, Eakins P. The formulation and introduction of a 'can't intubate, can't ventilate' algorithm into clinical practice. *Anaesthesia* 2009; 64(6): 601-8.

Frerk C, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. British Journal of *Anaesthesia* 2015; 115: 827-848.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Control of Catastrophic Haemorrhage

Main <C> kit is in Primary Bag in Haemorrhage

Adult Pelvic Binder is in Secondary Bag in Trauma Accessories

Reference Number	CSOP 006
Application	EMRTS Doctors and CCP's
Related SOPS	Multiple

Author(s)	James Chinnery
Internal reviewer(s)	Jonathan Whelan
External reviewer(s)	
Sign off	COB

Introduction & Objectives

Exsanguination is the commonest cause of death in the first hour after injury and remains an important cause in the first 24 hours. The acute coagulopathy of trauma shock (ACoTS) is present in up to 25% of patients in haemorrhagic shock after injury. ACoTs is associated with 48% mortality. Decisive treatment to stop bleeding with rapid transfer to a MTC for definitive control may improve survival . This CSOP outlines the following:

1. Patient Assessment and <C> kit location.
2. Early arrest of external haemorrhage using bandages, wound packing, and tourniquets.
3. Approach to Non-Compressible Torso Haemorrhage
4. Use of Tranexamic Acid.

Patient Assessment and <C> kit location

Trauma patients are assessed using the CABCDE approach prioritising arrest of catastrophic haemorrhage over airway control.

Minimal handling and movement of the blunt trauma patient in the pre-hospital environment minimises clot disruption. The **pelvic binder** should be regarded as a **<C> device** and applied with a limited <30 degree log roll along with the scoop stretcher.

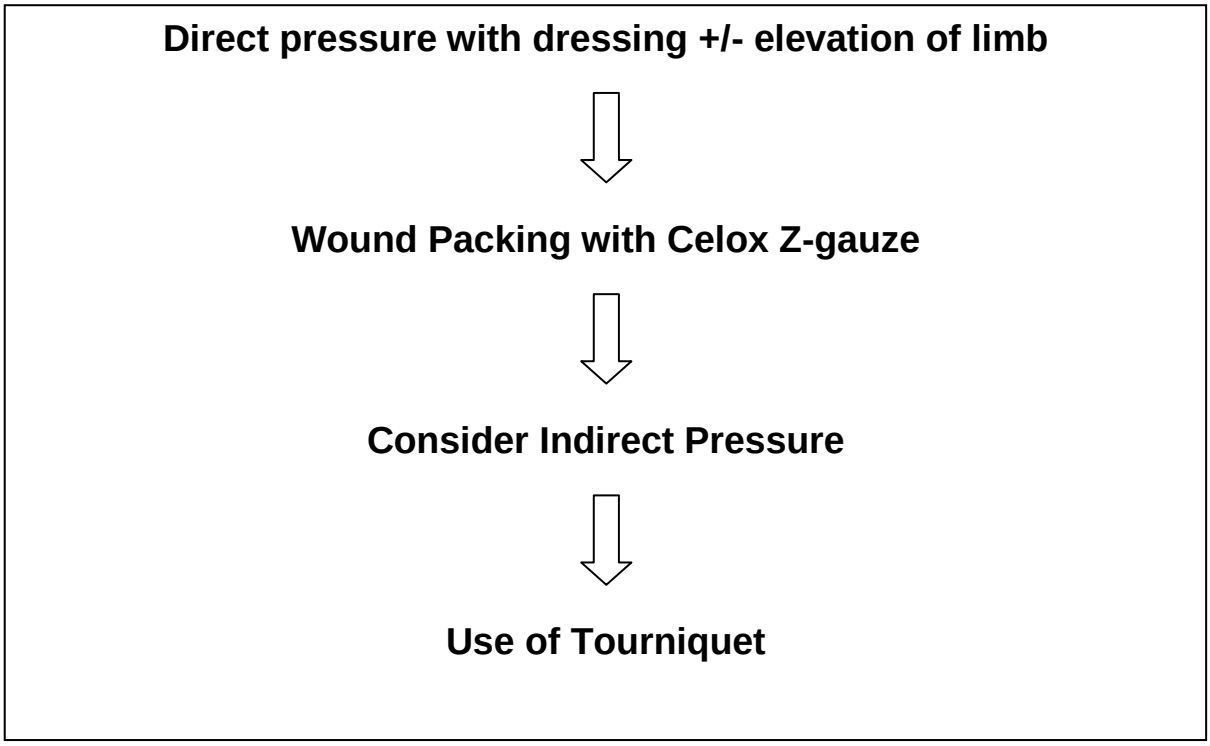
The risks of disturbing haematoma and/or axial skeleton fractures outweigh the diagnostic benefit of full 90 degree log rolling etc. However, **victims of penetrating trauma should be logrolled** and have their whole body (sides and back) examined for injuries, sources of haemorrhage and **entry and exit wounds**.

Main <C> kit is in Primary Bag in Haemorrhage

Adult Pelvic Binder is in Secondary Bag in **Trauma Accessories**

Early Arrest of External Haemorrhage

Should be managed in a systematic manner from simple to more advanced interventions:



Where there is obvious catastrophic haemorrhage immediate application of tourniquet and/or topical agents is appropriate.

Clamping of bleeding vessels should not be attempted unless vessels are easily identifiable in the stump of an amputated limb.

Bandages

The following bandages are carried:

1. **Oleas blast modular bandage** – which has a pressure cup that can be applied over the wound, velcro breaks to prevent accidental unrolling and gauze contained within the dressing to manage multiple wounds.

2. **Blast Bandage** – this can be applied to large, untidy and difficult to manage wounds (e.g. a limb amputation). It also contains a sterile sheath that can be used to dress eviscerated bowel or large exposed chest wounds.

CAT Tourniquet

Tourniquets are useful when applied soon after injury in the military context but less useful in the civilian context when the responders are on scene after a delay.

Indications

1. Immediate:

   - Life threatening haemorrhage.

   - Traumatic amputation with multiple bleeding points.

   - To expedite management of A and B problems where co-existent with significant bleeding.

   - Entrapment preventing access to undertake other control measures.

2. Last resort where other measures have failed as flow chart above.

3. Prior to performance of amputation (2 tourniquets applied) (See CSOP 023).

Procedure

Correct application is very painful due to pressures of ~300mmHg generated, but this is a potentially life saving intervention. Adequate analgesia should be provided when able (i.e. with ketamine).

1. **CAT Position** – should be applied as distal as possible but approximately 5 cm proximal to the injury (to allow stump preservation if distal limb non-viable). It should not be applied over joints as epicondyles are likely to prevent pressure on underlying vessels. The tourniquet should be applied over bare skin. For lower limbs a 2nd proximal tourniquet is required for lower limb wounds.

2. **CAT Application**

   - See images below for guidance.

   - Clearly document time of tourniquet application.

   - Effictiveness is judged by cessation of bleeding, NOT absence of a distal pulse.

   - If the CAT is inadequately tightened there will be occlusion of the venous outflow from the limb, but insufficient occlusion of arterial blood inflow. This will lead to increased bleeding from distal soft tissue injuries and damaged arteries. Therefore the tourniquet should be tightened until cessation of arterial haemorrhage is observed.

   - When a tourniquet has been applied to a hypotensive patient before resuscitation, haemorrhage may stop. However when the patient is resuscitated to a higher systolic blood pressure the bleeding may restart despite the continued use of a tourniquet. This problem can be avoided by aiming for a lower SBP or by tightening the tourniquet until control is re-achieved.

- In children the tourniquet may be too large to provide adequate compression. This can be overcome by increasing the diameter of the limb by placing a bandage around the limb and then applying the tourniquet over the limb.

3. **CAT Removal**

Should not normally be released until patient is in an operating theatre and definitive control possible. If time from application to arrival in hospital >1hrs, and when patient is stabilised and other haemostatic measures are in place release MAY be considered. If significant haemorrhage returns reapply the tourniquet and DO NOT remove again.

Topical haemostatic Agents

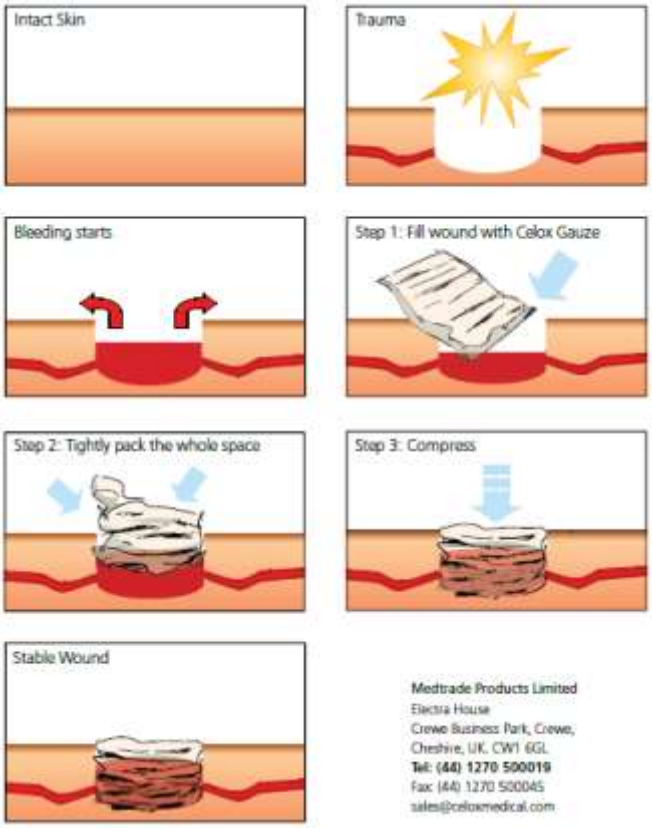
Use in wounds not responding or unlikely to respond to simple measures. First line in junctional haemorrhage, second line where a tourniquet can be applied.

Procedure

1. Wear gloves, avoid contact with eyes.
2. Must be applied deep into base of wound and packed well.

3. Apply pressure dressing over haemostatic agent for minimum 5 minutes.
4. Document use and ensure accurate handover to receiving team. Not all teams will be familiar with these agents, leaving the packaging with the team may be of benefit.

The EMRTS carries the Celox Z gauze shown below:



Non-Compressible Torso Haemorrhage (NCTH)

NCTH patients have a very high mortality.
Important considerations for NCTH patients are:

1. Gentle handling/minimal manipulation of the patient to prevent clot disruption
2. Resuscitate using DCR principles - see CSOP 019.
3. All actual or suspected pelvic fractures should be stabilised with a pelvic binder - see CSOP 008.
4. Limb reduction and splinting should be applied if indicated – see CSOP 009.
5. Resuscitative thoracotomy in traumatic cardiac arrest– see CSOP 021.
6. Early RSI should be considered in penetrating root of neck injuries with expanding haematoma. Difficult intubation conditions may develop if delayed.

Tranexamic Acid

Should be given as early as possible following IV access in all patients with major trauma and suspected active haemorrhage, (within 3 hours of injury).

Disposition of patient

Where possible these patients should be rapid transferred to the nearest MTC.

References and Further Reading

1. Mahambrey T, Pendry K, Nee A *etal*. Critical Care in emergency department: massive haemorrhage in trauma. *EMJ* 2012; doi:10.1136/emermed-2011-201061 Available online at http://emj.bmj.com/ [Accessed 29/4/13].
2. Kirkman E, Watts S, Hodgetts T, Mahoney P, Rawlinson S, Midwinter M. A proactive approach to the coagulopathy of trauma: the rationale and guidelines for treatment. *JR Army Med Corps*. 153(4): 302-306.
3. Hodgetts T, Mahoney P, Russell M *et al*. ABC to <C> ABC: redefining the military trauma paradigm. *EMJ* 2006 23: 745-746.
4. Revell M, Porter K, Greaves I. Fluid resuscitation in prehospital trauma care: a consensus view. *EMJ* 2002; 19: 494-498.
5. O'Jansen J, Thomas R, Loudon MA, Brooks A. Damage control resuscitation for patients with major trauma. BMJ 2009; 338: 1436-1440.
6. Nicholson TC & Berry RD. Pre-hospital trauma care and aero-medical transfer: a military perspective. *Continuing Education in Anaesthesia, Critical Care & Pain* 2012; 12(4): 186-189.
7. Milligan C, Higginson I, Smith JE. Emergency department staff knowledge of massive transfusion for trauma: the need for an evidence based protocol. *EMJ* 2011 28: 870-872.
8. Lee C, Porter KM, Hodgetts TJ. Tourniquet use in the civilian prehospital setting. EMJ 2007 24: 584-587.
9. Chapman J, Jacobs N, Midwinter MJ. Pre-Hospital haemostatic dressings: A systematic review. Injury2011;42: 447-459.
10. CRASH-2 trial collaborators. Effects of tranexamic acid on death, vascular occlusive events, and blood transfusion in trauma patients with significant haemorrhage (CRASH-2): a randomised, placebo-controlled trial. *Lancet* 2010.
11. Nice Clinical Guideline; Major trauma: assessment and initial management. NG39. February 2016.
12. Barnard et al. Resuscitative endovascular balloon occlusion of the aorta (REBOA): a population based gap analysis of trauma patients in England and Wales. EMJ 2015 32:926-932.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Chest Injury / Chest Procedures

THORACOSTOMY and CHEST SEAL kit is in Primary bag in Haemorrhage

INTERCOSTAL DRAIN is in Retrieval bag

Reference Number	CSOP 007
Application	EMRTS Doctors and CCPs
Related SOPS	CSOP 016, CSOP 021

Author(s)	James Chinnery
Internal reviewer(s)	Jonathan Whelan, Dindi Gill
External reviewer(s)	
Sign off	COB

Introduction & Objectives

This CSOP describes the assessment of blunt and penetrating chest injury and strategies required to maximise oxygen delivery through pleural drainage. It is divided into:

1. Patient assessment / kit location.
2. Interventions for pneumothorax including finger thoracostomy and intercostal drain insertion.
3. Management of flail chest and open pneumothorax.

Patient Assessment and kit location:

To effectively identify and treat pre-hospital chest pathology, a concerted effort is e made during the initial assessment to understand the mechanism of injury, identify clinical clues, interpret patient physiology and where appropriate use transthoracic USS.

In the pre-hospital phase, injury is evolving and may not demonstrate the classic clinical features present in 'fully established' disease. It is essential the benefits and risks for intervention are carefully

weighed up. Patients with actual or suspected injuries should have oxygen administered, targeting a SpO2 of 94-98%.

THORACOSTOMY and CHEST SEAL kit is in Primary bag in Haemorrhage pouch

INTERCOSTAL DRAIN is in Retrieval bag

The chest is fully exposed as part of the primary survey looking for the following :

1. Tachypnoea.
2. Asymmetry of chest wall movement.
3. Palpate for chest wall injury (incl. subcutaneous emphysema). REMEMBER concealed wounds in the axillae and the posterior chest wall.
4. Auscultation – difficult in noisy environment and unreliable, listening in the axilla may improve detection.

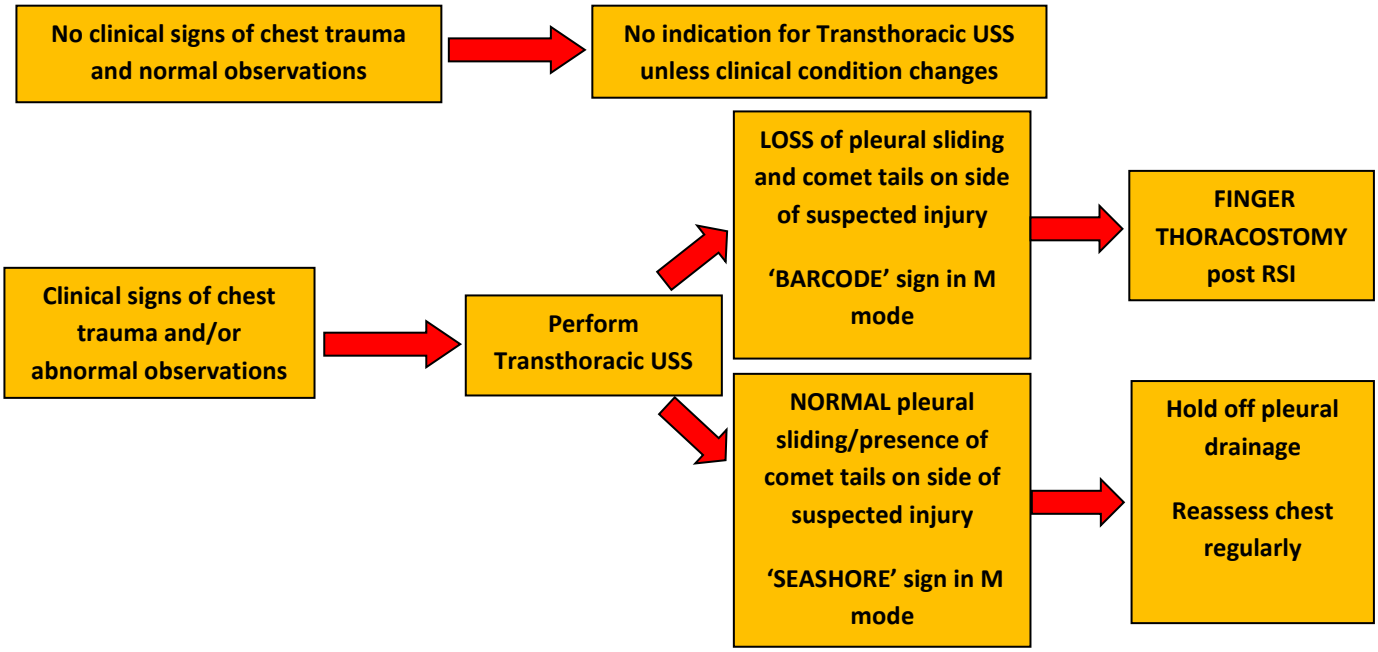
Other signs (incl. tracheal deviation, percussion and distended neck veins) are often unreliable.

In patients receiving positive pressure ventilation a simple pneumothorax can rapidly progress to a tension pneumothorax and the following physiological changes may develop:

1. Dropping saturations.
2. Hypotension.
3. Rising ventilator pressures.
4. Acute reduction in $ETCO_2$.

It is important for significant chest injury to be detected prior to emergency anaesthesia. For retrieval taskings it should be considered in all trauma patients prior to transfer. Check that signs are not due to endobronchial intubation before pleural decompression. Have a high index of suspicion for pneumothorax in trauma patients and asthmatics before air transfer in all cases.

To improve the diagnostic accuracy of detecting a pneumothorax over clinical assessment alone, Transthoracic USS can be used provided that it is undertaken by a trained practitioner. All EMRTS clinical personnel undergo training in this skill. **Ideally USS is carried out prior to RSI in the context of multisystem trauma.** The following algorithmic approach should be adopted (NB: Ultrasound will not penetrate surgical emphysema accurately):



Specific Interventions

Needle Decompression

Main indications

Any time or access issues that prevent formal thoracostomy:

1. Peri-arrest before moving to formal pleural drainage (e.g. thoracostomy).
2. Respiratory distress in trapped patient.
3. Not skilled to perform more formal pleural drainage (rare).

Procedure

1. Prepare skin with chlorhexidine wipe over 2nd intercostal space, mid-clavicular line.

2. Insert purpose made needle decompression device just superior to upper border of 3rd rib until air aspirated, remove needle and confirm correct position.
3. In devices incorporating a veres needle (e.g. ThoraQuick/PneumoFix) it is often difficult to puncture the skin due to the diameter of the device. Make a small skin incision to facilitate insertion (use scalpel fixed to back of Pneumofix packet).
4. In some patients where body habitus makes the 2ndintercostal space difficult the 4th/5thinter-costal space, mid axillary line can be considered.

Although quick, this technique does not completely re-expand the lung and therefore is a temporary measure until formal pleural drainage can be achieved. Moreover >50% of intravenous cannulae used for decompression do not reach the plural cavity, are prone to kinking, blocking and often dislodge during transfer. The purpose made needle decompression devices reduces the risk of this.

Formal pleural drainage with a thoracostomy remains the intervention of choice.

Finger Thoracostomy

Finger thoracostomy is the preferred technique for pre-hospital drainage, as recommended by NICE guideline NG39, It may be performed by EMRTS CCPs post-RSI who have undergone the appropriate training and are supervised by a consultant or by double CCP teams during traumatic cardiac arrest where this advanced clinical intervention is signed off.

Thoracostomy is preferred to chest drain insertion for the following reasons:

1. Majority of patients will have undergone RSI and therefore no need for 1 way valve due to positive pressure ventilation.
2. Allows re-exploration with sterile gloved finger to release/exclude re-tension in the event of deterioration in transport.
3. Significant risk of drain tubing kinking/blocking during transport – harder to rectify.
4. Reduction in scene time.

Main Indications

1. Clinical evidence of tension pneumothorax.
2. Clinical and/or USS evidence of pneumothorax in intubated patient.
3. Critical hypotension (SBP$\leq$90mmHg) and/or low saturations plus chest injury.
4. As part of initial management of traumatic arrest – see CSOP 016.

Procedure

1. Only in patients who are intubated and ventilated. **DO NOT DO THORACOSTOMIES ON SPONTANEOUSLY BREATHING PATIENTS.**

2. Maintain clean conditions by wearing gloves and applying chlorhexidine to the lateral chest wall/axilla.

3. Kneel next to the patient, at right angles to their chest. Patients arm should be abducted, and externally rotated. (NB: shoulder abduction risks displacement of humeral head IO needle if placed prior to thoracostomy in major trauma or traumatic cardiac arrest).

4. Identify $4^{th}/5^{th}$ intercostal space. If in doubt go higher and stay within the "triangle of safety" (see below).

5. Make a transverse incision (the width of two fingers) with scalpel just superior to the lower rib in between the anterior and mid axillary line. Making the initial incision of sufficient size will aid blunt dissection and reduce risk of re-tension.

6. Perform single cut through skin fascia and down onto rib itself. Use Spencer Wells to get into intercostals, spread them in the plane of the ribs and then puncture pleura. Perform a finger sweep feeling for lung, diaphragm, and organs and check the lung to feel for re-expansion. Note escape of air or blood.

   The procedure should be completed rapidly and ideally within 60 seconds of confirming TT position. This requires preparation and allocation of roles prior to RSI.

7. In the event of any deterioration a repeat finger sweep with a sterile gloved finger should be performed to rule out/release re-tension. If tension recurs, consider enlarging the tract of the thoracostomy.

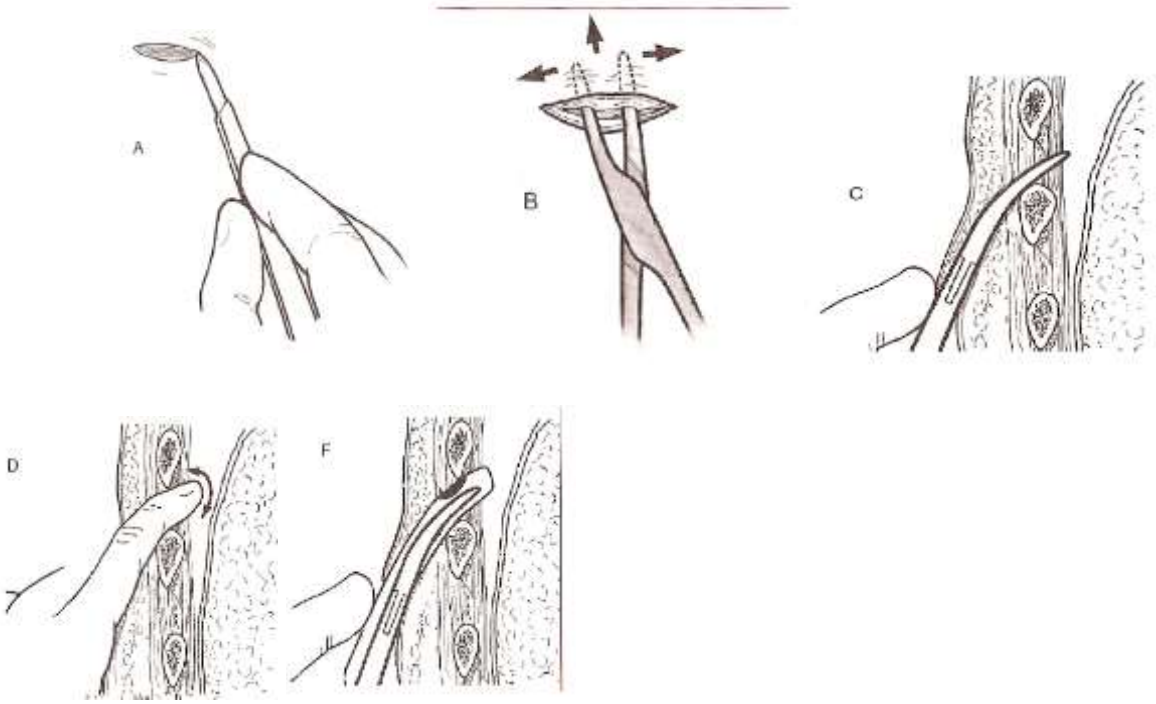
8. Administer prophylactic antibiotics after prehospital finger thoracostomy: Co-amoxiclav 1.2g IV should be given in the absence of a penicillin allergy.

9. The patient can be transferred directly to a CT scanner at the receiving centre without insertion of a chest drain if receiving positive pressure ventilation – do not occlude the thoracostomy with a dressing.

10. The **same stoma can be used** to insert a chest drain - unless it is heavily contaminated in which case an alternative site is chosen.

Figure 3 Diagram to illustrate the "safe triangle".

D Laws et al. BTS guidelines for the insertion of a chest drain. Thorax 2003; s8



Intercostal Drain

Only required in spontaneously breathing patients or patients where access may be difficult (e.g. land ambulance transfer and left sided injury) or long transfer time. This is a rare procedure in the pre-hospital environment. However, all chest drains inserted prior to a delayed primary or secondary transfer should be checked for length of insertion and appropriately secured as shown below. Review any CXR that has already been undertaken, but avoid CXR if transfer is time critical and chest drain is working appropriately.

If respiratory distress is minimal, the patient has single system disease and there is little to indicate an oxygen debt then consider leaving chest drain insertion until at definitive care hospital.

Use procedural sedation and local anaesthetic infiltration.

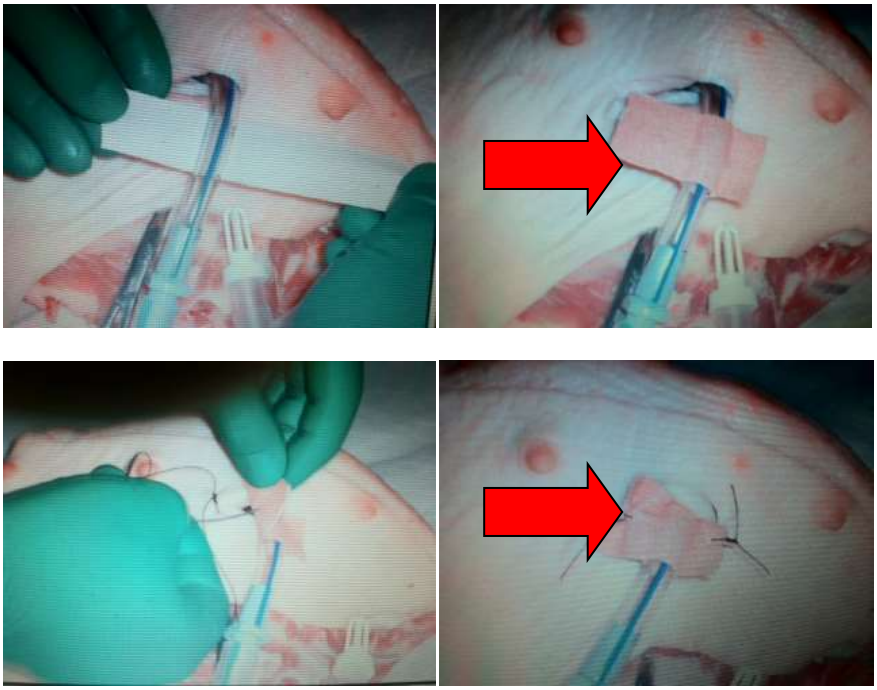
The following points must be adhered to:

1. Maintain clean conditions as indicated above.

2. Insert 24/28Fr drain in a cephalad direction, ensuring the final side hole is within the pleural cavity.

3. Attach to a collection bag (Portex) with one way flutter valve. Ensure the valve is patent ("flush" with air with a bladder syringe prior to connection) and that the bag is opened up.

4. The recommended technique is to utilise a tape flag which provides security and makes any movement of the drain out of the chest cavity readily apparent. The wound either side of the drain should be closed using interrupted nylon sutures. A 10cm strip of fabric adhesive tape is folded around the tube just above the skin incision to produce two "flags" that can then be used to secure the drain. A suture is then passed through the skin followed by the tape flag and secured. This process is repeated on both sides. The drain is now secure, and the flags mark the level of chest drain insertion at the skin. A large tegaderm should be placed over the insertion site. A tag can be fashioned out of tegaderm to hold the tube a little away from the chest wall to prevent the tube kinking and dragging on the insertion site. Sleek should be avoided.



Acknowledgements to GWAA for photos

Flail Segment

Two or more ribs fractured in two or more places (i.e. >3 fracture points), resulting paroxysmal wall movement can significantly impair respiratory mechanics as can the pain associated with the injury. The underlying lung injury is of greatest concern which can develop some hours after the injury so this problem may be encountered in the context of a secondary transfer by the EMRTS. An anterior flail chest is often missed and a high index of suspicion required to detect this clinically.

In patients who are compensating and without significant hypoxia or respiratory distress adequate analgesia (with opiate, ketamine, or serratus anterior block) and splinting may be sufficient.

Patients with significant compromise require RSI, mechanical ventilation and pleural drainage in the presence of a pneumothorax. A lung protective strategy should be adopted by providing low tidal volumes (6-8mls/kg) and keeping plateau pressures <30mmHg. Fluids should be judiciously used in patients with pulmonary contusions.

Open Pneumothorax

An open, sucking wound is treated with a **Russell chest seal** with a one-way valve to allow gas to escape from the chest but prevent further entrainment.

If there is evidence of significant respiratory compromise or suspicion of tension developing the first course of action is to check that the valve has not become blocked, if so, remove the dressing. If this is not the case or removal of the dressing does not improve the situation then proceed with treatment as for tension. Do not insert chest drains through a traumatic wound.

Disposition of patient

Patients with significant thoracic trauma are taken to the nearest MTC.

Audit Criteria

Complications of pre-hospital thoracostomies are monitored through the follow up of patients as part of the service evaluation.

References and Further Reading

1. Perkins Z, Gunning M. Life-saving or life threatening? Prehospital thoracostomy for traumatic trauma. *EMJ* 2007; 24: 305-306.
2. Fisher JD, Brown SN, Cooke MW (Eds). October 2006. UK Ambulance Service Clinical Practice Guidelines (2006). Norwich. Joint Royal Colleges Ambulance Liason Committee & The Ambulance Service Association.
3. Anderson ID, Woodford M, De Dombal FT, Irving M. Retrospective study of 1000 deaths from injury in England and Wales. *BMJ* 1988; 296: 1305-1308.
4. Leigh-Smith S, Harris T. Tension Pneumothorax-time for a rethink? EMJ 2005; 22: 8-16.
5. Huber-Wagner S, Lefering R, Qvick M *et al*. Outcome in 757 severely injured patients with traumatic cardiorespiratory arrest. *Resuscitation* 2007; 75(2): 276-285.
6. Spanjersberg WR, Ringburg AN, Bergs EA *et al*. Prehospital chest tube thoracostomy: effective treatment or additional trauma? *J Trauma*2005; 59(1): 6-101.
7. Parry GW, Morgan WE, Salama FD. Management of Haemothorax. *Annals of the Royal College of Surgeons England* 1996; 78: 325-326.
8. Ali J, Qi W. Effectiveness of chest tube clamping in massive haemothorax. *J Trauma* 1995; 38(1): 59-62.

9. Wilkinson RG, Stone MB. Sensitivity of bedside ultrasound and supine antero-posterior chest radiographs for the identification of pneumothorax after blunt trauma. *Acad Emerg Med*2010;17(1):11-7x.
10. Luchette FA, Barrie PS, Oswanski MF, et al. Practice Management Guidelines for Prophylactic Antibiotic Use in Tube Thoracostomy for Traumatic Hemopneumothorax: the EAST Practice Management Guidelines Work Group. Eastern Association for Trauma. *J Trauma* 2000;48(4):753-757.
11. Butler J, Sammy I. Antibiotics in patients with isolated chest trauma requiring chest drains. Best Evidence Topic Reports. Emergency Medicine Journal. 2002; 19: 553-554.
12. Nice Clinical Guideline; Major trauma: assessment and initial management. NG39. February 2016.
13. Leech C et al. The Pre-Hospital Management of Life Threatening Chest Injuries: A Consensus Statement of the Faculty of Pre-Hospital Care of the Royal College of Surgeons Edinburgh accessed at https://fphc.rcsed.ac.uk/media/1788/management-of-chest-injuries.pdf on 2/12/2017.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Abdominal and Pelvic Trauma

Reference Number	CSOP 008
Application	EMRTS Consultants and CCP's
Related SOPS	CSOP 006, CSOP 019, CSOP 022

Author(s)	Matthew O'Meara (ABM ULHB - Emrts Cymru), Mike Slattery
Internal reviewer(s)	Mark Knights (BCUHB - Anaesthetics)
External reviewer(s)	
Sign off	COB

Introduction & Objectives

Abdominal and pelvic injuries carry significant morbidity and mortality in both blunt and penetrating trauma.

CSOP objectives:

1. Recognition of abdominal and pelvic trauma including a high index suspicion for occult injuries.
2. Appropriate haemorrhage control and volume resuscitation using a Damage Control strategy.
3. Correct disposition of the patient in order optimise chances of survival and functional recovery.

Recognition of Abdominal and Pelvic Trauma

Abdominal Trauma

Based on a high index of suspicion and evidence based on the following factors:

Mechanism of injury (e.g. high speed motor vehicle (car or motorbike) crash, fall from a horse, fall from significant height, patient ejected from a vehicle, child pedestrian or cyclist hit by a vehicle, stabbing or gunshot to the torso)

Physiological: signs of shock although consideration needs to be given to subgroups of patients (e.g. extremes of age, pregnancy, medications) who may present with normal/slightly altered physiology.

Anatomical (as part of rapid primary survey):

- Presence of abdominal pain & tenderness.
- Bruising (e.g. "seatbelt sign").
- Distended or rigid abdomen.
- Open wounds & evisceration.

Diagnostic accuracy of clinical examination of the abdomen is often impeded by altered consciousness, spinal injury and associated injuries. Abdominal examination must be conducted prior to intubation, as clinical signs are lost after the patient is anaesthetised. FAST USS scanning can be conducted *en route* to hospital.

"Seatbelt sign" – consists of contusions and abrasions of the abdominal of a restrained occupant involved in a road traffic collision. It can indicate injury to underlying hollow viscera and spine, but may not have developed in the pre-hospital environment.

Pelvic trauma

Mechanism of injury: as above

Physiological: as above

Anatomical (as part of rapid primary survey):

- Pelvic pain.
- Open pelvic wounds.
- Bruising, swelling and deformity (esp. scrotal swelling and medial thighs).
- Leg-length discrepancy or rotational deformity of a lower limb.
- Tenderness or gap on gentle palpation at the symphysis pubis (can be indicative of an open-book type injury).

Under NO circumstances should the pelvis be sprung or compressed to assess mechanical stability. This has been shown to promote further bleeding, has poor diagnostic accuracy in the detection of pelvic injuries and causes unnecessary pain to the patient.

Appropriate Haemorrhage Control and Volume Resuscitation using a Damage Control Strategy

Abdominal Trauma

Blunt

There are no specific haemorrhage control measures for these injuries. The focus should be on Damage Control Resuscitation, initiating a massive transfusion (see CSOP 006) and rapid transfer to definitive care. Gentle handling is important to prevent clot disruption.

Penetrating

Commonest mechanisms are stab wounds and rarely gunshot wounds. Patterns of injury depend on location and path of penetrating objects. It is essential to examine anterior and posterior surfaces to establish object path and associated injuries. Damage Control Resuscitation (DCR) should be adopted. In the case of penetrating trauma fluids are avoided if the patient has a central pulse and is conscious. The priority is rapid transfer to definitive care. If a penetrating object is *in situ* avoid manipulation if at all possible. If a patient has an epigastric wound and fulfils the criteria in CSOP 021 proceed to Resuscitative Thoracotomy.

Evisceration

Rarely abdominal organs may be displaced or visible outside peritoneum. In these cases remove clothing gross contamination and cover the wound with saline soaked dressing. This should then be covered with an occlusive dressing to minimise drying. Otherwise treat as above.

Administer Tranexamic Acid 1g to patients who are bleeding OR have the potential to bleed.

Pelvic Trauma

The priority here is to limit further haemorrhage and initiate DCR as these patients have potential for massive blood loss. In order to limit haemorrhage a pelvic splint is applied to decrease the volume of the disrupted pelvis and promote haemostasis by splinting fractured bones. It also acts as a reminder not to move or roll the patient as this will dislodge blood clots and promote bleeding. This forms part of the packaging CSOP 015.

There are two groups of patients that will benefits from having a pelvic binder placed:

1. Conscious patients who have a mechanism of injury AND clinical assessment consistent with a pelvic injury.

2. Patients who are unconscious or shocked irrespective of mechanism of injury. There are clearly some exceptions to this rule (e.g. an isolated head injury following an assault).

EMRTS will use a standard/small size SAM sling 2. The binder is applied as follows:
During application patient movement should be kept to an absolute minimum. The splint is applied to skin and not over clothing.
There are two techniques for splint application. The team should judge which is the most appropriate for each patient.

- For severely disrupted pelvic injuries, it may be best to apply the binder before rolling takes place to position on the scoop. The pelvis should be lifted just enough to slide the binder in a cephalic direction under the patient's buttocks. It may require two people to perform the lift. The binder should be secured prior to further movement for packaging.

- In other situations the patient should be rolled on to the binder at the same time as the scoop stretcher (+/- blizzard heat is applied, minimal log roll to each side is all that is required, thus reducing rolling movements, which may disrupt clot formation.

1. Irrespective of the technique used it is essential that the legs are internally rotated prior to binder application. This position can then be secured by applying a bandage around the ankles and above the knees.

2. Correct placement of the binder is essential as a badly placed binder may open the posterior elements of the pelvis in some cases. Any binder device must be applied over the greater trochanters (and NOT the iliac crests). It is important to avoid damaging genitalia. If the binder is applied prior to EMRTS arrival its correct positioning is assessed and adjusted if necessary.

3. The pre-application position of the ASIS and iliac crest are identified. The belt is secured using Velcro straps. The endpoint of splint application is to bring the pelvic bones into an anatomical position. The straps do not need to be tightened until a 'click' as this may apply too much tension. Estimated normal alignment is the end point of tightening. When a gap at the symphysis was felt on clinical examination, this should be rechecked after the binder is applied. If the gap is still present, then binder should be snugged down again while direct pressure is applied manually over the greater trochanters.

4. For paediatric cases a SAM splint will be applied at the level of the greater trochanters and a tourniquet used to tighten the device to the end point stated above.

5. Appropriate analgesia and procedural sedation at the time of application.

6. Any concurrent fractured lower limbs should be stabilised by splinting (either by using a vacuum splint or to the uninjured leg. In the presence of femoral shaft fracture a Kendrick Traction Device should be applied as this will apply traction against an injured pelvis.

7. Any bleeding pelvic or perineal wounds should be packed with a haemostatic agent prior to binder application.

For shocked patients there must be concurrent volume resuscitation using blood products and administration of Tranexamic Acid.

Disposition

Patients with suspected significant pelvic fractures OR in the context of haemodynamic instability and/or multisystem trauma should be taken to an MTC.

References and Further Reading

1. BOAST – 3. Pelvic and acetabular fracture management. British Orthopaedic Association Standards for Trauma, 2008.
2. Clinical policy: Critical issues in the evaluation of adult patients presenting to the emergency department with acute blunt abdominal trauma, *Ann Emerg Med* 2011; 57: 387-404
3. Lee C, Porter K. The pre-hospital management of pelvic fractures. *EMJ* 2007; 24: 130-133.
4. Pre-hospital care standard operating procedure - pelvic splintage. London Air Ambulance Policy Board, 2013.
5. Morriston hospital major trauma guidelines – management of pelvic trauma in hypovolaemic shock. Major Trauma Centre Project Group, 2014.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Extremity Trauma

Reference Number	CSOP 009
Application	EMRTS Doctors and CCP's
Related SOPS	Multiple

Author(s)	LE Jackson, B Warrick, O McIntyre
Internal reviewer(s)	Mark Knights
External reviewer(s)	
Sign off	COB

Introduction & Objectives

To outline the assessment, clinical decision making and pre-hospital management of patients with extremity trauma.

Overview

Extremity trauma is relatively common and can contribute to, or cause, life threatening haemorrhage

Extremity trauma is evaluated as part of the CABCDE assessment and focused physical examination. All trauma patients need full exposure and a thorough clinical assessment to identify sources of haemorrhage and injury.

Principles of Assessment and Management

Major Limb Injuries

Key Management Principles are:

- Haemorrhage control
- Reduction of fractures/dislocations where appropriate
- Neurovascular assessment pre and post intervention
- Adequate analgesia

1. Traumatic Amputation and/or Catastrophic Haemorrhage

Catastrophic haemorrhage is controlled using:

- direct pressure + haemostatic dressings +/- elevation
- indirect pressure
- tourniquet

See CSOP 006 – Control of Catastrophic Haemorrhage
CSOP 023 – On Scene Amputation

2. Reduction of Fractures/Dislocations

- O2 is applied and IV access gained when preparing for analgesia or procedural sedation (See CSOP 003)
- Prior to application of splints /traction devices manual traction can align a deformed limb and reduce blood loss.
- The limb should then be held in the reduced position until the splint/traction device is applied.

Skin under critical tension is an indication for urgent reduction of the limb deformity.

Femoral Fractures are reduced by applying a traction device to the limb.
EMRTS carries Kendrick Traction Devices for use in unilateral and bilateral injury. The SAM Pelvic splint should be applied first if pelvic injury is suspected.
Consider femoral nerve block as per Regional Anaesthesia CSOP 052.

Contraindications for applying traction include a distal injury on the same side as the injury (e.g. knee, lower leg, ankle, foot). The theoretical risk of making a pelvic injury worse, should be considered but where haemorrhage from a fractured femur is suspected over significant pelvic fracture traction should be applied.

3. Neurovascular Assessment

Always complete an assessment of pulses, sensation and motor movement distal to the injury.

This is repeated following reduction or splinting and documented in the patient record.

4. Multi-modal Analgesia

Pain scores should also be performed (when possible) and documented pre and post procedure.

Adequate multi-modal analgesia is paramount which include splinting and immobilisation.

Regional anaesthesia should also be considered if appropriate and practical.

On-scene Management

EMRTS is tasked to patients with extremity trauma in the context of multisystem trauma or as isolated injuries.
The following general principles apply:

- Patients with multi-system trauma often require intubation either as part of their resuscitation

strategy or on humanitarian grounds in the presence of multiple extremity injuries.
- Reduction of limb injuries should be carried out after anaesthesia, unless immediate haemorrhage control is required.
- In patients with isolated limb injuries adequate analgesia and procedural sedation should be offered with consideration of regional analgesia prior to manipulation.
- Any gross contamination is removed followed by application of saline soaked gauze and dressings. Take photo in line with photography at scene SOP.
- There is no indication for washing the wound at scene.
- If there is adequate circulation, joint injuries which are not grossly deformed may be splinted in the position they are found in.
- Limbs are reduced into their anatomic position by applying manual traction.
- After reduction check distal pulses.
- Apply splint/traction to the limb immobilising the joint above and below the injury.
- Consider prophylactic antibiotics in suspected open fracture or contaminated wound.

Adult Dose - Augmentin 1.2g **Paediatric Dose 30mg/kg** IV
Adult Dose - Clindamycin 600mg **Paediatric Dose 10mg/kg** IV if penicillin allergic.

- Amputated parts are wrapped in sterile gauze moistened with normal saline, protected from contamination (e.g., placed in an examination glove or Ziploc®-type bag) and put in ice water (this limits warm ischaemia time). The extremity should not be exposed directly to ice.

In summary Pre-hospital, on-scene reduction of a joint including the shoulder **should only be attempted** under the following circumstances:

- Significant distal neurological and/or vascular compromise
- Overlying skin is under critical tension
- Prolonged extrication is predicted, particularly where reduction may expedite the process

Treat crush injuries of the limbs as indicated in CSOP 013.

Disposition of patient

Patients with isolated closed limb injuries are transported to the nearest hospital with Trauma and Orthopaedic services.

Patients with major amputation, open fractures of the lower limb or extensive tissue destruction should be transferred directly to an Orthoplastic Centre (e.g. Royal Stoke University Hospital or Morriston Hospital).

The caveat to this is if the patient needs to be managed elsewhere for other injuries that may take priority (e.g. concurrent head injury).

References and Further Reading

1. NICE guidelines November 2017. https://www.nice.org.uk/guidance/ng37/chapter/Recommendations#pre-hospital-settings

2. American College of Surgeons Committee on Trauma (Ed). Advanced Trauma Life Support for Doctors, American College of Surgeons, Chicago, IL 2012.

2. Swan KG Jr, Wright DS, Barbagiovanni SS, et al. Tourniquets revisited. J Trauma 2009; 66:672.

3. http://www.uptodate.com.abc.cardiff.ac.uk/contents/severe-extremity-injury-in-the-adult patient?source=search_result&search=extremity+injury&selectedTitle=1%7E150 www.ambulanc.qld.gov.au/docs/09_cpg_trauma.

4. Nanchahal J, Nayagam S, Khan U, Moran C, Barrett S, Sanderson F, et al. Standards for the Management of Open Fractures of the Lower Limb. The Royal Society of Medicine Press Ltd, 2009.

5. Lee C, Porter K M. Prehospital management of lower limb fractures. *Emerg Med J* 2005 22: 660-663 doi: 10.1136/emj.2005.024489

6. EMRTS Cymru, Lessons Learnt Bulletin Issue 4 Spring 2017

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Head injury including secondary transfer

Reference Number	CSOP 010
Application	EMRTS
Related SOPS	CSOP 002, CSOP 003, CSOP 004a and 004b, CSOP 018, CSOP 019, CSOP 032

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Sign off	COB

Introduction & Objectives

Traumatic brain injury is present in the majority of severely injured patients in the UK and represents a major burden in terms of both mortality and morbidity.

The key treatment interventions in the management of severe brain injury are rapid diagnosis, prevention of secondary brain injury, and prompt transfer to a neurosurgical centre.

Patient Assessment

Traumatic brain injury may be an isolated injury, or co-exist as part of multi-system injury.

Initial assessment should follow a standard systematic <C>ABCDE approach as outlined in CSOP 001 and 019.

A blood glucose measurement should be taken urgently to exclude hypoglycaemia as a cause of reduced conscious level.

Patients who have suffered a significant head injury will commonly have an airway at risk due to a reduced GCS. Emergency anaesthesia is often required.

Prior to RSI, it is important to note the patient's GCS, pupil reactions, and any obvious other neurological deficit which is identified. These will be lost after the patient is anaesthetised and provide important prognostic information that will need to be communicated to the receiving unit.

Spinal injury is commonly associated with significant head injury; therefore spinal immobilisation precautions are used.

Management

Resuscitation

The key principles in preventing secondary brain injury are to:

1. Ensure adequate oxygenation.
2. Ensure adequate ventilation, avoiding significant hyper- or hypo-ventilation.
3. Avoid hypotension.
4. Avoid hypoglycaemia.
5. Rapid, safe transfer to definitive care (aim for within 2 hours of injury).

Adequate oxygenation requires a patent and protected airway, which in unconscious patients will require RSI. (See CSOP 004a and 004b)

Following intubation, ventilation is set to achieve:

1. PaO_2 > 13kPa (but avoiding hyperoxia once established on ventilation).
2. $PaCO_2$ 4.5-5.0kPa ($EtCO_2$ 3.0-4.5kPa) – there is often a 1-1.5 kPa difference between $ETCO_2$ and $PaCO_2$, which may be greater in chest injuries and hypovolaemia.
3. Try to avoid high levels of PEEP if possible (may reduce cerebral perfusion pressure).

Avoidance of hypotension is critical throughout the management of head injured patients. Even brief episodes of hypotension can significantly reduce cerebral perfusion pressure in the context of a raised intracranial pressure.

Consideration should be given to use of ketamine as an induction agent to reduce this risk.

A pre-induction dose of fentanyl can reduce the risk of raised ICP with laryngoscopy and sympathetic response to ketamine. It should be considered in this group of patients in the absence of hypotension.

If patients are hypovolaemic then appropriate fluid resuscitation should be concurrently instituted as per DCR CSOP.

In the context of severe closed head injury, in the absence of ICP monitoring, aim for:

1. **Mean** Arterial Blood Pressure 90mmHg. NIBP monitoring every 2mins.
2. Tight and accurate BP control is essential – for patients already in a hospital early invasive blood pressure monitoring should be instituted either prior to RSI (if feasible) or rapidly afterwards.

3. Ongoing Anaesthesia

Continued adequate anaesthesia reduces cerebral oxygen requirements.

Sedation options include bolus or continuous infusions as outlined in the Emergency Anaesthesia CSOP. Always use sedation with analgesia. Beware of risk of hypotension with sedative and analgesic drugs.

A long acting muscle relaxant should be used to prevent coughing.

Monitor vital signs, $ETCO_2$, SpO_2, blood glucose, temperature and pupil size/reactivity.

If hypotension occurs:

1. Look for source of bleeding, control if possible, and volume resuscitate as per DCR CSOP. Target the presence of a radial pulse.
2. In the absence of hypovolaemia, iv fluid and vasopressors may be required to maintain a MABP of 90mmHg.
    - 250ml fluid boluses.
    - Bolus doses of adrenaline 10mcg/ml OR metaraminol 0.5mg/ml. Start with 1ml and titrate to effect.
    - If ongoing vasopressor requirement then convert to a continuous infusion to avoid peaks and troughs in blood pressure. This is usually in the context of an inter-hospital transfer.

Seizures

Seizures can result in a significant increase in cerebral oxygen consumption and should be treated urgently. Seizures following a head injury should prompt strong consideration of RSI if not already anaesthetised.

Rapid control of seizures is usually be achieved with benzodiazepines.

If seizures recur, repeat dose and consider loading with Levetiracetam:

LEVETIRACETAM (KEPPRA)

Intravenous. Put dose in 100ml saline and give over 15 minutes.

Dose: 30mg/kg to a maximum of 2g.

In the anaesthetised patient, suspected seizure activity may also be controlled by using increased doses of sedative anaesthetic agents (eg. midazolam, propofol or small additional bolus doses of thiopentone).

It is important to remember that muscle relaxants control the physical signs of seizure activity (ie. Jerking movements in limbs) but do not have any effect on cerebral oxygen requirements. As such, suspected seizures if observed should be controlled using sedative and anti-convulsant therapy as described above.

Packaging

Prompt and urgent transfer to an appropriate facility is key. The aim should be to reach definitive care (hospital with neurosurgical facilities) within 2 hours of injury, or quicker if possible. However simple additional packaging measures should be undertaken where feasible, particularly with longer transfer times and/or secondary transfers, including:

1. Ensure strap is not too tight when using a Thomas tube holder (may impede venous return and raise ICP). Alternatively tape TT in place.

2. Consider loosening cervical collar once immobilised or omit cervical collar if in line stabilisation adequate (to reduce ICP).
3. Where feasible aim 20-30 degrees 'head up' tilt to reduce ICP.
4. Splinting of fractures (pain will increase ICP).
5. Oro-gastric tube placement (avoid multiple attempts as laryngoscopy may cause raised ICP) – inter-hospital transfer.
6. Urinary catheterisation to avoid bladder distention – inter-hospital transfer.

For time critical transfers, the 'top cover' consultants should determine whether the above has been carried out through discussion with the referring centre whilst the EMRTS team is *en route*. This will reduce the time require to prepare the patient for transfer once team arrives.

Management of Impending Tentorial Herniation

In the absence of an immediate surgical option (i.e. if pre-hospital or at a non-neurosurgical hospital), temporary measures may be employed to reduce ICP in patients with signs of impending herniation (asymmetrical and/or unreactive pupil/s; abnormal posturing such as decerebrate or decorticate posturing; or Cushing's response – bradycardia and hypertension).

These measures only exert a temporary effect and are not a substitute for neurosurgical intervention.

1. Brief mild hyperventilation (to $PaCO_2$ 4kPa or $ETCO_2$ 3kPa) will reduce ICP but also reduce cerebral blood flow.
2. Administration of hypertonic saline solution (5% sodium chloride, usual dose 3ml/kg up to a maximum of 250ml over approx. 10 minutes IV). This may be repeated at the discretion of the treating clinician where required, but it is strongly recommended that a second dose be guided by measurement of plasma sodium (and should not be given if the plasma Na+ is greater than 155mmol/l)

Emergency reversal of anticoagulation

See CSOP 018 for acute reversal of warfarin and direct oral anticoagulants in the context of suspected head injury.

Disposition of patient

Head injury patients require transfer to a neurosurgical centre. Early referral to the appropriate receiving hospital/major trauma centre is critical.

Unless there is a need for an immediate intervention in the emergency department, consider handover in the CT scanner to expedite diagnosis of a potential neurosurgical amenable pathology. (As per EMRTS 'Direct to CT' Protocol).

For a delayed primary transfer of a severe head injury (particularly in the presence of clinical signs of tentorial herniation) it may be appropriate to rapidly transfer the patient from a peripheral hospital to a neurosurgical facility prior to CT scanning. The patient should be received in the CT scanner at the receiving centre with neurosurgical theatres on standby. Involve 'top cover' in these circumstances.

Destination Hospitals:

Hospital	Patient Groups	Helipad
University Hospital of Wales, Cardiff	Adults & Children	On Site
Southmead Hospital, Bristol	Adults	On Site
Bristol Royal Hospital for Children	Children	On Site
University Hospital of North Staffordshire, Stoke (Royal Stoke University Hospital)	Adults	On Site
Queen Elizabeth Hospital, Birmingham	Adults	On Site *(Not suitable for night landings)*
Birmingham Children's Hospital	Children	On Site *(Unlit, not staffed, requires police presence to close road)*
Liverpool Collaborative MTC (The Walton Centre)	Adults	No
Alder Hey Children's Hospital, Liverpool	Children	No

These are incorporated in the EMRTS APP.

Audit Criteria

- Patent airway in 100% of patients.
- Transient complications at induction (hypotension or desaturation) in patients with traumatic/non traumatic brain injury – 10%.
  - Hypotension – SBP $\leq$90mmHg within 5mins of induction.
  - Desaturation – SpO_2 $\leq$92% within 5mins of induction.
- GCS, pupil size/reactivity, blood glucose measured and recorded in 100% of patients.
- Waveform capnography measured and recorded in 100% of intubated patients.
- Transfer to definitive care within 2 hours of injury (to measure timescale routinely; no specific target as highly dependent on primary or secondary missions, and geographical location).

References and Further Reading

1. Nathanson MH, Andrzejowski J, Dinsmore J, Eynon CA, Ferguson K, Hooper T, Kashyap A, Kendall J, McCormack V, Shinde S, Smith A, Thomas E. Guidelines for safe transfer of the brain-injured patient: trauma and stroke, 2019: Guidelines

from the Association of Anaesthetists and the Neuro Anaesthesia and Critical Care

Society. Anaesthesia. 2020 Feb;75(2):234-246.1

2. Head Injury: Triage, assessment, investigation and early management of head injury in infants, children and adults. NICE (http://www.nice.org.uk/nicemedia/pdf/CG56guidance.pdf)
3. SIGN 46 Early Management of Patients with a Head Injury (2000) (http://www.sign.ac.uk/guidelines/fulltext/46/index.html)

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Maxillo-Facial Haemorrhage

Reference Number	CSOP 011
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 004a and 004b, CSOP 010, CSOP 012, CSOP 019

Author(s)	Camilla Waugh, Kate Humphries
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External reviewer(s)	
Sign off	COB

Background

Severe maxillofacial injury is a cause of haemorrhage and airway compromise. The point of impact and energy transfer will influence the injury pattern and clinical effects. Mandibular and upper neck injuries can cause mechanical airway compromise while extensive maxillary injuries may cause torrential bleeding into the airway.

These injuries often co-exist with other injuries including associated brain, spinal and chest injury.

Airway Compromise

Not all patients with maxillofacial fractures require definitive airway control. Some can be managed with oxygenation, monitoring and positioning, however when airway obstruction develops it can be rapid. It may be due to blood, oedema, tissue prolapse, reduced conscious level or a combination of factors. Compromised swallowing and impaired reflex protective mechanisms lead to an increased risk of aspiration even in a fully conscious patient. Impending airway compromise may be indicated by:

- Torrential maxillofacial haemorrhage
- Palpated bony deformity in the mid-face
- Significant tissue loss (e.g., gunshot injuries)
- Voice alteration

- Stridor or snoring
- Neck, tongue or pharyngeal swelling / disruption.
- Respiratory distress or compromised oxygenation
- Reducing conscious level

Look for evidence of impeding airway compromise and balance the benefits of intubation with the risks of pre-hospital anaesthesia and transfer without a definitive airway.

Emergency Anaesthesia

When pre-hospital anaesthesia is carried out a standard approach should be adopted. In a majority of cases intubation will be uncomplicated. However, there is the potential for difficulty even with minor injuries. Carry out a thorough assessment of the airway and predict / plan for difficulties.

Preparation and Spare Equipment

- Always have two suction units available (pre-hospital anaesthesia CSOP). Have spare suction disposables on hand in case tubes become blocked with blood. Ensure flexible suction catheters are to hand for immediate endotracheal suction.
- Have a second catheter mount, HMEF and capnography line available in case the first gets blocked with blood.
- Plan for a surgical airway. Landmarks should be established prior to induction. Ensure kit is prepared and within reach.
- With blood in the airway and the potential for splatter PPE should be worn including goggles.

Pre-Oxygenation

- A patient may need to be sat upright for the pre-oxygenation phase. If a patient is awake allow them to adopt a position of comfort.
- Maintain a degree of head up if the patient is unconscious.

Anaesthesia and Intubation

- All patients should be maintained with some head up tilt during intubation.
- Video laryngoscopy may fail due to blood on the camera. Have a low threshold for backing up DL using the VL blade or standard laryngoscope.
- If torrential bleeding present delegate a person to hold the Yankauer suction catheter in the mouth during laryngoscopy.
- Consider the presence of blood in the tracheal tube as a reason for difficult ventilation.
- After failed intubation and where oxygenation cannot be maintained immediately perform a surgical airway.
- Spinal precautions are secondary to maintenance of oxygenation and may be abandoned temporarily if required.

Post Intubation

- The tracheal tube should be tied. A Thomas tube holder will obstruct access to the mouth for haemorrhage control. Tape is unlikely to stick if there is blood contamination.
- Re-establish spinal control if lost during airway control.
- Once the airway is checked and secured proceed immediately to haemorrhage control.

Specific Injuries - Bilateral Mandibular Fractures

Bilateral anterior fractures of the mandible cause a flail mandible and loss of tongue support. This causes airway obstruction when the tongue falls back into the oropharynx. Allow an awake patient to sit up and forward to maintain their airway. In an unconscious patient the obstruction can be relieved by pulling the tongue and mandible anteriorly.

Specific Injuries - Associated Laryngo-tracheal Injury

Injuries of the larynx and trachea associated with maxillofacial injury are rare. Carefully assess for external evidence of injury including the presence of laryngeal crepitus. If there is a problem passing a bougie or ETT then consider whether the equipment has entered a false passage through a defect in the airway.

Specific Injuries – Persistent Trismus

Trismus, when present is usually pain related and usually resolves on induction. Trismus persisting after anaesthesia will likely be due to an anatomical deformity of the mandible and /or zygomatic arch. The presence of a foreign body can also reduce mouth opening. If this occurs and compromises laryngoscopy, attempt to manually reduce the fracture. This may require manipulation of both the mandible and the zygomatic arch. If the jaw fails to open and oxygenation is not maintained proceed to a surgical airway. Do not attempt nasal intubation.

Specific Injuries – Severe Facial Disruption / Tissue loss

Where facial disruption is severe, and the patient is unconscious there may be difficulties in manual airway control. A supraglottic airway may be a suitable temporary measure prior to a definitive airway. If laryngoscopy is impossible and the cords or an entrance to the trachea are obvious through the injury, then direct tracheal tube placement can be attempted.

Haemorrhage

Nasal Bleeding

Blood loss into the nasal cavity can be extensive due to the multiple and extensive blood supplies. (sphenopalatine/palatine/ethmiodal vessels). Nasal packing can be used to control the bleeding and slow blood flow directly into the airway.

Maxillary Vessels

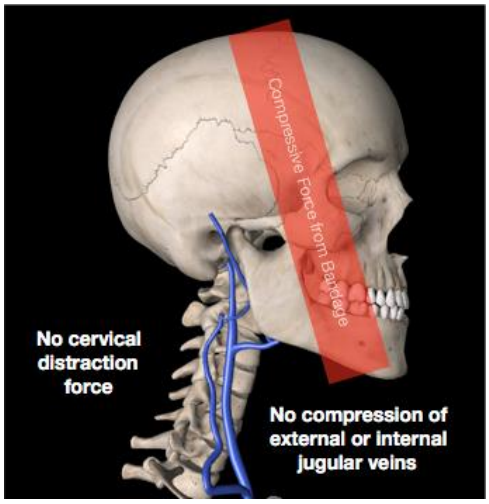
Posterior displacement of the maxilla causes disruption of the maxillary artery / vein and their branches including the intra-osseous branches. Blood flow from the fracture site can be high. Stabilisation of the maxilla is of importance in controlling the loss at this site.

Haemorrhage Control

Nasal packing to control nasal cavity bleeding has the tendency to open up the maxillary fracture site making maxillary vessel bleeding worse. **Therefore, the maxilla must be stabilised before nasal packs are placed.**

Maxillary Stabilisation

- Secure the airway first – confirm correct ET tube position.
- Select bite blocks. EMRTS now carry a single size of bite block.
    - Green handle – medium
- Open the mandible and check that there are no loose teeth that may be pushed further into the airway.
- The blocks are anatomically curved. Ensure the block is held the correct way, concave medially, to follow the anatomical line of the teeth.
- Place each block so that the core of the device lies between the molars. The anti-swallow handles should be resting on the outside of the mouth.
- Once the blocks are in place manually push the mandible superiorly towards the maxilla to stabilise the face and hold in position.
- An assistant should tie an Oleas or similar bandage around the bottom of the maxilla up and over the skull while the mandible is being held in position.
- Place the pressure cup under the mandible and ensure that the bandage is tight at each Velcro braking point.



A hard collar must not be used

- It has an adverse effect on ICP.
- It allows 30 degrees of movement even when fitted well.
- It does not conform properly to a disrupted mandible.
- It does not provide superior displacement of the mandible without distraction of the cervical spine.
- It has the potential to increase venous bleeding at the fracture site.

The patient may experience a trigemino-cardiac reflex during facial manipulation. Bradycardia can be treated with atropine.

Nasal Packing

The RR900 has replaced the previously used Epistat II, the new device differs in that it uses **AIR** rather than saline to inflate the cuffs.

Rapid Rhino RR900

- Ensure the mandible is stabilised as best as possible prior to insertion.
- Both sides of the nose must be packed even if the bleeding appears to be unilateral.
- Cut open 100ml bag H2O and soak the device in sterile water for a FULL 30 seconds.
- Insert the device posteriorly along the floor of the nasal cavity until the blue indicator is past the nares.
- Using a 20ml syringe inflate the Rapid Rhino pilot cuff with **AIR** only. Stop inflation when the pilot cuff becomes rounded and feels firm when squeezed.
- Inflate the other cuff (**AIR** only) to provide a gentle, low-pressure tamponade.
- Tape the cuffs to the patient's cheek, away from the upper lip.
- Reassess after 15-20 minutes; re-inflate if necessary.
- Do not remove.

Disposition

Most patients should be taken to a major trauma centre especially if there are associated injuries (spine / brain) or a significant mechanism.

Patients with isolated facial trauma may be taken to a trauma unit if that unit has a maxillofacial surgery capability.

References and Further Reading

Murphy AP, Doran HJ, O'Sullivan I, et al
The McKesson prop—an essential tool for the emergency physician?
Emergency Medicine Journal 2010;27:156-158.

Schaller B.
Trigeminocardiac reflex. A clinical phenomenon or a new physiological entity?
J Neurol. 2004 Jun;251(6):658-65.

EMRTS maxillofacial injury equipment review
September 2017.

C Gilman.
Focus on: Treatment of Epistaxis.
American College of Emergency Physicians. ACEP News. June 2009. (accessed on line November 2017)

Barak M, Bahouth H, Leiser Y, Abu El-Naaj I.
Airway Management of the Patient with Maxillofacial Trauma: Review of the Literature and Suggested Clinical Approach. *BioMed Research International*. 2015;2015:724032.

S Mukherjee K Abhinav, and PJ Revington
A review of cervical spine injury associated with maxillofacial trauma at a UK tertiary referral centre
Ann R Coll Surg Engl. 2015 Jan; 97(1): 66–72

Harris T, Rice S, Watts B, Davies G. The emergency control of traumatic
maxillofacial haemorrhage. Eur J Emerg Med. 2010 Aug;17(4):230-3.

James CY, Riemann BL, Munkasy BA, Joyner AB. Comparison of Cervical Spine
Motion During Application Among 4 Rigid Immobilization Collars.
J Athl Train. 2004 Jun;39(2):138-145.

Salentijn EG, Peerdeman SM, Boffano P, van den Bergh B, Forouzanfar T.
A ten-year analysis of the traumatic maxillofacial and brain injury patient in Amsterdam: incidence and aetiology.
J Cranio-Maxillo-fac Surg. 2014;42(6):705–10.

Haug RH, Savage JD, Likavec MJ, Conforti PJ.
A review of 100 closed head injuries associated with facial fractures.
J Oral Maxillofac Surg. 1992;50(3):218–22

Mobbs R.J., Stoodley M.A., and Fuller J.
Effect of cervical hard collar on intracranial pressure after head injury.
ANZ J. Surg. 2002 72, 389–391

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Spinal Injury

Reference Number	CSOP 012
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 010

Author(s)	Jonathan Whelan
Internal reviewer(s)	Tracy Phipps
External reviewer(s)	
Sign off	COB

Introduction & Objectives

To describe the assessment, triage and treatment of patients with spinal injuries. The objectives are to:

1. Describe the indications for spinal precautions.
2. Describe the types of spinal precaution.
3. Describe the treatment and triage of spinal cord and column injury.

Background

Spinal precautions describe the devices and manoeuvres used to minimise the risk of spinal cord damage in patients with an unstable or injured spinal column. The principle of pre-hospital management of spinal cord injury (SCI) is to limit neurological deficit and prevent secondary injury**.** This is achieved through:

1. Maintaining a high index of suspicion of a potentially unstable cervical spine injury.
2. Identification and reversal of life threatening injury in the primary survey.
3. Appropriate spinal immobilisation.
4. Cardiovascular and ventilatory support.
5. Ensuring appropriate thermoregulation.

Types of Spinal Precaution

1. Self-immobilisation by a conscious, co-operative patient.
2. Manual in-line stabilisation (MILS).
3. 10-degree logrolls if possible.
4. Rigid cervical collar.
5. Immobilisation on an orthopaedic scoop stretcher.
6. Head restraints and straps when on scoop stretcher.
7. Vacuum Mattress or MIBBS stretcher (may be used by mountain rescue or HART).

The long spinal board is an extrication device solely, not an immobilisation device. For pre-hospital taskings, the service transports patients with suspected spinal injuries on a scoop stretcher and a scoop stretcher with cushioned pads for all inter-hospital transfers.

Clearing the Cervical Spine

Clinical judgment should be used in all cases.

Penetrating trauma without neurological signs does not require immobilisation.

Patients can be stratified into four main groups:

1. Compliant & cooperative with no neurology
    - No value in immobilisation
    - Clear the spine if possible (using CCR, see below)
    - Transport in a 'position of comfort' if requires c-spine imaging
    - Give patient the option to self-extricate.
2. Compliant with altered neurology
    - Extricate in neutral position
    - MILS with blocks and straps
3. Non-compliant
    - Do not impose immobilisation
    - Rapid extrication in neutral position
    - Transport to definitive care asap
4. Unconscious
    - Higher likelihood of spinal cord injury and other traumatic injuries also likely
    - Rapid extrication +/- use collar to aid neutral neck position during extrication
    - Transport in neutral position if possible
    - Optimum care is MILS with blocks and straps
    - Transport to definitive care

Thoracolumbar spinal Injuries

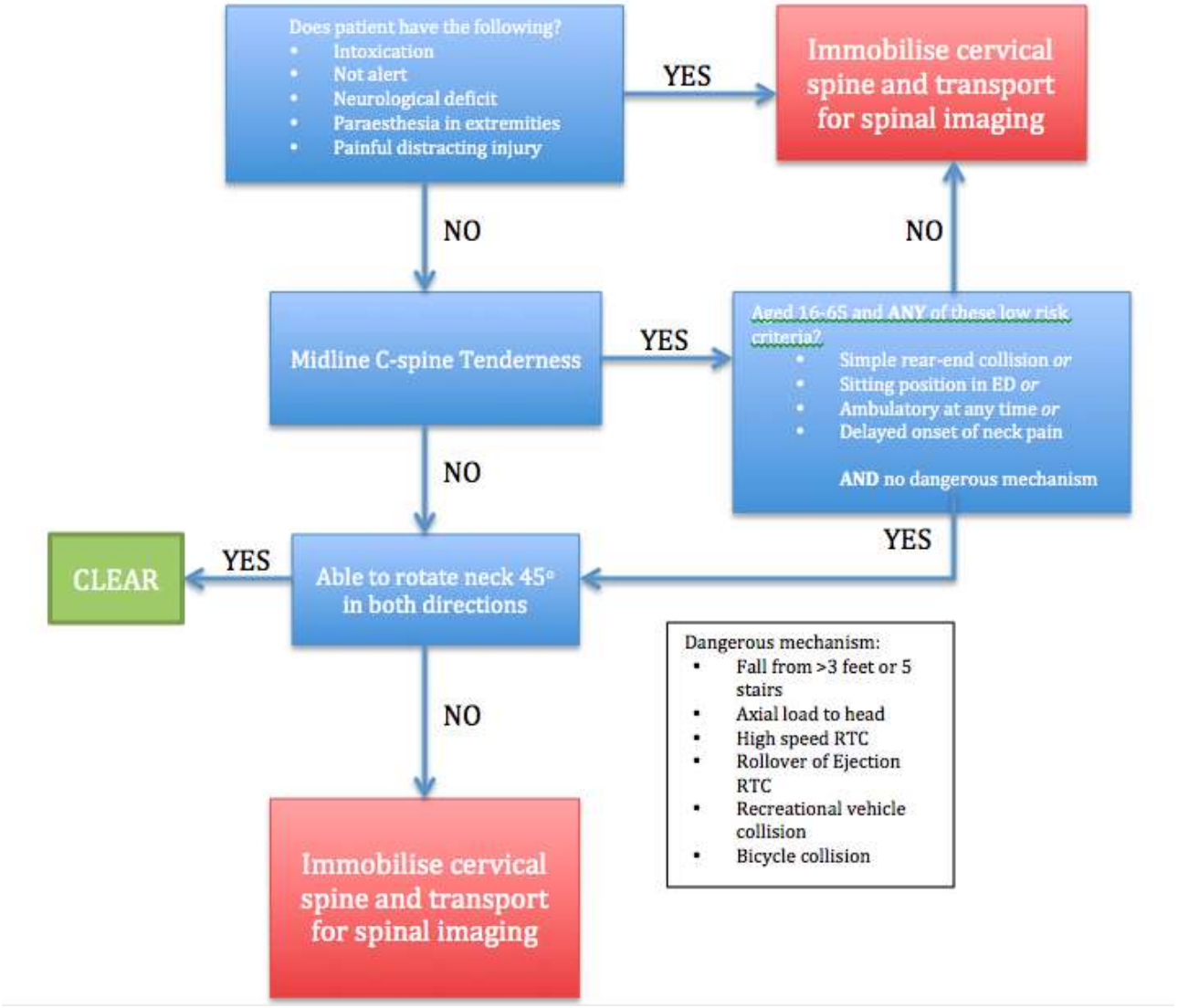
Suspected thoracolumbar spinal injuries are kept in a position of comfort or lying flat if tolerated. A pragmatic approach is adopted in the case of concurrent chest injuries. These patients may need to be transported sitting up to optimize oxygenation and ventilation especially where the suspicion of thoracolumbar spinal injury is low.

Documentation and Handover

It is essential that if the patient's cervical spine is cleared at scene this decision is clearly documented in the patient care record, irrespective of whether the EMRTS are conveying or not. This includes a description of both positive and negative features outlined in the algorithm below. If the cervical spine is not cleared at scene, but the patient is allowed to self immobilise or MILS is only applied with blocks/straps it is important that the documentation reflects that decision. It should be made clear to ambulance service personnel and the receiving hospital that although the cervical spine has not been fully immobilised it has NOT been cleared.

All patients who are discharged at scene having had their spine cleared must be provided a verbal and written (patient leaflet) 'safety net.' Document that this has been given.

Combination of Nexus guidelines and Canadian C-spine Rules (CCR) to assess c-spine injuries.



In patients under 10 years old, neither the CCR's nor the Nexus low risk criteria are as reliable as in the adult population.

It is important to note that the closer the painful distracting injury to the spine (e.g. a dislocated shoulder), the more likely the injury will be regarded as distracting. Transient motor/sensory neurology should also raise the index of suspicion for a spinal injury.

Specific Management of Spinal Cord Injury

1. **Oxygenation**
   The spinal cord is neurological tissue and may suffer secondary injury in the same manner as the brain. Titrate oxygen flow to **maintain saturations of 98 - 100%.**

2. **Ventilation**
   Determine whether breathing feels normal or presence of shortness of breath. Observe for diaphragmatic breathing as this may indicate a high cervical lesion. In a high cervical spine injury (e.g. C4-5), or if there is concomitant major injury (e.g. chest injury), have a low threshold for intubation. Respiratory difficulty can ensue quickly. In the non-intubated patient, insert nasal cannula to measure ETCO2. **Aim for $EtCO_2$ 3.0-4.5kPa**

3. **Hypotension**
   Hypotension (SBP < 100 mmHg) may require correction. In isolated cord injury, BP can be raised with intravenous fluid boluses and intravenous adrenaline (20mcg aliquots titrated to effect in an adult). In the polytrauma patient, causes of hypotension should be sought in the usual manner (e.g. hypovolaemia, tension pneumothorax etc). Treatment for these identified problems should follow standard procedures. Where all other causes have been excluded and/or treated and the patient is thought to be euvolaemic, it is appropriate to initiate inotropic/vasopressor support.
   Target a MAP of around 85mmHg.

4. **Temperature control**
   Remember that the spinally injured patient may become cold – they will lose the ability to thermoregulate and so due consideration must be given to keeping the patient warm, especially in the autumn or winter. **Aim for normothermia.**

5. **Neurological examination & documentation**
   A thorough examination must be completed including formal assessment of limb movement, sensory level, deformity, cardiovascular findings and priapism. Ensure this is done prior to delivery of anaesthesia or sedation.

Disposition of patient

Patients with a high index of suspicion for a spinal injury (e.g. neurological deficit) should be taken to University Hospital of Wales or Royal United Stoke Hospital. Other patients should initially be managed at their local hospital unless other injuries mandate that should be transferred to a specialist centre.

References and Further Reading

1. Connor D, Greaves I, Porter K *et al*. Pre-hospital spinal immobilisation: an initial consensus

statement consensus group, Faculty of Pre-Hospital Care. *EMJ* 2013 Dec; 30(12): 1067-9. doi: 10.1136/emermed-2013-203207.
2. https://ambulance.qld.gov.au/docs/09_cpg_trauma.pdf.
3. Vale FL, Burns J, Jackson AB *et al*. Combined medical and surgical treatment after acute spinal cord injury: results of a prospective pilot study to assess the merits of aggressive medical resuscitation and blood pressure management. *J Neurosurg* 1997; 87(2): 239.
4. Ryken TC*, et al*. Correction of hypotension in spinal cord injury. *Neurosurgery* 2013; 72: 84-92.
5. Paul Harrison, Clinical Development Officer at Princess Royal Spinal Cord Injury Centre, Sheffield (Tel: 0114 271 5616 E-mail: paul.harrison@sth.nhs.uk) for a current British view.
6. Spinal Injury, London Air Ambulance, 2014.
7. Emcrit Podast 63 – A pain in the Neck –Part 1. https://emcrit.org/emcrit/cervical-spine-injuries-i/

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Crush Injury and Crush Syndrome

Reference Number	CSOP 013
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 009, CSOP – 023

Author(s)	Pete Williams
Internal reviewer(s)	
External reviewer(s)	
Sign off	COB

Introduction & Objectives

This CSOP outlines the management and treatment of crush injury and crush syndrome.

Background and Definitions

A crush injury is a direct injury resulting from crush. Crush syndrome is the systemic manifestation of muscle cell damage resulting from pressure or crushing and was first described in 1941 after a patient trapped in rubble during the Blitz subsequently died of renal failure.

Development of crush syndrome is fundamentally based on three criteria

1. Involvement of muscle mass.
2. Prolonged compression (usually 4-6 hours, but may be <1hr).
3. Compromise to local circulation.

Crush syndrome is also known as traumatic rhabdomyolysis. While the patient is experiencing the crush force, there is an accumulation of sodium, calcium and water in the muscle cell, and a release of metabolites including potassium, myoglobin, phosphate and urate. When the crushing force is released and reperfusion of the affected area occurs, these toxins are released into the systemic bloodstream. This causes metabolic mayhem, characterised by acidosis, hyperkalaemia, hypocalcaemia, hypovolaemic shock and renal failure.

While Crush Syndrome arises from the classic mechanism of entrapment in collapsed masonry, it is more commonly encountered after a brief entrapment with a massive force (such as industrial machinery), or from the prolonged application of relatively little force, as seen in non-entrapment crush syndrome typified by the unconscious patient lying on a hard surface.

Initial care

Consider the following for the initial care of patients suspected of having crush injury:

1. Scene safety of self, team and patient. Consider the need for specialist teams (e.g. Fire and Rescue, USAR, HART).
2. Ensure adequate PPE, including for patient (helmet / gloves / goggles / dust masks)
3. Treat life threatening injuries using CABCD approach.
4. Assess limbs for signs of critical limb ischaemia: 5 P's - Pain, Paraesthesia, Paralysis, Pallor and Pulse less.
5. Note initial time of entrapment and document on patient record.

Specific care

Prior to release of crushing force in the pre-extrication phase:

1. Gain two points of IV/IO access in unaffected limbs. Use of POC testing to check for acidosis and hyperkalaemia
2. Administer warm saline 0.9% and aim for a preload of 2 litres. In paediatrics aim for 20ml/Kg/ over 1 hour. Do not use Hartmann's solution.

   NB. Gaining IV/IO access and fluid administration must **NOT** delay the extrication of the patient If the patient is bleeding use warmed blood products instead of saline and ensure tranexamic acid has been administered
3. In patients with heart failure, ensure frequent clinical examination and adjust fluid resuscitation accordingly
4. Maintain thermoregulation of patient and record temperatures
5. IV/IO analgesia should be used and ketamine without concomitant use of midazolam is an effective means of relieving pain and may be considered to aid in extrication
6. Tourniquets should be placed if there is life-threatening haemorrhage. Where it is not possible to examine the limb prior to release, they should be placed to allow rapid application if there is catastrophic bleeding on release. Whilst there is no good evidence for the use of tourniquets to prevent reperfusion injury, consideration may be given to their use as a temporising measure. This would involve application prior to patient release to allow movement to a position with 360 access away from immediate scene safety issues (e.g. risk of further building collapse) and the rapid placement of two vascular access points if not already achieved. They should then be removed immediately. The aim is not to delay the reperfusion of the affected limb/s, but to allow effective immediate resuscitation in a safe environment.

7. On site amputation is indicated only for life saving interventions; i.e to liberate the patient, but not to prevent crush syndrome. See CSOP 023.

Extrication

Extricate patient in conjunction with the Fire & Rescue service, HART or specialist rescue teams.

Post-Extrication

1. Prepare to resuscitate the patient as the clinical signs and symptoms may dictate
2. Obtain reassessment of blood gas and K+ on POC testing. ECG monitoring can also be used, suspect hyperkalaemia if T waves become peaked and/or the QRS is prolonged. If needed administer calcium chloride 10% 10ml over 10mins
3. Administer warm saline 0.9% at approximately 1000ml/hour, if entrapment is prolonged >2 hours, reduce the rate of fluid administration so as not exceed 500ml/hour
4. Consider alternating saline 0.9% with 5% dextrose solution if retrieving a patient to definitive care.
5. Consider early catheterisation and measurement of urine pH. Target urine output for adult is >300ml/h. This is applicable for patients undergoing inter-hospital transfer by the EMRTS, who should also be considered for invasive monitoring prior to transfer
6. Consider adding 50mmol aliquots of bicarbonate (50ml 8.4% sodium bicarbonate) to the fluid regime to keep urinary pH above 6.5
7. Pre-alert to appropriate hospital with capability to provide critical care and renal replacement therapy
8. If there is an open fracture or significant tissue destruction, administer intravenous antibiotics and consider availability of appropriate orthopaedic / orthoplastic services at destination hospital

Exceptional Circumstances

Crush injury is sometimes associated with mass disaster such as building or mine collapse. In these circumstances coordination will need to be undertaken to make sure dialysis and critical care beds are available for patients. Early notification to receiving hospitals should be undertaken highlighting this requirement. This will be the responsibility of the medical advisor or 'top cover' consultant for the service.

References and Further Reading

Greaves I, Porter K, Smith J. Consensus statement on crush injury and crush syndrome. *Trauma* 2002; 4:129-134.

Gonzalez D. Crush syndrome. *Crit Care Med*. 2005; 33 (1): S34-S41.

Lee C, Porter K. Hodgetts T. Tourniquet use in the civilian prehospital setting. *Emerg Med J* 2007; 24: 584-587.

Sever M. Vanholder R. The workgroup on recommendations for the management of crush victims. Recommendations for the management of crush victims in mass disasters. *Nephrol Dial Transplant*. 2012; 27 Suppl 1.

Malinoski D, Slater M, Mullins R. Crush Injury and rhabdomyolysis. *Critical Care Clinics* 2004; 20:171-192.

Jagodzinski N, Charita W, Porter K. Crush injuries and crush syndrome – a review. Part 1: the systemic injury. *Trauma*. 2010; 12:69-88

Jagodzinski N, Weerasinghe C, Porter K. Crush injuries and crush syndrome – a review. Part 2: the local injury. *Trauma* 2010; 12: 133-148.

Brown C, Rhee P, Chan L, Evans K Demetriades D, Velmahos G. Preventing renal failure in patients with rhabdomyolysis: do bicarbonate and mannitol make a difference? *J Trauma* 2004; 56: 1191-1196.

Bywaters EGL, Beall D. Crush injuries with impairment of renal function. *BMJ* 1941; 1: 427

Vanholder SV, Lameire R. Management of crush-related injuries after disasters. *N Engl J Med*. 2006; 354:1052-1063.

Homsi E, Barreiro MF, Orlando JM, Higa EM. Prophylaxis of acute renal failure in patients with rhabdomyolysis. *Ren Fail.* 1997; 19:283-8

US Department of Health and Human Services Centers for Disease Control and Prevention. Crush injury and crush syndrome. June 2009. https://www.acep.org/MobileArticle.aspx?id=46079&parentid=740

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Burns

Reference Number	CSOP 014
Application	EMRTS Doctors and CCP's
Version	5
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Related SOPS	NA

Author(s)	Gareth Thomas, Owen McIntyre
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Sign off	Clinical Reference Group

Introduction & Objectives

Burns affect a small proportion of the population, but have the potential for significant morbidity and mortality if not managed appropriately from the outset. The majority of the cases seen by EMRTS will be in the primary response setting with a very small number of secondary transfers from remote sites.

Scene Management

Burns are often associated with potentially dangerous environments, including ongoing fire and explosion, exposed electrical equipment and unstable structures. Patient contact may also pose a danger due to contamination from chemical or radiation.

On arrival at scene, early contact with the appropriate agencies should be made such as Fire & Rescue or the Ambulance Service Hazardous Area Response Team (HART). Appropriate personal protective equipment must be worn as dictated by the scene.

Mechanism

There should be careful consideration of the events surrounding the injury in order to guide subsequent management.

Mechanism	Examples
Exacerbation of burn injury	Confined space, entrapment
Specialist burns	Chemical, electrical, radiation
Concurrent trauma	Fall from height, RTC, blast Injury
Associated medical and psychiatric events	Self-harm, overdose, CVA, seizure, electrocution

Airway

Assessment and management of the airway is a key point in managing burns. All patients must have their airways re-assessed on a regular basis throughout the course of the management. Patients who require intubation for airway or breathing compromise must be intubated using an **uncut** endotracheal tube.

On Scene Intubation

Patient with inspiratory stridor or pharyngeal oedema on examination should be intubated at the earliest opportunity.

Minimising IV fluids and keeping the patient head up can help to reduce airway oedema prior to intubation. Once intubated the patient does not need to remain head up and fluid administration can be initiated.

The standard RSI should be used with a low threshold to perform a surgical airway should intubation and oxygenation fail. Videolaryngoscopy may help to improve a difficult airway but may also be hindered by soot in the airway which may require reverting to direct laryngoscopy. A smaller ETT may be required because of oedema but try to insert the largest tube size possible as this will help management of airway burns in hospital.

Decision to Intubate

Patients with a hoarse voice, intra oral swelling, obvious intra oral burns, circumferential neck burns or circumferential chest burns should be considered for intubation on scene.

If signs are significant and worsening then teams should proceed with intubation however if signs are mild, there are no other indications for pre-hospital RSI and the distance to hospital is short then transfer un-intubated but with regular re-assessment.

Transfer without intubation

Patients with burns around the mouth or nose soot in mouth or nose or singed nasal hairs should be transferred un-intubated if clinical parameters are satisfactory and there are no other signs or symptoms.

Flash burns to the face may look severe but often do not require immediate intubation at scene. Careful consideration of the mechanism and the above factors is key.

Breathing

High flow oxygen should be administered to all burns patients particularly where there has been entrapment, exposure to smoke and smoke inhalation injury. Carboxyhaemoglobin (COHb) will give falsely high SpO2 readings so continue high flow oxygen until COHb can be measured on a co-oximeter in the Emergency Department.

Carbon monoxide and cyanide poisoning should be suspected in all patients with smoke exposure particularly when presenting with reduced GCS, collapse or cardiac arrest.

In patients with suspected cyanide poisoning Cyanokit (cyanocobalamin) can be considered at the receiving ED.

Patients with respiratory failure who fail to oxygenate should be intubated and ventilated. Teams should have a low threshold to intubate a patient if respiratory failure is impending and the transfer times are long. Maintaining FiO2 at 100% will reduce the half-life of COHb.

Circulation

If a burns patient presents with early shock rule out differential diagnoses eg trauma and medical causes.

Intravenous fluid resuscitation is required if the burn area is ≥15 % in Adults or ≥10 % in Children (<16yrs).

The Parkland Formula is used to calculate fluid requirements in burns patients however in the pre-hospital setting it may be more practical to use fluid boluses at 5ml/kg and repeated as necessary.

For Secondary transfers the Parkland Formula can be used with additional fluid boluses as required.

IV access should be placed though healthy skin if possible. There should be a low threshold to acquiring IO access if IV access is difficult and prolonged.

Neurological

Patients with a low GCS should be intubated and ventilated noting best GCS prior to RSI. Consider carbon monoxide and cyanide poisoning , poor perfusion status or other injury/medical causes.

Analgesia is important for intubated and unintubated patients. Fentanyl and Ketamine should be considered in addition to propofol infusion for intubated patients.

Exposure

Clothing and Burnt Material

Clothes, particularly if wet and jewellery should be removed but adherent material left in place. These should be taken to hospital with the patient for examination.

Burns Assessment

Burn area and depth should be assessed to guide management and referral. This must be done rapidly but is notoriously difficult in the pre-hospital setting. It is recognised that the initial assessment is often inaccurate partly due to its dynamic nature and the balance between exposure and warming.

Pre-hospital assessment techniques include Serial halving and Rule of Nines adjusted for age.

Alternatively the Mersey Burn App can be used.

If using this app the 2ml/kg setting should be selected for children under 6 years of age the weight must be manually entered after calculation using correct paediatric formula.

Do not rely on the calculation performed by the App.

Some assessment of burn depth should be made however soot over wounds makes this very difficult. Do not waste time.

Epidermal/Superficial	Erythema/ Red only. May be painful. Skin intact
Partial Thickness	Red. Moist. Blistering. Blanches.Very Painful
Full Thickness	Firm. Leathery. White. No Blanching. No Sensation.

When assessing burns only full or partial thickness burns should be included.

Areas of simple epidermal damage and erythema should not be included in the assessment and therefore fluid calculations.

The presence of full thickness circumferential burns should be identified and included in the ATMIST.

First Aid - Wound Management

Irrigation and Dressings

Smaller burns (≤20% adults, ≤10% children) should be irrigated with water for a **single period of 20 mins only**. The water should be running and tepid (15 degrees). Tap water is appropriate.

Care should be taken to avoid hypothermia in large TBSA Burns.

After irrigation, cover with cling film. The first 10 – 20 centimetres of the roll should be discarded before placing the dressing. The sheets should be placed one layer thick on the wound longitudinally and not circumferentially. They must not be pulled tight across the wound.

Water irrigation should be **omitted** in the following situations

1. Large thermal burns (≥20% adults, ≥10% children) due to risk of hypothermia.
2. Facial burns
3. Other time critical factors requiring immediate transfer to hospital.

Escharotomies

Escharotomies should not be attempted. Circumferential full thickness neck and chest burns must be intubated and ventilated. A higher ventilation pressure may be required. Limbs with circumferential burns should be elevated if possible.

The presence of circumferential burns should be communicated to the Burns Centre

Caustic Substances

Use extreme care when handling the patient. PPE must be worn. The management of these patients is best done with the assistance of Fire and Rescue.

Remove all contaminated clothing and irrigate with copious amounts of water regardless of burn size.

Diphoterine amphoteric solution can be used instead of water to irrigate chemical burns to both the skin and eyes and is likely to be more effective.

Do not cover with cling film. Always note the substance involved and bring the chemical data safety sheet if available.

Special Caustic Substances

If dealing with white phosphorous keep wet after irrigation. Use water soaked gauze.

The following metallic substances undergo an adverse chemical reaction with water:

Do not irrigate…

Lithium Sodium Potassium Magnesium.

If available the burns area should be covered with mineral oil. Metallic pieces should be removed with forceps and these should also be placed in mineral oil. Use loose dry dressings.

Dry powder burns may also be exacerbated with water. Powder should be carefully brushed off.

Packaging

All patients should be packaged as per packaging CSOP. Blizzard heat warming blankets must be used. Care must be taken to avoid direct contact of the heating elements with the burned areas. The temperature of the aircraft or the ambulance should be maximum.

Intubated patients must have continuous oesophageal temperature monitoring. Non-intubated patient must have their temperature checked regularly.

If the core temperature of the patient drops below 36.5 degrees then blankets must be used to cover dressings / clingfilm to prevent airflow and further heat loss.

Other Pathology

All major trauma patients should be triaged to a major trauma centre.

When major haemorrhage is apparent a damage control resuscitation strategy takes priority over the parkland formula. They can be transferred onto a burns centre after initial trauma management if necessary.

Medical pathologies should be identified and treated based on history and clinical findings.

Secondary Transfer

Initial management if not already initiated by the hospital should be carried out as outlined above. Particular attention should be made to airway assessment and predication of airway compromise when facing a prolonged transfer. Insert large NG tube and urinary catheter before transfer as necessary. Most patients will require invasive monitoring IABP and CVC.

Disposition of patient

Major burns should be triaged directly to a Burns Centre but **ALWAYS via the Emergency Department** with an appropriate ATMIST pre-alert.

South & Mid Wales

Adult burns patients should be transferred to Morriston Hospital Burns Centre:

All resuscitation burns should be discussed directly with the Morriston Consultant Burns Surgeon On-call via the hospital switchboard. See Direct Referral Pathway in Appendix A

Paediatric burns patients should be discussed with a Consultant Burns Surgeon at Morriston Burns Centre before transfer to ensure the appropriate disposition.

North Wales

Adult burns patients should be transferred to the North West Burns network with the initial point of contact Whiston Hospital Burns Centre.

Paediatric burns patients should be discussed with Alderhey Hospital before transfer to ensure the appropriate disposition.

Many less severe burns can be taken to the local Emergency Department for assessment locally and then discussion and electronic referral with video to the Burns Centre as needed.

Disposition of Burns Patients

Hospital	Location	Age Group	Notes
Whiston Hospital (Burn unit)	Liverpool	Adult	No MTC No primary helipad
Alderhey Hospital (Burns service)	Liverpool	Paediatric	No primary helipad Paediatric MTC

Wythenshawe Hospital (Burns Centre)	Manchester	Adult	No MTC Primary helipad
Queen Elizabeth Hospital (Burns Centre)	Birmingham	Adult	Primary helipad MTC
Birmingham Children's (Burns centre)	Birmingham	Paediatric	Helicopter landing requires police assistance to close roads Paediatric MTC
Morriston Hospital: Welsh Burns Centre (Adult Burns centre/ Paed Burn Unit	Swansea	Adult Paediatric TBSA <20% & **not requiring PICU****	Primary helipad MTC
Bristol Childrens Hospital (Paediatric Burns centre)	Bristol	Paediatrics Complex burns & PICU	Primary helipad

References and Further Reading

National Burn Care Referral Guidance. Version 1 February 2012. National Network for Burns Care.

Allison K, Porter K Consensus on the prehospital approach to burns patient management. *EMJ* 2004; 21(1): 112–4.

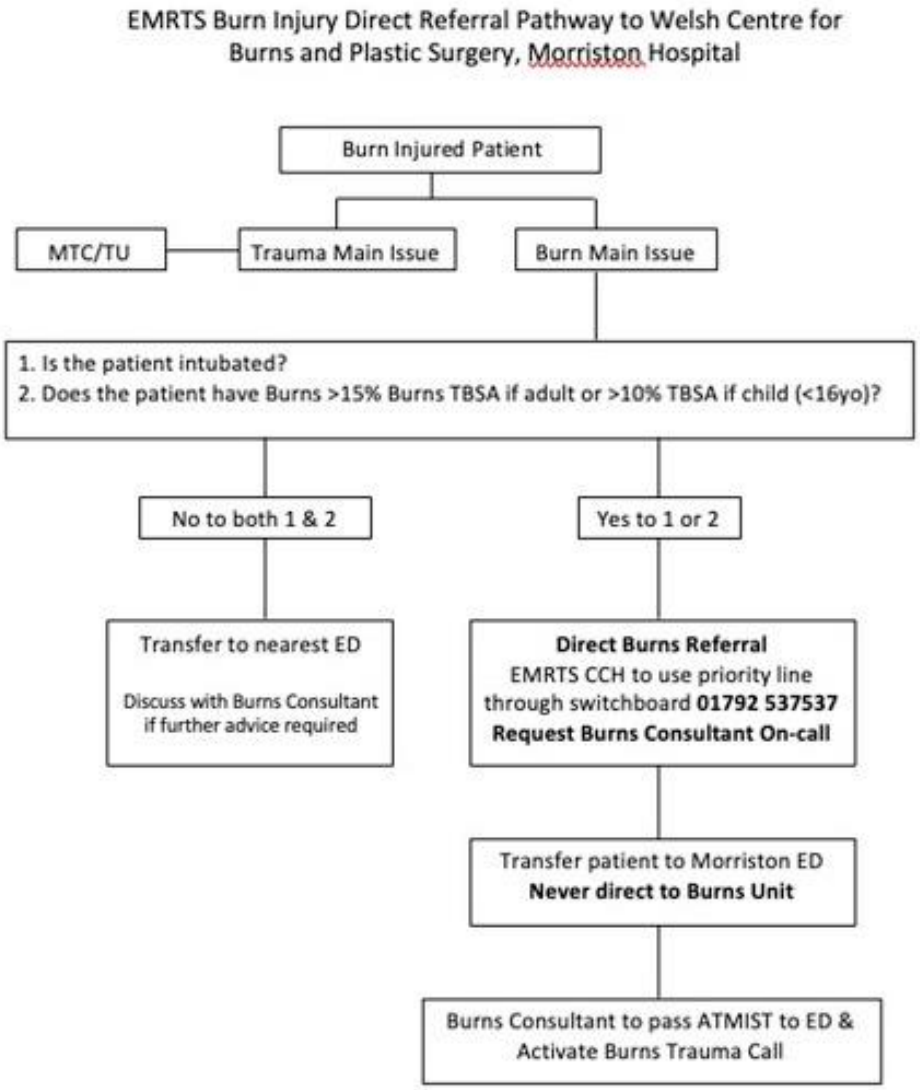
Bourke P, Dunn K. The use of polyvinyl chloride film (cling film) with burn injury in the pre-hospital setting – the clear facts. *Journal of Paramedic Practice*. Vol 7 No 1.

Barillo DJ, Cancio LC, Goodwin CW. Treatment of white phosphorus and other chemical burn injuries at one burn center over a 51-year period. *Burns* 2004; 30(5): 448-52.

SWUK Burn Network Paediatric Referral Guidelines https://www.nbt.nhs.uk/sites/default/files/attachments/SWUK%20Referral%20Guidance%20Diagram%20Paediatrics%20V1%20May18.pdf

Stiles K, Goodwin N. British Burns Association First Clinical Practice Guidelines. www.burnsassociation.org

Appendix A


EMRTS Burn Injury Direct Referral Pathway to Welsh Centre for Burns and Plastic Surgery, Morriston Hospital
Burn Injured Patient
MTC/TU
Trauma Main Issue
Burn Main Issue
1. Is the patient intubated?
2. Does the patient have Burns >15% Burns TBSA if adult or >10% TBSA if child (<16yo)?
No to both 1 & 2
Yes to 1 or 2
Transfer to nearest ED
Discuss with Burns Consultant if further advice required
Direct Burns Referral
EMRTS CCH to use priority line through switchboard 01792 537537
Request Burns Consultant On-call
Transfer patient to Morriston ED
Never direct to Burns Unit
Burns Consultant to pass ATMIST to ED & Activate Burns Trauma Call
V2.1 Oct2020 PDrew OMcIntyre

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Packaging and Handling

Reference Number	CSOP 015
Application	EMRTS Consultants and CCP's
Related SOPS	Multiple

Author(s)	Bob Tipping
Internal reviewer(s)	Ian Bowler
External reviewer(s)	
Sign off	COB

Introduction & Objectives

The aim of this CSOP is to ensure that all EMRTS patients, whether managed in the pre-hospital environment or retrieved from a healthcare facility, are packaged consistently. The aim is to preserve and protect physiology in order to optimise outcome. Packaging is viewed as a key part of the therapeutic process and not simply a mechanism for transferring the patient to hospital.

Optimal packaging aims to:

1. Minimise spinal movement and limit cord injury.
2. Minimise clot disturbance and reduce blood loss.
3. Minimise cytokine release.
4. Maintain normothermia.

Pre-Hospital Environment

General principles

1. Cut clothes along the sides, including the sleeves. Do not cut midline.

2. Position the scoop to skin (except pelvic binder). Use minimal handling to place each side ideally 10-20 degrees logroll maximum. The lower half of the cut clothes should now be separate from the patient on the floor under the scoop.
3. If a pelvic fracture is suspected place one half of a pelvic binder at the appropriate position over one blade of the scoop with the other half of the binder folded over. Once one side has been placed unfold binder at the same time as the other blade of the scoop is inserted.
4. Remove top half of clothes while maintaining dignity. Place a sheet onto the patient and use to keep wires and lines secure from snagging.
5. Self warming blankets are used if there is risk of hypothermia (see below). Place scoop into the unfolded Blizzard blanket and wrap patient. Ensure warming device is not in direct contact with skin.
6. The scoop can be placed directly onto the ambulance trolley or aircraft and the patient secured.
7. Ensure access to thoracostomy sites, lines and monitoring.

Patients found in lateral/prone position

1. Rapidly assess in the lateral position. If there is an immediate time critical intervention needed that cannot be done in this position turn supine before cutting clothes.
2. If time allows cut the clothes before moving. This should be done at the back from top to bottom, using an inverted Y-shape vertically down the midline and down the back of both legs.
3. Place 1 blade of the scoop on the ground so that it lies behind the patient. The side of the patient facing upwards should land on the blade when rolled supine.
4. Consider whether a pelvic binder is required and if so position it correctly on the blade of the scoop.
5. Log roll onto the scoop, apply pelvic binder (if indicated) and complete scoop using minimal handling.
6. Clothing removal is completed by cutting the sleeves down the side and the packaging completed.
7. If patient requires rapid movement (e.g. due to airway compromise) consider rolling onto intact scoop.

Temperature management

1. Aim for normothermia.
2. Check and documented temperature on leaving scene and again on arrival at hospital.
3. Intubated patients require continuous temperature monitoring via placement of an oesophageal temperature probe.

Self warming blankets must be used if there is risk of hypothermia. This includes all anaesthetised patients unless significantly hyperthermic. The blankets take 5 to 20 minutes to reach their maximal temperature and so they should be opened well before they are required for use. Place the scoop onto the blanket and then wrap the patient. To reduce the risk of burns with poor peripheral perfusion and prolonged contact time during transfer a sheet must be placed between the patient and the warming blanket as outlined above.

Special Clinical Circumstances

Head injured patients

After packaging, the patient should have blocks applied in the usual manner. The rigid cervical collar is no longer recommended for C-spine immobilisation. If possible the scoop should be tilted 20 degrees head up.

If the decision is made to place a collar then is should be loosened once on the aircraft or ambulance. The collar can be re-secured if the patient requires further movement or if there may be movement due to poor road conditions or poor weather conditions during flight.

Spinal injuries

All patients with suspected spinal injuries should be transferred flat. Care should be taken to avoid pressure area damage.

Resuscitative thoracotomy

If a return of circulation has been achieved and the patient requires transfer to hospital by road then consider placing the patient the 'wrong way' round on the ambulance stretcher (head is towards the rear of the vehicle). On arrival at hospital the ambulance trolley should be sited end to end with the hospital stretcher and the scoop 'walked up'.

Both of these measures allow cardiac massage/aortic occlusion to be continued without interruption.

Other Scene Considerations

Long boards

Spinal/long boards are for extrication only and should not be used for packaging/transportation.

Patients packaged by other services

EMRTS will frequently encounter patients who have already been packaged by WAST and other organisations. A clinical decision will need to be made as to whether the patient requires re-packaging. This decision will be influenced by the patient's condition, physiology, distance to definitive care and the transport to be utilised. In general, no patient should be transported on a long board and if in any doubt, it is preferable to scoop them off the long board.

Specialist Rescue Vertical Lifting

On occasion the EMRTS will be involved with patients requiring a vertical lift during specialist extrication/ rescue. In these cases the scoop will be insufficient. Specialised equipment is required. Fire and Rescue

(USAR), HART, Mountain Rescue or Search and Rescue may be called upon to provide specialist equipment for this purpose.

Handover at Hospital

The patient remains the responsibility of the EMRTS team until they have been transferred onto the hospital stretcher and a formal handover has taken place.

If a log roll has been performed on scene then the ED team should be informed and the findings clearly documented in the notes. If a log roll has not been undertaken then this information should also be handed over.

Patient's retrieved from other healthcare facilities

Where possible the Top Cover Consultant will advise the referring facility as to how the patient should be packaged for transfer. Usual practice will be for the patient to be packaged skin to scoop or placed onto a vacuum mattress.

For patients managed in the pre-hospital setting, the EMRTS team should apply standard monitoring, ensure easy access to intravenous lines and thoracostomy sites and ensure that patient temperature is monitored (See CSOP 002).

References and Further Reading

Langhelle A, Lockey D, Harris T, Davies G. Body temperature of trauma patients on admission to hospital: a comparison of anaesthetised and non-anaesthetised patients. *EMJ* 2012; 29: 239-242.

Connor D, Greaves I, Porter K, Bloch M. Pre-hospital spinal immobilisation: an initial consensus statement. *EMJ* 2013; 30: 1067-1069.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE

Traumatic Cardiac Arrest

Reference Number	CSOP 016
Application	EMRTS Doctors and CCPs
Related SOPS	multiple

Author(s)	Camilla Waugh
Internal reviewer(s)	David Lockey
External reviewer(s)	
Sign off	COB

Introduction

Survival after traumatic cardiac arrest (TCA) is approximately 8%. EMRTS will be dispatched to trauma patients with TCA and periarrest. Management must be rapid and decisive with a focus on reversible causes. The management outlined in this CSOP can be applied to both traumatic arrest and peri-arrest situations.

There are a number of algorithms available to assist with management of TCA. All emphasise rapid treatment of the most common and potentially reversible pathologies associated with TCA.

The pathologies and immediate treatments are:

1. Hypovolaemia: Replace volume with blood products, prevent further haemorrhage
2. Oxygenation: Provide adequate airway and ventilation
3. Tension pneumothorax: Decompress chest with bilateral thoracostomies.
4. Cardiac tamponade secondary to penetrating trauma: Consider surgical decompression.

The EMRTS team need to utilise all available personnel to deliver all key interventions simultaneously within a few minutes to provide the best chance of survival. Cardiac compressions should be commenced immediately – although ineffective in hypovolaemic arrest it has a place in other situations where ventricles are filled and patients in this group make up the majority of survivors. After these

interventions have been achieved ultrasound assessment of ventricular filling state may assist specific diagnosis.

Assessment of Ventricular State

In a majority of traumatic arrests the ventricles will be empty and should be treated as such. This includes anyone with penetrating trauma, major tissue loss, external bleeding, truncal injury or a significant acceleration / deceleration mechanism.

Causes include:

- Hypovolaemia
- Tension Pneumothorax
- Cardiac Tamponade

In certain circumstances the ventricles may be full.

Causes include:

- Isolated head injury leading to airway obstruction /hypoxic cardiac arrest
- Maxillofacial injury leading to airway obstruction
- Isolated neck injury leading to respiratory arrest (e.g. hanging)
- Hyperkalemia (e.g. crush injury, suspension trauma)
- Primary medical cause (leading to the injury mechanism)

The assessment should be made primarily on the history and mechanism. However clinical examination, capnographical response to CPR and ultrasound assessment and may help.

Empty Ventricular States

If the ventricles are empty, CPR will not be of benefit. Continuing CPR may exacerbate injury and will detract from the immediate management. If CPR has been started then ask the bystander or ambulance crew to stop.

Reversible causes must be targeted immediately, within the first 30 seconds of patient contact.

Use a team approach to achieve the interventions highlighted below either in quick succession or ideally, in parallel. Use other professionals (Police, Fire and Rescue) or sensible bystanders to do simple tasks (e.g. direct pressure, ventilation using the self inflating bag).

Catastrophic Haemorrhage Control and Correction of Hypovolaemia

Control obvious catastrophic external haemorrhage. Use direct pressure, haemostatic agents and tourniquets as indicated by the clinical situation. Relocate limbs to an anatomical position. Place pelvic binders and fix legs in slight internal rotation if the mechanism may be consistent with a potential pelvic injury. Use femoral traction devices as indicated.

Ideally site an 8.5 FG subclavian line but have a low threshold for using peripheral IV or IO routes if this is not quickly achievable.

Give blood and lyophilised plasma in a 1:1 ratio. All blood products should be warmed. Tranexamic acid and calcium should be given early in management. Critical hypovolaemia may require up to and over 20 ml/kg of volume achieve a ROSC.

Tension Pneumothorax

Perform bilateral finger thoracostomies regardless of clinical findings. Needle decompression techniques are usually ineffective.

Cardiac Tamponade (see resuscitative thoracotomy CSOP)

A resuscitative thoracotomy should be performed if there is a penetrating injury to the neck, thorax, axilla, or upper abdomen. An assessment of the back using gloved hands may reveal a previously unknown penetrating wound.

Consider a thoracotomy in penetrating injures where the wound is distant to the thorax but there is the potential for an object to reach the pericardium (e.g. high velocity ballistic, swords, long / sharp farming equipment)

In addition consider performing a resuscitative thoracotomy in blunt trauma that has been applied directly to the chest if a tamponade is suspected:

- demonstrated on ECHO
- suspected with ECG findings (low complex QRS and / or electrical alternans) or
- suspected due to clinical findings (distended neck veins)

Exclusions include:

- No signs of life within the last 15 minutes
- No organised electrical activity on the ECG and / or no cardiac movement seen on ECHO

Hypoxia

Though not a cause of an empty ventricular state, airway control and correction of hypoxia is vital . Establish an airway ideally with intubation to avoid aspiration. If intubation cannot be rapidly achieved use a supra-glottic airway and quickly move onto to other reversible causes. Over ventilation (tidal volumes and rates) must be avoided to avoid compromising critical venous return.

Re-assessment and ROSC

When not performing CPR the flow of 2 minute checks are sometimes lost. Always time the resuscitation and reassess central pulses / monitoring at 2 minutes. While an abrupt end tidal CO2 rise above the arrest baseline is often associated with a ROSC the correction of hypovolemia may result in a slower ETCO2 rise.

Targets should be an ETCO2 above 3 kPa and / or a central pulse.

Restarting CPR

If the ventricles have been filled and there is no sustained output, contractility failure (PEA) and/or depolarisation failure (asystole) may be preventing reperfusion of the coronary arteries. This may be due critical myocardial acidemia, hypoxia and electrolyte disturbances. (hyperkalaemia). ECHO assessment and clinical findings (full veins) may indicate a full ventricle.

Consider restarting CPR (open bimanual massage in a thoracotomy) in order to re-perfuse coronary arteries. However prolonged CPR in this circumstance should be avoided, as outcome is likely to be poor. Adrenaline, bicarbonate and calcium may be considered in selected cases though this is not evidence based. An ABG may guide management. Do not give bicarbonate and calcium through the same line without flushing first.

Full Ventricular States

A traumatic cardiac arrest may be seen in the context of a full ventricle (e.g. hypoxia secondary to an isolated head injury). In these circumstances and when the team are certain of the cause of arrest, the clinical management should take a more standard ALS approach. CPR should be continued / started with regular 2 minute checks. There should be a focus on reversible causes. Adrenaline can be considered.

Hypoxia

In isolated head injuries and airway obstructions focus should be on early and effective airway management and re-oxygenation.

Major Spinal Injury

A major spinal injury may cause marked vasodilatation and bradycardias leading to arrest. Vasodilated warm lower limbs may suggest this as a pathophysiological cause. Consider using vasoconstrictor / ionotropic support early in management.

Medical Arrest

Medical arrests may be suspected from the history or the mechanism seen. Standard ALS guidelines should be followed. However always consider both concurrent medical and traumatic causes for an arrest especially in the elderly patient with a significant mechanism of injury.

Further Considerations

Arrhythmias

Arrhythmias should not be overlooked in the trauma patient and can occur due to acidemia hyperkalaemia, hypoxia, direct cardiac injury or sympathetic storms due to brainstem compromise. Monitoring checks should be made at the standard 2 minute intervals whether CPR is active or not.

VF and pulseless VT should be treated with a synchronised DC shock at 150J Biphasic. If the chest is open at this stage flick the cardiac apex with a finger. If this fails, allow the clamshell surgical wound to close and shock using standard self-adhesive pads

Hyperkalaemia

Always consider a high potassium when there is marked tissue disruption whether CPR is active or not. Arterial blood gas analysis may guide management.

Use of the LUCAS 2

The LUCAS 2 is not contra indicated in traumatic arrest and can be considered in limited situations:

- there is no actual or suspected upper truncal trauma (chest / upper abdominal) and
- the ventricular state is thought to be full.

The LUCAS 2 should not be used in these circumstances:

- Evidence of any upper truncal trauma (chest / upper abdominal) or
- Empty ventricles when CPR should not be in progress anyway.

In these cases, CPR if used, should be manual.

Discontinuing Resuscitation

Non-survivable injuries

At initial assessment non-survivable injuries may be apparent. (Decapitation, hemi-corporectomy, decomposition). In this situation do not to start resuscitation efforts. Non survivable injuries may also be identified at thoracotomy. Stop resuscitation efforts at this point.

Prolonged Resuscitation Attempts

If still on scene at 30 minutes post arrest with a patient who is still in cardiac arrest after appropriate and full intervention then resuscitation attempts may be futile. The decision to stop further interventions must be discussed and agreed by the team. No electrical activity on the monitor should re-enforce this decision. Obtain a rhythm strip for documentation purposes.

Immediate Debrief

Bystanders and rescue personnel should be debriefed immediately after the event.

Discussions with Police

Give the police the time the resuscitation was discontinued. Make sure they have the contact details and names of the team in order to get statements. The police must be informed as to which injuries have been sustained during the incident and which have been made by the team. This avoids confusion when the police misinterpret open thoracostomies or surgical airways as traumatic stab wounds. Always document events carefully on the EMRTS paperwork.

Stopping Paediatric Resuscitation

Discontinuation of paediatric resuscitation must involve a top cover discussion. If a resuscitation attempt of a child is stopped on scene then the body must transferred to the nearest ED for immediate paediatric examination of the body as guided by Public Health Wales Procedural Response to Unexpected Deaths in Childhood (PRUDiC) 2014.

References and Further Reading

Truhlář A, Deakin CD, Soar J, Khalifa GE, Alfonzo A, Bierens JJ, Brattebø G,Brugger H, Dunning J, Hunyadi-Antičević S, Koster RW, Lockey DJ, Lott C, Paal P, Perkins GD, Sandroni C, Thies KC, Zideman DA, Nolan JP; Cardiac arrest in special circumstances section Collaborators. European Resuscitation Council Guidelines for Resuscitation 2015: Section 4. Cardiac arrest in special circumstances.Resuscitation. 2015 Oct;95:148-201.

Lockey DJ *et al.* Development of a simple algorithm to guide the effective management of traumatic cardiac arrest. *Resuscitation* 2013; 84: 738-742.

Sherren PB *et al.* Algorithm for the resuscitation of traumatic cardiac arrest patients in a physician-staffed helicopter emergency medical service. *Critical Care* 2013; 17(2): 281.

Zwingmann J *et al*. Survival and neurologic outcome after traumatic out-of-hospital cardiopulmonary arrest in a paediatric and adult population: a systematic review. *Critical Care* 2012; 16: R117.

Public Health Wales Procedural Response to Unexpected Deaths in Childhood (PRUDiC) 2014.

Pokorná, M et al. A sudden increase in partial pressure end-tidal carbon dioxide (P ET CO 2) at the moment of return of spontaneous circulation. *The Journal of emergency medicine*, *38*(5), 614-621

Mattox, K et al Role of External Cardiac Compression in Truncal Trauma. Journal of Trauma and Acute Care Surgery: November 1982

Barnard E et al. Epidemiology and aetiology of traumatic cardiac arrest in England and Wales - A retrospective database analysis. Resuscitation. 2017 Jan;110:90-94. doi: 10.1016/j.resuscitation.2016.11.001

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Vascular Access

Reference Number	CSOP 017
Application	EMRTS Clinical Teams
Related SOPS	Multiple

Author(s)	Jonathan Whelan
Internal reviewer(s)	Ian Bowler
External reviewer(s)	
Sign off	COB

Introduction & Objectives

This CSOP describes the key aspects of vascular access in the critically ill or injured patient.

Patient Assessment

Vascular access is a key component of resuscitation in patients who are critically ill or who have suffered major injuries. Vascular access also facilitates administration of analgesia and anaesthesia. All critically ill/injured and/or ventilated patients being transferred must have two working points of vascular access.

The type of vascular access will be tailored to the needs of the patient, their injury or illness, their physiological state and the skills of the operator.

Where there is a need for emergency vascular access and if peripheral IV access is proving difficult (e.g. shocked trauma patient), the preferred means of securing vascular access is the use of bilateral humeral head intraosseous access using the EZ-IO system or the placing of a large central catheter into the subclavian vein. NOTE intraosseous access can be achieved in 10 seconds which is considerably quicker than peripheral IV access.

Vascular Access Options

Peripheral Venous Cannulation

Peripheral cannulae size should be selected according to the patient (adult or paediatric) and the desired maximum rate of fluid administration. Flow rates are primarily dependant on the diameter of the cannula, with potential flow rates up to 500ml/min being achieved via a 14G IV cannula coupled with the use of a rapid infuser device.

Major trauma patients or critically ill medical patients should ideally have 2 x 14G peripheral cannulas secured. The cannula can be secured using a standard dressing. A large Tegaderm dressing can also be placed over the top for extra security. Dislodgement is minimised by curving over the giving set and securing it to the limb.

Upper limbs are the favoured site for peripheral cannulae.

The external jugular vein route can be used, but preferably avoid in trauma patients where cervical spine immobilisation is necessary. Lower limb veins can be used, but avoid in patients with known or suspected lower limb or pelvic injury.

Where large IV access is not possible and difficulty in insertion will delay time critical treatment (e.g. emergency anaesthesia or blood product resuscitation) consider the intraosseous route.

Ultrasound can be used to help locate veins, but in an emergency situation this is time consuming.

Central Venous Access

Central venous access provides an excellent route for the rapid administration of drugs. Large bore central lines can also be used effectively for rapid fluid volume administration if required. An 8.5 FG central line can facilitate rapid fluid administration at flow rates up to 300ml/min (or higher if a pressure infusion system is used).

Smaller multi-lumen central lines may also be encountered, particularly in patients for secondary transfer. These offer flexibility with 4 or 5 separate ports, but the individual lumens themselves are small, limiting flow rates. If using a multi-lumen line, the gauges of the individual lumens are marked on the injection ports of each lumen (beware, they are not all the same). If rapid administration of fluid is desired the largest port (the smallest number gauge, usually a 14G) should be chosen.

Insertion of a central line should only be undertaken by appropriately trained personnel. Ultrasound imaging improves success rates and reduces complications – and should be considered where appropriate for all central line insertions.

The vein of choice is the subclavian vein which is large and easy to locate. In the context of chest injury, the line should be inserted in the same side as the injury.

Full monitoring should be instituted prior to insertion, including 3-lead ECG monitoring.

Central lines should be placed as aseptically as possible, especially if the environment allows for this (e.g. in a hospital setting prior to a retrieval). In suboptimal conditions (e.g. pre-hospital or during resuscitation attempts) intra-osseus access is the technique of choice. However if a central line is placed in suboptimal conditions this information should be handed over to the hospital critical care team. This allows them to plan a line change within 24 hours to avoid line sepsis and other complications.

Intraosseous Access

Intraosseous access is less reliable than intravenous access but can be used for all anaesthetic drugs including muscle relaxants.

The optimal insertion site is the lateral aspect of the humeral head. Other options include the proximal tibia (medial to the tibial tuberosity), the iliac crest and the lateral femoral condyle.

If the intention is to fly the patient, the left humeral head is the optimal site as this facilitates easiest access in flight.

Fractured bones should be avoided. The lower limb should also be avoided in patients who may have fractures proximal to the planned insertion site or suspected pelvic or abdominal haemorrhage.

Key steps in insertion:

1. Identify chosen insertion site.
2. Use fully aseptic technique wherever possible.
3. Local anaesthetic to skin in conscious patients.
4. Select appropriate IO needle and affix to EZIO drill.
5. Push needle through skin until bone reached, ensuring at least 5mm of the needle is visible above the skin prior to drilling.
6. Penetrate cortex by squeezing drill trigger and applying gentle downward pressure.
7. Release trigger when 'give' is felt upon entry to medullary space.
8. Remove stylet while holding IO needle.
9. Observe sharps safety.
10. Attach primed extension tube with 3-way tap & secure IO needle in place.
11. Attempt aspiration of bone marrow (can be used for blood glucose or for cross matching if required).
12. Flush with 10ml of 0.9% saline to open medullary space.
13. **In conscious patients, use an initial flush of 2-4ml of 1% lidocaine prior to 0.9% saline to reduce pain on injection**

Flow is limited so fluids are best administered via either a pressure infusion system, or by the use of a 50ml syringe attached to the 3-way tap to aspirate from the giving set, then to inject as boluses via the IO needle.

Monitor for signs of swelling around IO insertion site which indicates a misplaced needle.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Emergency Reversal of Anticoagulation

Reference Number	CSOP 018
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 010, CSOP 019

Author(s)	Matt O'Meara
Internal reviewer(s)	Scott Farmery
External reviewer(s)	
Sign off	EMRTS Clinical and Operational Board

Objectives

To ensure that all injured patients who are known or suspected to be on warfarin, have an INR measurement taken as soon as possible after injury. The option of emergency reversal should be considered and where indicated this should be delivered, prior to arrival at hospital. Specific objectives include:

1. Describe the rationale for the pre-hospital administration of Pro-thrombin Complex Concentrate (PCC).
2. Describe the steps to be followed in order to correctly administer PCC.
3. Illustrate the correct dosing regimen for the chosen PCC to be administered.
4. Describe the administrative processes associated with the pre-hospital use of PCC.

Background

Pro-thrombin Complex Concentrate (PCC – trade name is Beriplex®), is a combination of blood clotting factors II, VII, IX and X, as well as protein C and S, prepared from fresh-frozen human blood plasma. It is used to reverse the effects of oral-anticoagulation therapy when bleeding occurs. Warfarin is an oral medication that inhibits Vitamin K participation in the synthesis of clotting factors. SBHB stocks Octaplex® as the chosen PCC. This is a human Pro-thrombin Complex Concentrate derived from human donor plasma and contains all of the Vitamin K-dependent clotting factors. PCC is licensed for emergency reversal of Warfarin.

Emergency reversal of Warfarin can prevent or slow the expansion of intracranial haematoma and may reduce the risk of catastrophic clinical deterioration occurring prior to definitive neurosurgical care.

Indications for Use

1. Confirmed or strongly suspected to be taking Warfarin
   AND
2. Clinical suspicion of intracranial OR ongoing exsanguinating haemorrhage
   AND
3. INR confirmed to be greater than 2 on near-patient testing. Patients with an INR of less than 2, but who otherwise meet the criteria for administration should also be discussed with the 'Top Cover' Consultant

Administration of PCC

The dose is based on patient weight and measured INR. PCC is given immediately after reconstitution as a slow intravenous bolus over 15-30 minutes. The EMRTS will carry 6 vials of PCC (500IU/vial, 20ml reconstituted). These will be kept in the retrieval bag. A supply will be kept at each base in the drug fridge.

The packaging contains a double-ended needle. Both the powder vial and the water vial have a rubber stopper. Perforate the water vial first with the short end of the double-ended needle, and then perforate the powder vial with the other end. A vacuum draws in the water. Once all the water is drawn in, remove the needle and empty water vial and slowly rotate the powder vial until the powder is completely dissolved. Do not shake. Use the filter needle to perforate the powder vial and attach a 20ml syringe to draw up the contents of the vial. Aide memoire – "shorter to water" i.e. short end of needle into water vial. Undertake process on a flat surface.

In order to avoid extended scene times, PCC will usually be reconstituted and administered on route to hospital.

Normalisation of coagulation should be as rapid as possible. If it is not possible to obtain an INR reading and the diagnosis of haemorrhage is strongly suspected, probabilistic dosing can be used.

Dosing chart for Beriplex® (different for Octaplex®)

Pre-treatment INR	2.0 – 3.9	4.0 – 6.0	> 6.0
Approximate dose ml/kg body weight	1	1.4	2
Approximate dose IU (Factor IX)/kg body weight	25	35	50

The maximum dose should not exceed 3000IU. See Beriplex Calculator

Documentation and Traceability

1. This follows the same procedure as other blood products.
2. A wristband is attached to patient with 5 identifiers.
3. The PCC sticker is completed, attached to an All Wales Transfusion Record (which includes 5 patient identifiers) and then complete record handed to the team leader and scribe to form part of the in-patient record. Please photocopy and take back record for database.
4. Hand over must explicitly state that PCC has been administered and that a bolus dose of Vitamin K 10mg should be given in hospital.
5. When completing the database ensure PCC is selected on the database.
6. The products will be issued with a batch product record sheet – when a product is used, the recipient's details MUST be entered onto the sheet against the appropriate batch product (including the second PCC sticker if available). The completed form is then returned to the blood bank.
7. To replenish used stock contact the BT department on 01792 703054 – this will generally be at the same time as requesting blood stock replacement.
8. Octaplex is a blood product. All documentation must be 100% and a trigger is required to re-supply from Blood Bank at Morriston Hospital. This is audited.

Warfarinised Patients with Multiple Injuries and Suspected Bleeding

This group of patients may benefit from emergency reversal of anticoagulation provided that they have an INR above 2.

Reversal of Direct Oral Anticoagulants (or Novel Anticoagulants)

The reversal of direct oral anticoagulants poses a particular challenge to the EMRTS, in the context of life threatening haemorrhage. Increasingly patients requiring thromboprophylaxis are placed on these agents which have the advantage of requiring minimal monitoring in comparison to warfarin. These drugs can be divided into two groups:

1. Factor Xa inhibitors (Rivaroxaban and Apixaban) – no value in testing the INR as an normal INR does not exclude a therapeutic level.
2. Direct thrombin inhibitor (Dabigitran) – no value in testing the INR as not affected by dabigitran, required testing of the Thrombin Clotting Time.

In both cases if a patient is identified to have taken one of these drugs within the previous 24hrs AND clinically has signs of the life threatening haemorrhage:

1. Administer 1g of tranexamic acid.
2. Administer PCC, 50mg/kg (max 3000IU).

As PCC is not licensed for this indication please complete a patient information leaflet, take a copy for our records and hand original to receiving hospital.

References and Further Reading

Strein M, May S, Brophy GM. Anticoagulation reversal for intracranial hemorrhage in the era of the direct oral anticoagulants. Curr Opin Crit Care. 2020 Feb 4.

Kaide CG, Gulseth MP. Current Strategies for the Management of Bleeding Associated with Direct Oral Anticoagulants and a Review of Investigational Reversal Agents. J Emerg Med. 2019 Dec 9.

Franchini M, Lippi G. Prothrombin complex concentrates: an update. *Blood Transfusion* 2010; 8: 149-54.

Imberti *et al*. Emergency reversal of anticoagulation with a three-factor pro-thrombin complex concentrates in patients with intracranial haemorrhage. *Blood Transfusion* 2011; 9: 148-55.

Bernard V. Bench to bedside review: Optimising emergency reversal of vitamin K antagonists in severe haemorrhage – from theory to practice. *Critical Care* 2009; 13: 209 (doi: 10.1186/cc7001).

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Damage Control Resuscitation (Incl. Blood Products)

Reference Number	CSOP 019
Application	EMRTS Doctors and CCPs
Related SOPS	Multiple

Author(s)	Bob Tipping
Internal reviewer(s)	Dindi Gill
External reviewer(s)	Richard Price
Sign off	EMRTS Clinical & Operational Board

Introduction & Objectives

EMRTS sometimes need to initiate Damage Control Resuscitation (DCR) on patients in hypovolaemic shock from blood loss and initiate early blood product resuscitation prior to arrival at definitive care. This prevents the detrimental effects of the lethal triad (hypothermia, acidosis and coagulopathy of trauma shock or CoTS). Although the focus of this CSOP is on the bleeding trauma patients many of the interventions outlined here can be applied to other causes of blood loss including GI bleeds. This CSOP should be read in conjunction with the supplementary reading provided.

DCR and administration of blood products can be considered in two groups of bleeding major trauma patients that the EMRTS attends. These are considered in turn:

1. Pre-hospital. Read in conjunction with CSOP 001.
2. Inter-hospital transfers from a peripheral hospital to a specialist centre (i.e. MTC) or delayed primary transfer.

EMRTS carry the following:

1. 4 units PRBCs – in Credo blood boxes.
2. 4 bottles of Lyophilised plasma (LyoPlas, 200ml/bottle) – 1 bottle in the pouch attached to each Credo box and two in the specialist fluids pouch in the secondary bag.
3. 4g of Fibrinogen (4 X 1g bottles) – 2 bottles in each pouch attached to each Credo box.
4. 3000U (500U X 6 bottles) of Prothrombin Complex Concentrates (Octaplex) – in the INR pouch of the

retrieval bag.

The service will adhere to the operational governance processes outlined by the Welsh Blood Service pertaining to checking, documentation and traceability. See operational SOPs.

Blood products are be carried by the EMRTS by road or air to all taskings irrespective of the initial tasking as the team may get re-tasked at any time. Decision making to take blood to a scene or into a hospital must be based on information from the Air Support Desk and overhead assessment of the incident if pre-hospital. If the blood boxes/retrieval bag is in the aircraft they should be retrieved by the pilot or a member of the Emergency Services can be asked to do this.

Pre-hospital

1. Catastrophic haemorrhage control (see CSOP 006)	For obvious sources of haemorrhage where temporary control can be achieved: Application of tourniquets and haemostatic agents – these are changed to pneumatic tourniquets on arrival in hospital/theatre Internal rotation of lower limbs and pelvic binder application as appropriate (Advanced haemorrhage control techniques using junctional tourniquet use)
2. Rapidly secure vascular access	Rapid IV access attempts. If failed: Bilateral humeral head IO access preferable – blood products can be delivered IO using a 50 ml syringe and 3-way tap if necessary
3. Rapid control of the airway	If suspicion of massive haemorrhage or shock definitively secure the airway. Do not wait to start resuscitation – airway management is part of the resuscitation strategy. This is especially important in patients with reduced GCS, expectant clinical course and those that require air transfer. An appropriate risk/benefit analysis must be undertaken Achieve by omitting the need for a pre-induction dose of fentanyl, reduce ketamine dose to maximum 1mg/kg and give rocuronium 1mg/kg Maintain anaesthesia with boluses of ketamine/fentanyl or propofol infusion
4. Identification of significant chest trauma	Thoracostomies as indicated by clinical assessment and Transthoracic USS (to be achieved rapidly post RSI)
5. Initiate blood product resuscitation (if not already commenced)	Place large bore central access (8.5Fr Swan line) into subclavian vein (avoid femoral) in patients with poor IV access. Alternatively use wide bore IV access if already placed. Obtain pre-transfusion crossmatch blood sample (pink top bottle). Administer Tranexamic Acid 1g

	If no radial pulse (i.e. SBP ≤90mmHg) commence warmed PRBC's and LyoPlas (use blood warmer in all cases with a 3-way tap and 50ml syringe) as close to 1:1 as possible, recheck radial pulse regularly If no radial pulse (i.e. SBP ≤90mmHg) after 4 units of PRBC's and LyoPlas - give up to 70mg/kg of Fibrinogen Give Fibrinogen earlier in DIC (e.g. obstetric haemorrhage) Once radial pulse achieved (i.e. SBP 90mmHg) stop blood products and monitor clinical condition In the presence of hypovolaemic shock and where a traumatic brain injury is likely to be the predominant issue, a less restrictive approach to blood product resuscitation should be used to maintain cerebral perfusion. NOTE: blood product resuscitation should be initiated prior to transfer, but then continued on route as necessary to reduce delay to definitive care Avoid crystalloids and vasoconstrictors in bleeding patients Consider emergency reversal of anticoagulation – see CSOP 018
6. Controlling the 'biochemical storm'	Reserve POC testing on route to definitive care if practical Empirically administer 10ml 10% calcium chloride (to help correct hypocalcaemia) after each 4 units of blood or blood products.
7. Temperature management on scene and during transport	Oesophageal temperature monitoring in all intubated patients (aim for ≥36°C) Careful attention to heat loss during exposure and packaging of patient (minimal movement to reduce clot disruption) Patient in scoop (with gel pads) and blizzard warming system
8. Communication prior to leaving scene	Complete the documentation and traceability paperwork - mandatory ATMIST with MTC Massive Haemorrhage policy. Platelets will be required for patients with large areas of tissue damage. Declare **CODE RED** for resupply

Inter-Hospital or Delayed Primary Transfer

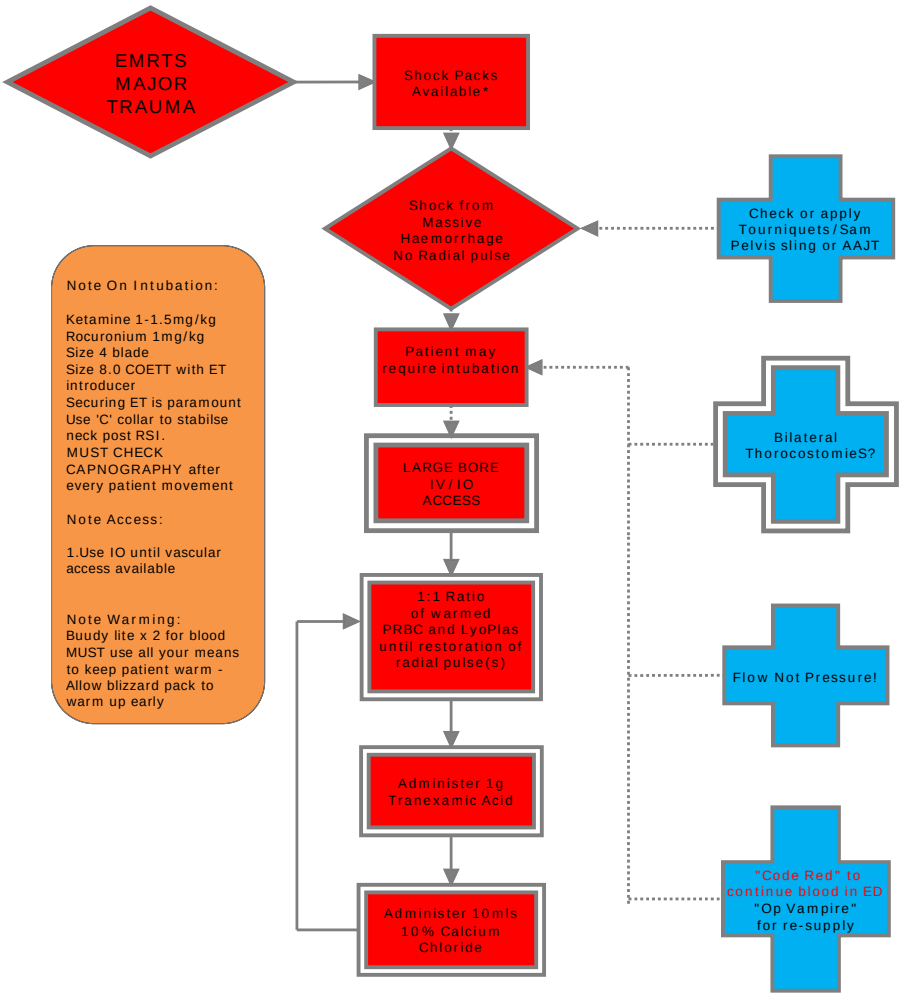
In the addition to the above interventions which may be indicated prior to transfer the following checks could also be considered. This section should be read in the conjunction with CSOP 002 which provides a standardised approach to time critical transfers.

1. Interventions required prior to arrival of the EMRTS	The 'top cover' consultant should contact the referring centre request a clinical update on the patient's condition and advise on interventions (as indicated above) to be instituted whist EMRTS team are *en route*. This information should then be conveyed to the team
2. Immediate actions on arrival of the EMRTS	Should follow the approach outlined above but with some additional conditions: - Check any haemostatic interventions (Tourniquets, pressure dressings, Celox) are still effective - Place large bore central access (8.5Fr Swan line) into subclavian vein (avoid femoral) in patients with poor IV access for ongoing blood product resuscitation - Cycle NIBP every 3 mins, Do not attempt arterial line insertion until SBP ≥90mmHg and/or presence of a radial pulse - Clarify that Tranexamic Acid 1g bolus has been given and infusion over 8hr has started: continue this in transfer - Review and record the most recent laboratory results: FBC, U&E, Calcium and Clotting (but availability should not delay transfer). Review blood gas - Initial resuscitation is empiric until it is possible to tailor the resuscitation using POC testing and ROTEM - Administer warmed PRBC's and Lyoplas/FFP in a 1:1 ratio (haemostatic resuscitation) as indicated - Give boluses of 250ml titrated to a SBP 90mmHg and/or presence of a radial pulse until haemorrhage controlled. Check observations in between to avoid over resuscitation If no radial pulse (i.e. SBP ≤90mmHg) after total 4 units of PRBC's and LyoPlas/FFP - give up to 70mg/kg of Fibrinogen In the presence of hypovolaemic shock and where a traumatic brain injury is likely to be the predominant issue, a less restrictive approach to blood product resuscitation should be used to maintain cerebral perfusion. Give Fibrinogen earlier in DIC (e.g. obstetric haemorrhage) - Assess state of bleeding:

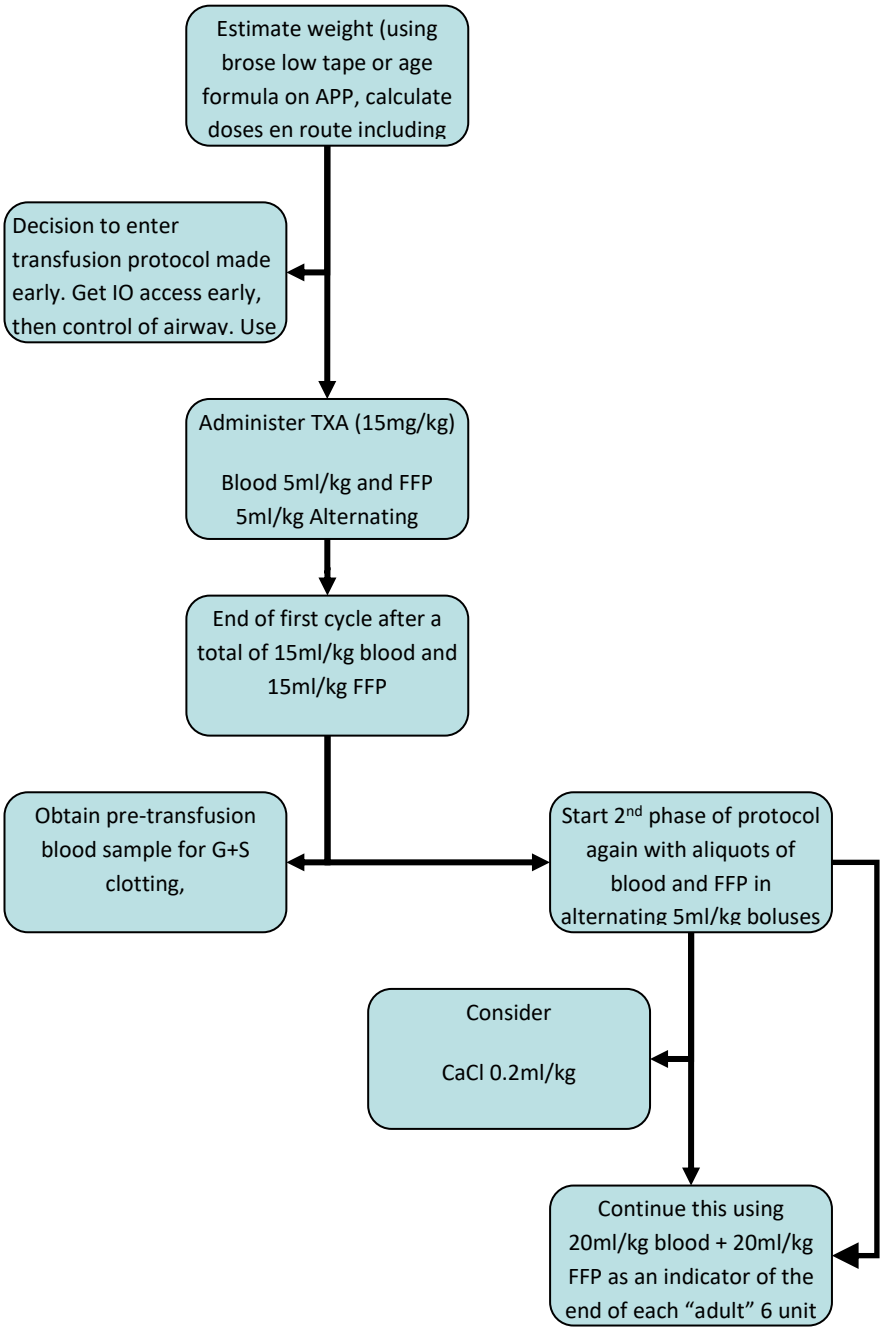
	If the patient is being moved for haemorrhage control then ongoing transfusion should be done on route with the EMRTS blood products. Minimise delay to transfer Where haemorrhage control has been achieved at the referring centre then further resuscitation can be conducted in conjunction with the referring centre blood bank and laboratory services: this needs to be mindful of local resource, availability of laboratory and POCT as well aviation/transport considerations. In this circumstance, resuscitation should be guided by POC testing: the EPOC allows measurement of base deficit, pH, ionised Ca^{2+} and K^{+}. - Look for hypocalcaemia. Calcium levels are frequently low and associated with worsening clotting. Give 10mls 10% Calcium Chloride to maintain ionised Ca^{2+} >1.0mmol/l. If levels not known empirically administer after each 4 units of blood products - Look for hyperkalaemia. Potassium levels can rise quickly, especially in blast or crush injury. Use 50mls 50% Dextrose with 15 units of insulin infused over 20minutes to maintain K^{+} <5mmol/l
3 Transfer to definitive care	Establish whether haemorrhage control can be achieved locally OR that transfer is the only option to achieve this. Discussion with 'top cover' in equivocal cases Clear communication is required with receiving centre especially if immediate haemorrhage control is required. Expectation of ongoing massive transfusion in the receiving unit must be clearly communicated prior to transfer in order to mobilise further blood products (incl. platelets and cryoprecipitate)

Access to information as to surgical facilities, IR capability, availability of blood products and POC testing (blood gas analyser/ROTEM) are available on the EMRTS APP.

Appendix 1: DCR Algorithm



Appendix 2: Paediatric Transfusion Algorithm



Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Trauma in Pregnancy

Reference Number	CSOP 020
Application	EMRTS Doctors and CCP's
Related SOPS	Multiple

Author(s)	Stuart Gill
Internal reviewer(s)	Ami Jones
External reviewer(s)	
Sign off	COB

Introduction & Objectives

Outline of the initial management of the pregnant trauma patient, indications for Peri-mortem Caesarian section and legal obligations.

Trauma is a leading cause of perinatal mortality in the western world; an increasing proportion of maternal trauma is due to domestic abuse and violence. In general what is best for the mother is also best for the fetus but maternal wellbeing takes priority.

Initial Management

Use the standard trauma CABCDE approach with the following considerations:

External Catastrophic Haemorrhage

External catastrophic haemorrhage is dealt with in the same way as all trauma patients using direct pressure, tourniquets and novel haemostatic agents as indicated.

Airway

The airway may be difficult to manage due to laryngeal oedema, breast enlargement and lateral position; progesterone causes relaxation of the lower oesophageal sphincter, increasing risk of aspiration. Intubation should be carried out by most experienced clinician since desaturation can be rapid. Any decision to undertake pre hospital anesthesia must be done for a clear benefit and take the increased risks into account.

Breathing

Increased minute ventilation, decreased functional residual capacity (FRC) with airway closure during tidal respiration plus increased cardiac output (CO) mean that chest trauma and apnoea are poorly tolerated resulting in rapid desaturation and hypoxia.

Chest drains and thoracostomies should be sited two spaces above the usual 5th intercostal space because displacement of abdominal contents upwards elevates the diaphragm and causes lateral spread of the ribs.

Circulation

>20/40 weeks' gestation (uterus palpable at level of umbilicus) manage in 15-30^{o} left lateral position (wedged or resting on resuscitator's knees) or with manual lateral displacement of uterus. Increased circulating volume means hypovolaemia/shock may manifest late.

There should be a low threshold to place a pelvic binder. This should be sited as normal at the greater trochanters.

As the primary aim is the survival of the mother, blood pressure targets are the same as in a non - pregnant trauma patient. Aim for a palpable radial pulse or SBP of 90 mm Hg using Fibrinogen as a priority and then PRBC's/plasma as per our standard protocol. Give Tranexamic Acid if the cardiovascular status is unstable or bleeding is suspected. Studies from Obs Cymru using ROTEM have shown that pregnant women tend to need fibrinogen earlier than the standard population so strongly consider giving the full 4g early rather than waiting to see how much product is required g.

Peri-mortem C-section

Traumatic arrests should initial be dealt with in the same way as a non-pregnant patient. However if circulation is not restored after intubation and ventilation, bilateral thoracostomies and volume replacement then thoracotomy and/or peri-mortem caesarian section should be considered as early as possible - see CSOP 051.

Delivery of the placenta is critical to haemostasis; pack the wound and ensure oxytocin 5u IV is given. Consider the use of IM ergometrine if bleeding is still not controlled and the uterus is atonic. Off license internal use of novel haemostatic dressings may be considered if control is difficult.

If resources are available, equipment should be prepared for a neonatal resuscitation. However the mother is the priority.

C-section is unlikely to be of benefit to either mother or fetus at gestations < 24 weeks.

Non-Survivable Injury

If maternal injury is deemed non survivable (e.g. hemi-corporectomy, decapitation etc.) and the team are on scene within 10 minutes of cardiac arrest a peri-mortem cesarean section can be considered if the gestation is over 24 weeks, with a focus on neonatal resuscitation.

Hospital Transfer and Pre Alert

Unless both mother and baby are clearly dead transfer should be done in parallel with resuscitation. The pre-alert should include a request to activate the hospital massive transfusion protocol if appropriate and to have availability of a senior obstetric surgeon on arrival with the trauma team.

North Wales

All major trauma patients should be transferred to the MTC at the Royal Stoke University Hospital In certain circumstances teams may elect to transfer to the closest trauma unit (weather, distance with ongoing cardiac arrest etc.) All trauma hospitals in North Wales and the MTC have obstetric support.

South Wales

The current situation in South Wales is more complex. An assessment of injures, on scene treatment and response to treatment should be made. Again the priority of care is to the mother. Complex major injury should be transferred to UHW. See EMRTS APP.

References and Further Reading

CMACE (formally CEMACH). Saving Mothers Lives – The 8th Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom. March 2011.

Hector MF *et al*. Trauma in pregnancy: an updated systematic review. *Am J Obs Gynae* 2013; 209 (1): 1-10.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Resuscitative Thoracotomy

Reference Number	EMRTS CSOP 021
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 004a and 004b, CSOP 007

Author(s)	Jonathan Whelan
Internal reviewer(s)	
External reviewer(s)	
Sign off	EMRTS Clinical and Operational Board

Introduction & Objectives

Ensure that all EMRTS clinical teams are familiar with the indications, process and procedure for performing a Resuscitative Thoracotomy in the pre-hospital and in-hospital settings.

1. Define the patient population the procedure aims to benefit.
2. Describes the indications for Resuscitative Thoracotomy (RT).
3. Describe the RT procedure.
4. Describe post RT care.

Background

The prognosis for patients who lose their vital signs on scene following penetrating trauma is very poor. Performing chest compression and traditional ALS style resuscitation in this patient group is

futile as there is either complete obstruction to blood flow through the heart or the heart is completely empty through hypovolaemia.

Immediate surgical intervention is the key to maximising the chances of survival in this patient group. It is important to appreciate that a resuscitative thoracotomy only aims to address patients with a simple cardiac wound and an associated cardiac tamponade, it does not seek to address patients with more complicated wounds and hypovolaemic cardiac arrest. RT may also have a role in the control of sub-diaphragmatic major haemorrhage. Under these circumstances, RT allows manual occlusion of the descending aorta, volume loading with blood and high quality, internal cardiac massage.

The resuscitative thoracotomy technique used by the EMRTS is the 'clamshell' approach, which provides maximal exposure to allow rapid identification of anatomy requires minimal equipment and gives the best operating field.

Each doctor and CCP within the service will receive one to one tuition with an EMRTS Consultant who has been trained/performed a RT.

The availability of Pre-hospital Ultrasound and rapid assessment using the FAST procedure now allows easy diagnosis of cardiac tamponade. This should be performed if 1. the patient has not arrested or 2. if thoracotomy in blunt trauma is being considered and the images saved.

Resuscitative Thoracotomy Policy

Indications

PENETRATING TRAUMA

1. In cardiac arrest with organised electrical activity on the ECG AND/OR cardiac movement on FAST.

   OR

2. In an agonal state (dilated pupils, Cheyne-Stoke breathing, barely palpable central pulse).

   AND

3. Recent signs of life (presence of respiratory effort/pulse, limb movements OR sustained ETCO2 compatible with an output if intubated).*

   AND

4. Penetrating wound that involves the chest OR abdomen/pelvis.

A penetrating wound that could involve the heart usually means one of the following four examination findings:

Wound to the front of the chest between the nipples.
Wound to the back of the chest between the shoulder blades.
Wound to the central upper abdomen (epigastrium).
Wound to the neck.

*Some authors recommend 10-15 minutes as a window in which the procedure should be performed following loss of vital signs. In reality, obtaining exact timings is difficult. Witnessed arrest in front of the EMRTS or WAST crew may provide useful start points.

BLUNT TRAUMA

The focus of resuscitation here should follow the principles outlined in the traumatic cardiac arrest CSOP. The priority should be to secure the airway, place bilateral thoracostomies and adequate delivery of blood products. A role for RT does exists in patients in traumatic cardiac arrest for blunt trauma, but its indications are more limited. Isolated blunt trauma to the chest including the presence of pericardial tamponade on ultrasound carries the highest probability of survival. Proximal control of haemorrhage has a limited role in isolation. RT should generally be avoided in patients with multiple blunt injuries (including those of the head).

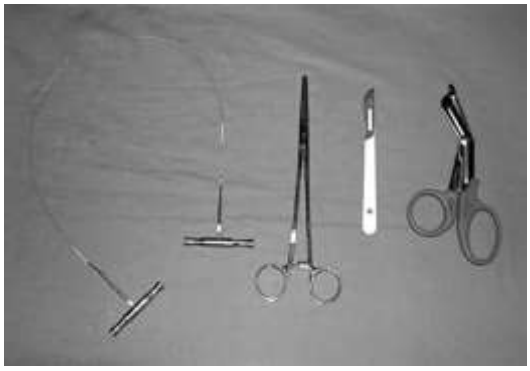
In summary you need a good reason not to do a Resuscitative Thoracotomy in penetrating trauma and a good reason to do it in blunt trauma.

Process

The decision to perform a RT should be made within 10 -15 seconds of arrival on scene and establishing the patient has no vital signs (or that vital signs are about to be lost). The diagnosis is clinical and confirmation with ultrasound (if skilled) and does not require the application of monitoring initially. Delays arise from not making a timely decision to proceed with the procedure.

The patient should be rapidly extricated to an area that allows complete 360 degree access to perform the procedure.

Equipment contained within the thoracotomy pack includes the following:



Gloves must be worn.

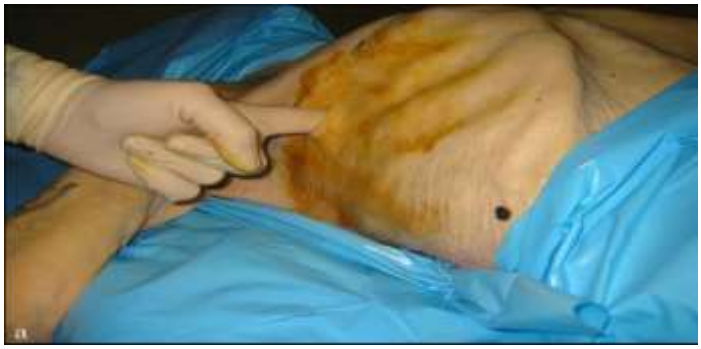
The EMRTS CCP should create a 'kit-dump' on the left hand-side of the patient.

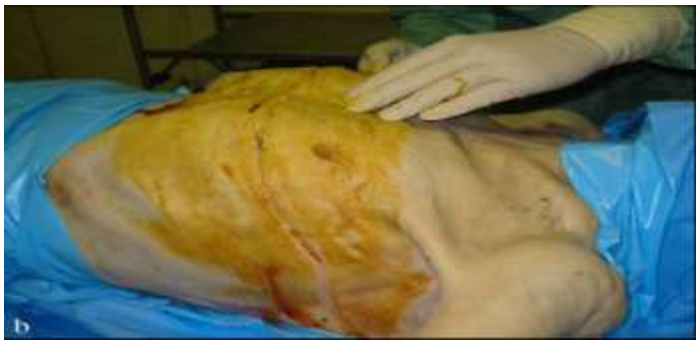
Do not be concerned with IV access/advanced airway management if these have not yet been achieved. The initial aim is to relieve the primary cause of the patient's cardiac arrest and these procedures can be completed after surgery (or simultaneously if resources allow).

1. Rapidly clean the skin with chlorhexidine swabs. Identify the markings for the 4th intercostal space.

2. Undertake a simple thoracostomy on the side of injury initially using a 22 blade scalpel and a pair of Spencer Wells. Repeat on the other side. If a tension pneumothorax is identified and signs of life return then STOP at this point.

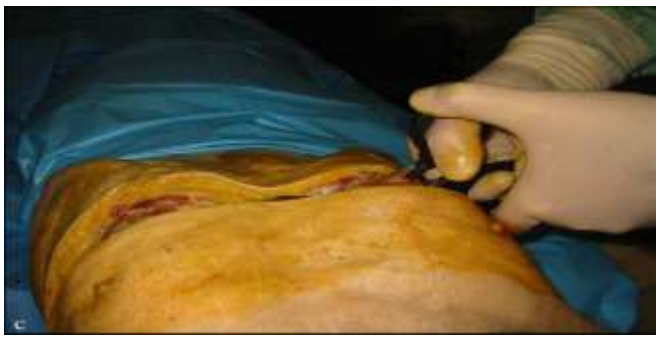
3. Mark the trajectory of the 4th interspace with a pen, it should follow a 'swallow' type shape, this will be the line of the skin incision:





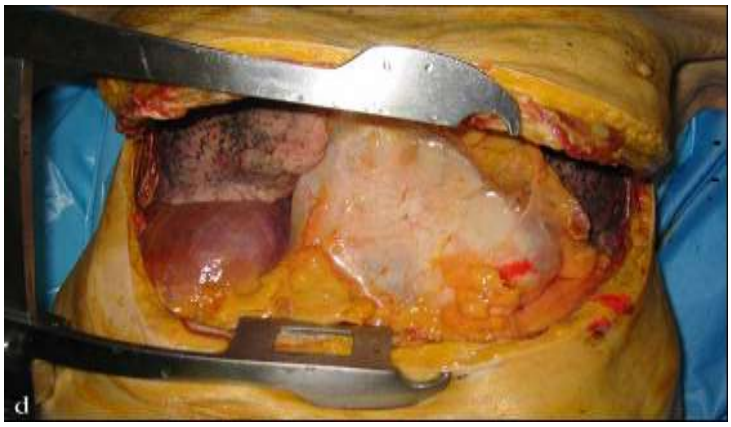
4. Make a broad skin incision using a 22-blade scalpel along the line of the 4th interspace, connecting the left and right thoracostomies. The incision should be deep and go through all skin layers to fat / muscle.

5. Using a pair of Tuffcut shears, extend the thoracostomy wounds on both sides up towards the sternum. Use a finger to push the lung away from the incision. It may be possible to cut through the sternum using the Tuffcut shears, if not then the Gigli saw must be used (this should require no more than 2-3 pulls) and is a single person technique:



6. Before proceeding to open the chest, extend the incisions in the intercostal space posteriorly to the posterior axillary line (this will improve chest opening and increase your field of view).

7. Lift the chest wide open (using someone to retract the chest wall, EMRTS does not carry rib retractors). This person can use gauze swabs to protect themselves from sharp rib edges. Apply suction to assist with clearing the field to aid identification of the anatomy:



8. Identify the heart (if a tamponade is present then pericardium may appear blue and tense however absence of these signs does not exclude a tamponade). Use the Spencer Wells to tent the pericardium on the anterior surface of the heart and cut a small vertical hole. Extend the hole using fingers to gain wide exposure which avoids phrenic nerve damage. This allows better access to inspect heart and clear out clotted tamponade.

9. Remove any blood clots with your hands. The outcomes on first clearing the tamponade could be subdivided into:

- Immediate good Return of Spontaneous Circulation (ROSC) – Intubate, muscle relaxation and sedate then deal with cardiac wound.

- Low output ROSC – give blood/calcium/adrenaline, if limited response, deal with wound, muscle relaxation and sedate. Calcium is the inotrope of choice initially.

- Ventricular Fibrillation - flick 2-3 times with finger, if no response close chest and defibrillate as below.

- Asystole – flick 2-3 times with finger, if no response commence internal massage, give blood/calcium/adrenaline. Use a two handed technique and ensure the heart is not kinked on its vascular pedicle (i.e. it lies flat).

10. If the pericardium is empty begin internal cardiac massage, secure vascular access and begin blood product resuscitation. You will be able to feel whether the heart is full /empty. Do not overfill the heart. Inspect each hemithorax and think about bleeding below the diaphragm.

11. An assistant should simultaneously apply manual compression to the descending aorta at the time of inspecting the pericardium. This is integral to ALL thoracotomies and ONLY evacuation of cardiac tamponade takes priority.

12. Once perfusion has been restored, the internal mammary arteries may begin to bleed and will require clamping.

13. If and when a sustained ROSC is achieved cling film can be placed over the open chest wall prior to transfer. This is will minimise heat loss whilst allowing visualisation of the thorax for cardiac contractility and further bleeding.

Cardiac wounds

1. Full inspection of the heart especially for posterior wounds and inferior wounds from epigastric stab wounds can be missed. Though this must be done with caution to not put the great vessels under torsion.

2. Wounds less than around 1cm can usually be left alone but if larger (or if there is significant bleeding from the wound) then they should be sutured or occluded with digital pressure. Do not insert a finger into the wound as this may cause it to extend. Deep sutures are more likely to occlude the LAD artery.

3. Use of a skin stapler is an effective method for closing cardiac wounds.

Ventricular fibrillation

1. Coarse VF – if this occurs then close the chest cavity, apply defib pads to the chest wall and defibrillate in the normal way.
2. Fine VF – continue internal cardiac massage and filling with blood, until either coarse VF develops or spontaneous organised cardiac activity returns.

Aortic Occlusion

Using the left hand, enter the left hemi-thorax and pass the hand up behind the lung until the spine is felt. Using the fingers of the left hand, compress any soft tissue structures in front of the spine onto the spines anterior surface. You should feel a pulse from a spontaneous or augmented cardiac compression if the heart is adequately full.

Vascular Access

Large-bore vascular access is preferred. This can be achieved via peripheral venous cannulation, in particular, the external jugular may be useful. Consider central access if appropriate. IO access is useful for drug administration, but is difficult to provide high volume fluid resuscitation through. In extreme circumstances, the right atrium can be cannulated with a small venflon or foley catheter through a small incision. Care must be taken not to overinflated the balloon.

Triage

Patients who have undergone a Resuscitative Thoracotomy and obtained a ROSC should be transported to the nearest cardiothoracic centre. During the pre-alert call make it clear that the patient has undergone a thoracotomy; declare **Code Red**. If transferring to Bristol transfer to Southmead Hospital (MTC).

If a return of circulation has been achieved and the patient requires transfer to hospital by road then consider placing the patient the ‘wrong way’ around on the ambulance stretcher (head is towards the rear of the vehicle). On arrival at hospital the ambulance trolley should be sited end to end with the hospital stretcher and the scoop ‘walked up’.

Both of these measures allow cardiac massage/aortic occlusion to be continued without interruption.

If despite all the above measures the situation appears hopeless then life can be pronounced extinct at the scene. It is vital to document the procedure in the clinical notes and to inform the Top Cover Consultant that a thoracotomy has been performed.

To aid the Coroner and Police, where possible, try to document any wounds/injuries that were present prior to the thoracotomy being performed (especially if the thoracotomy incisions have gone through /obscured any these).

Common Reasons for problems

1. Anterior location of thoracostomies preventing adequate access into the chest cavity.
2. Failure to open the pericardium and identify wounds.
3. Single handed, poor quality cardiac massage.
4. Failure to rapidly manually compress the descending aorta on opening the chest.

Key Points to Success

1. Aim to achieve rapid access into the chest (<1 min from initial skin incision to entering the pericardial sac).
2. Extend the thoracostomy wounds to the posterior axillary line.
3. Two handed cardiac massage.
4. Continuous aortic occlusion against the spinal column.
5. Extend the opening of the pericardium as far cranially as possible.

References and Further Reading

Wise D, Davies G, Coats T *et al*. Emergency Thoracotomy: How to do it. *EMJ* 2005; 22: 22-24.

Aylwyn C, Brohi K, Davies G *et al*. Prehospital and in-hospital thoracostomy: indications and complications. *Ann R Coll Surg Engl* 2008; 90: 54-57.

A practical approach to resuscitative thoracotomy. Rehn M, Davies G, Lockey D. Surgery (Oxford). 2015;33:455-8.

Pre-hospital thoracotomy and the evolution of pre-hospital critical care for victims of trauma. Lockey DJ, Brohi K. Injury. 2017 Sep;48(9):1863-1864.

Cardiac arrest in special circumstances section Collaborators. European Resuscitation Council Guidelines for Resuscitation 2015: Section 4. Cardiac arrest in special circumstances. Truhlář A, Deakin CD, Soar J, Khalifa GE, Alfonzo A, Bierens JJ, Brattebø G, Brugger H, Dunning J, Hunyadi-

Antičević S, Koster RW, Lockey DJ, Lott C, Paal P, Perkins GD, Sandroni C, Thies KC, Zideman DA, Nolan JP; Resuscitation. 2015 Oct;95:148-201.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

On Scene Amputation

Reference Number	CSOP 023
Application	Clinical Staff
Related SOPS	CSOP 009, OSOP 002

Author(s)	Camilla Waugh
Internal reviewer(s)	
External reviewer(s)	
Sign off	COB

Introduction & Objectives

On scene amputation of a limb is a rare but life saving technique that can be used to facilitate extrication and promote a rapid rescue in life threatening circumstances. The decision to amputate should not be taken lightly. The physiological and psychological impact of the procedure plus the potential for immediate and late complications can be catastrophic. The procedure should only be considered when the potential benefits outweigh the risks of the situation

Time Critical vs. Non-Time Critical

Patients who are considered for an amputation will fall into two broad categories. The time critical patient where there is an immediate threat to life and the non-time critical patient where the amputation will be of practical benefit.

The Time Critical Patient

Indication

Amputation is indicated when all of the following criteria are met:

1. The patient is physically trapped by a limb with no immediate possibility of release.
2. The patient must be at immediate risk of death or significant morbidity if they are extricated by conventional and slower rescue techniques. This could either be from physiological deterioration or from an environmental threat.
3. The entrapment is preventing interventions that would prevent death or significant morbidity.
4. There is no option for a rescue maneuver or lesser clinical procedure that damages the limb but avoids amputation.
5. The amputation site will likely be amenable to haemorrhage control measures (i.e. not high junctional)
6. The amputation will significantly speed the rescue process.

Threat Assessment – Physiology

Any physiological deterioration should be causing a severe compromise. This type of patient is rapidly deteriorating and the deterioration cannot be dealt with while the patient is trapped.

Threat Assessment – Environment

Environmental threats may be obvious like fire or drowning but may also be subtle and developing like severe hypothermia or building collapse. These environmental threats may also be a risk the whole team. The safety of the team is a higher priority than the safety of the patient and team evacuation may be the best course of action. Careful communication and co-ordination with rescue services is essential.

Rescue Assessment

Discuss the extrication with the rescue team leader. Ascertain options and realistic time frames for each option. During the discussion the severity of the patients condition must be clearly communicated to the rescue team leader.

Decision to Proceed

Once all threat and rescue information has been obtained, a decision has to be made on the best option. Amputations vs. conventional rescue. This will depend largely on the given time frames for extrication vs. the deterioration / predicted death of the patient.

The decision may be difficult to make and if time permits it should be discussed with top cover. However ultimately the decision to proceed is the decision of the EMRTS consultant on scene and discussion should not delay rescue.

The Non-Time Critical Patient

Indications for amputation for non-time critical patients include the following:

1. The limb has been almost completely amputated but is still attached partly by a residual and ineffective tissue bridge.
2. The entrapped limb is deemed completely unsalvageable and division of non-viable tissue would significantly speed up extrication.
3. Where the limbs of a deceased patient are preventing extrication of another live patient and the amputation is to be performed postmortem to facilitate the rescue.

For points 1 and above care should be taken when forming an opinion on whether a limb is salvageable. Entrapped limbs can be difficult to properly and difficult to assess**.**

Procedure

Preparation

1. Prepare RSI kit dump in anticipation of likely need for anaesthesia following extrication
2. Obtain pre-amputation photographs.
3. If possible place 2 tourniquets proximal to amputation site. These should as distal as possible ideally below elbow or knee if the entrapment mechanism allows.
4. Ensure heamostatic dressings are immediately available.
5. Establish IO or IV access.
6. Give warmed blood products as required (see CSOP 019)
7. Carry out procedural sedation using ketamine (see CSOP 003).
8. Ensure access to sharps containers and maintain sharps safety.
9. If possible clean the surgical site with Chlorhexidine (use Chloraprep sticks)

Amputation

1. Divide the skin circumferentially as distal as possible to preserve viable tissue for a stump.
2. Cut through the subcutaneous tissue and open the fascia of the underlying muscle groups.
3. Identify muscle groups and cut through with scissors.
4. Tie off or clamp longitudinal structures assumed to be blood vessels.
5. Divide bone with a Gigli saw.
6. Examine stump for further obvious blood vessels and tie off.
7. Apply direct pressure with novel haemostatic gauze. Dress with blast bandage.
8. Aim to be complete within 90 seconds.

Post Procedure

1. Extricate to an appropriate area with 360 degree access and reassess.
2. Deal with any time critical pathology as per standard CSOPs.
3. Give broad spectrum antibiotics.
4. Check potassium (EPOC) and treat if raised especially if the limb is crushed.
5. Transport limb with the patient (may be required for tissue grafting or post mortem examination)

Modifications To the Standard Procedure

The standard procedure may need to be modified in the following situations.

Time Critical - Limited Access to Limb

If access to the limb is limited and prevents a full surgical technique, attempt to implement as much of the standard procedure as physically possible. Be prepared for catastrophic haemorrhage if tourniquets cannot be placed. A rescue hacksaw can be used if the environment limits correct use of the Gigli saw (e.g. reaching through a gap with a single hand to saw) This equipment is usually standard kit. This will produce cut of a similar quality to the Gigli saw. The patient will need gentle traction when a hacksaw is used. Be aware of blood splatter from the saw and wear appropriate PPE. After the procedure, perform standard post procedure management including the establishment of haemorrhage control if not already in place.

Time Critical – No Access for Medical Teams

If there is no access for medical teams (fire, rising flood water, chemical contamination) and HART are not immediately available, a reciprocating saw can be used by fire and rescue personnel with near supervision. This technique is rapid and is appropriate to use in immediate environmental threat. Give advice to the rescue personnel about use of a tourniquet and advise to cut as distal as possible avoiding joints. If breathing apparatus is not in use, goggles and FFP3 masks must be used due to aerosolised blood from the device during use. After the procedure the patient should be rapidly extricated to a safe area for medical team management. Perform standard post procedure management. Check the tourniquet position, re-site if necessary and add a second tourniquet.

Time Critical – Limb Underwater

The Holmatro CU 3020 dedicated cutter can be used underwater in environments down to minus 20 degrees C. This may be an option if the entrapped limb is underwater and not accessible for any other medical or non-medical equipment. There may a posterior tissue bridge still present after the procedure, which will need dividing. The device causes more soft tissue injury than the other equipment so should only be used if there are no other options.

Non-Time Critical

The procedure should be appropriately modified depending on the situation.

Where the procedure is carried out post mortem, amputated limbs should be left on scene with the body. The police should be made aware that the procedure has been carried out and this should be documented clearly in the EMRTS documentation.

Disposition

All patients who have undergone an on scene amputation should be taken to a major trauma centre unless clinical or operational factors dictate transfer to a closer trauma unit for safety reasons.

Audit Criteria

All pre-hospital amputations should be discussed at governance day.

References and Further Reading

Prehospital amputation
Porter. K. Emerg Med J 2010; 27: 940-942.

Man or Machine? An experimental study of prehospital emergency amputation
Leech C. Porter. K. Emerg Med J 2016; 33: 641-644

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

MI, ACS and Reperfusion

Reference Number	CSOP 24
Application	EMRTS Doctors and CCPs
Related SOPS	CSOP 026, CSOP 027, CSOP 025a and 025b, CSOP 028, CSOP034

Author(s)	Mark Knights (Previous version Richard Lee)
Internal reviewer(s)	Owen McIntyre
External reviewer(s)	TBC
Sign off	EMRTS Clinical and Operational Board

Short Summary:

Patients with cardiac chest pain or post cardiac arrest:

Whilst obtaining history:

a. Immediate 12 lead ECG
b. Oxygen to keep SaO2 94-98%
c. iv (or io) access (left side if possible)
d. Aspirin 300mg, GTN, analgesia (fentanyl or morphine), ondansetron.

Confirmed STEMI:

1. Refer to PCI. (South Wales → Swansea or Cardiff. North Wales → Glan Clwyd. Mid Wales go to nearest.)
   Need to know:
   a. Background history (including any known IHD or comorbidities).
   b. Age & Demographics.
   c. Timings of: chest pain / symptoms / cardiac arrest / CPR / ROSC / etc.
   d. ECG findings (including any arrhythmias, reciprocal changes, evolving changes).
   e. Thrombolysis.
   f. Patients GCS / neurological state.
   g. Whether patient is intubated & ventilated.
   h. Estimated Time of Arrival.

Bundle Branch Block:

If known to be new Left Bundle Branch Block (ie documented recent normal ECG) treat as STEMI. If not known to be new or in a paced rhythm use Modified Sgarbossa criteria **(See Appendix 3)**

If the patient has significant co-morbidities with functional limitation then they are unlikely to benefit from PCI and should be taken to nearest ED).

Non-STEMI:

There is no agreed process in place so use best judgement:

1. If definite cardiac symptoms and ECG changes discuss with PCI lab and ask their advice.
2. Cardiac arrest patient – if history suggestive of MI take to ED of a hospital that has cardiac angiography capability, otherwise take to nearest ED. (Check Local policies)

En-route considerations:

1. Transport on LUCAS back plate and defib pads attached. Inform ASD if patient arrests.
2. Morphine / fentanyl & GTN infusion for ongoing chest pain.
3. Arterial line left radial (only if this will not delay transport.)

Introduction & Objectives

This guideline covers: ST Elevation Myocardial Infarction (STEMI), and non-ST Elevation Myocardial Infarction/Unstable Angina (NSTEMI/UA). The objectives of this guideline are:

1. To describe immediate management of ACS.
2. To differentiate STEMI from NSTEMI/UA.
3. To describe triage pathways for patients with ACS, including Primary Percutaneous Coronary Intervention.
4. When EMRTS should be tasked. see Appendix 2.

Immediate Management of Suspected Acute Coronary Syndrome

Suspect ACS through standard history with establishment of type of pain and risk factors. Consider other life-threatening causes of chest pain, which include PE and Aortic Dissection. Do not use response to GTN or antacids to make a diagnosis. The following investigations and treatment should be instigated:

1. Perform a 12-lead ECG.
2. Administer oxygen to target SpO_2 of 94-98%.
3. Iv access left side if possible (so that right wrist free for angiography access by cardiologists)
4. Administer GTN
5. Pain relief: fentanyl or morphine. Fentanyl is quicker onset however needs to be titrated carefully.
6. Administer Aspirin 300mg.
7. Caution with anti-emetics (Cyclizine → tachycardia, Ondansetron can prolong QTc & trigger arrhythmia in cases of prolonged QTc)

Management of NSTEMI / patients with non-specific ECG changes but classical symptoms:

These patients do not meet standard criteria for immediate reperfusion therapy. Manage as above. A form of risk assessment is useful to inform decision making. In a prehospital setting this is done qualitatively based on the patient's history, ECG findings, and clinical stability. In essence, patients felt to be at high risk with history strongly suggestive of ACS should be discussed with a PCI centre for consideration of immediate or urgent angiography. Patients at low risk can be transferred to their nearest hospital.

ST Elevation MI/ new-onset LBBB - Management

The National Institute for Clinical Excellence (NICE) has produced relevant guidance on this topic, which has been incorporated into the points below:

1. PPCI is the treatment of choice for reperfusion. The efficacy of this treatment is time dependent. EMRTS can impact positively by providing rapid transfer by air to receiving PPCI centres.
2. Where the ECG shows changes consistent with a diagnosis of STEMI, and symptoms began less than 12 hours ago, immediate transfer to the nearest PPCI centre should be the treatment goal.
3. Such patients presenting with STEMI should arrive at the PCI centre within 60 minutes of recognition.
4. If the MI is diagnosed prior to EMRTS arrival it is usually quicker for WAST to just take by road, however air transfer may be quicker for patients in remote rural communities. Secondary transfer times at the helipad (YGC and Morriston) should be taken into account. EMRTS should still be deployed if the patient requires critical care interventions – **see Appendix 2**.
5. Where patients cannot reach a PCI centre within 60 minutes from the time that thrombolysis could have been given, they should receive pre-hospital thrombolysis and then be transferred to the PPCI centre. (90 minutes for patients going to Glan Clwyd in North Wales). Speak to Cardiologists first. **See Appendix 1.**
6. All patients with cardiogenic shock should be discussed with a PPCI centre.

Referral to a PPCI centre.

The PCI centre will require the following information about a patient:

i. Background history (including any known IHD or comorbidities).
j. Age & Demographics.
k. Timings of: chest pain / symptoms / cardiac arrest / CPR / ROSC / etc.
l. ECG findings (including any arrhythmias, reciprocal changes, evolving changes).
m. Thrombolysis.
n. Patients GCS / neurological state.
o. Whether patient is intubated & ventilated.
p. Estimated Time of Arrival.

Some patients will clearly not benefit from aggressive therapy. Where patients have extreme comorbidity or poor functional status, this should be communicated to the PCI centre. Such comorbidity may include metastatic/advanced cancer with palliative care intent, stroke with severe functional impairment, severe dementia, or severe cardiorespiratory disease. It may then be decided to take these patients to their local hospital following discussion with the PCI centre.

Management *en route* to PCI centre

In addition to the above management the following treatments may be requested by the PCI centre **after discussion with cardiologist.**

1. 2nd line antiplatelet agents (Clopidogrel 600mg OR Prasugrel 60mg OR Ticagelor 180mg).
2. Unfractionated Heparin – 5000U IV.
3. Pre-hospital thrombolysis (PHT) if patient if patient cannot reach PPCI within 60 minutes travel time – see Appendix 1.

In addition:

1. The patient must receive continuous ECG monitoring whilst *en route* to the PCI centre, which must continue during transfer from the ambulance to the Lab.
2. STEMI patients are at acute risk of deterioration and cardiac arrest. Defibrillator pads should be routinely applied prior to transfer. Place the back plate of the automated chest compression device behind the patient during packaging. Have a clear plan rehearsed with the whole team (inc. the pilot).
3. If the patient arrests en route inform ASD. If sustained cardiac arrest it is best in most cases to divert to ED resus. Again pre-alert ED via ASD.
4. Treat arrhythmias – see CSOP 028.
5. Manage cardiogenic pulmonary oedema (consider CPAP) (CSOP 25a) and cardiogenic shock (consider adrenaline infusion or titrate pre-drawn adrenaline) (CSOP 25b).
6. Need for invasive arterial monitoring (e.g. haemodynamic instability and problems obtaining NIBP). A risk/benefit analysis should be carried out to avoid unnecessary delays. If inserting avoid right radial or femoral approach.

Potential Audit Criteria:

- Conscious ACS patients receiving antiplatelet therapy within 20 mins of EMRTS arrival (95%).
- STEMI patients encountered by EMRTS referred to a PPCI centre for treatment (95%).
- Patients where time from diagnosis to PCI >60 minutes receiving pre-hospital thrombolysis.
- STEMI patients accepted for PPCI and transferred by EMRTS who arrive within 2 hours of first contact with medical provider (80%).
- Direct referrals vs. Rescue referrals (post PHT) should be audited.

References and Further Reading

1. Association of Ambulance Chief Executives, UK Ambulance Services Clinical Practice Guidelines 2013. Class Publications Bridgwater 2013.
2. Antiplatelet agents in acute non-ST elevation acute coronary syndromes. In: Up-to-date, Post TW (Ed), Up-to-date, Waltham, MA. (Accessed on November 30th, 2014).
3. Antiplatelet agents in acute ST elevation acute coronary syndromes. In: Up-to-date, Post TW (Ed), Up-to-date, Waltham, MA. (Accessed on November 30th, 2014).
4. Granger CB *et al*. Global registry of acute coronary events. *Arch Int Med* 2003; 163(19): 2345-2353.
5. Life in the fast lane blog on Sgarbossa criteria: https://lifeinthefastlane.com/ecg-library/basics/sgarbossa/

Appendix 1 – Pre-Hospital Thrombolysis (PHT)

Indications for thrombolysis:

- More than 60 minutes travel time to PPCI (this may be from pre-hospital or in some cases in hospital)

- Typical chest pain >20mins within the last 12 hours **and either**

ST elevation >1mm in 2 limb leads or

ST elevation >2mm in 2 chest leads or

New left bundle branch block (patients with pre-existing LBBB but symptoms of ACS should be discussed with the PCI centre) or

Posterior MI – dominant R wave and ST depression V_1-V_3

Absolute contraindications to thrombolysis:

GI bleeding within last 4 weeks
CVA in last 3 months or previous intracranial haemorrhage
Major surgery, trauma or head injury within last 6 weeks
Other known intracranial pathology
Bleeding disorder or active bleeding
Prolonged CPR (>30 minutes)
Sustained hypertension SBP>180 or DBP>120
Aortic dissection
Acute pancreatitis
Cavitating lung disease

Relative contraindications to thrombolysis

Major hepatic or renal disease
Anticoagulant therapy without knowledge of recent INR
Pregnancy, within 6/52 post-partum or menstruation
Non compressible puncture site
Known terminal illness
Recent retinal laser treatment

If BP is only contraindication, treatment with nitrates/opiates/beta-blockade may lower BP to acceptable limits. If in doubt over eligibility for thrombolysis discuss with PCI centre.

Thrombolysis - EMRTS carries – Tenectaplase 50mg (5mg/ml) – 10000U

PATIENT WEIGHT	<60 Kg <9st 6lb	60–69 Kg 9st 6lb–11st	70–79 Kg 11st 1lb-12st 8lb	80–89 Kg 12st 9lb-14st 2lb	>90 Kg >14st 2lb
DOSE	30mg (6000U)	35mg (7000U)	40mg (8000U)	45mg (9000U)	50mg (10000U)
VOLUME	6mls	7mls	8mls	9mls	10mls

Appendix 2 - EMRTS deployment to confirmed MI

You may be asked to provide advice from crew requests to transfer confirmed MI's that have been accepted for PPCI at a cardiac centre. This may come to ASD and the top cover consultant. EMRTS have ability to offer critical care, but also second line antiplatelet agents, rate control and a GTN infusion if needed. However, the service should not delay access to PPCI unless critical care is required. Therefore, careful decision making is required.

The following approach should be undertaken:

1. Confirm that the patient has a clinical history AND ECG consistent with a MI.
2. Determine whether critical care required (i.e. airway management, cardio-respiratory support, post cardiac arrest management even is patient is awake). If patient is unwell then team should go.
3. Determine timescale for travel by road vs. air (including any secondary transfers at either end).
4. Accept the tasking under the following circumstances:
    - If critical care required irrespective of distance.
    - If critical care not immediately required BUT we are going to confer a significant time benefit by transferring the patient.

5. If the patient does not require critical care and air support will significantly increase the time from recognition of MI to PPCI then request that the road crew undertake the transfer of the patient BUT inform the crew that if the patient deteriorates in any way to get back in contact with the ASD.
6. NOTE: target is time of recognition to time of arrival at PPCI centre should ideally be less than 60mins (90 mins for North Wales).

Appendix 3 - Sgarbossa Criteria [5]

- In patients with left bundle branch block (LBBB) or ventricular paced rhythm, infarct diagnosis based on the ECG is difficult.
- The baseline ST segments and T waves tend to be shifted in a discordant direction ("appropriate discordance"), which can mask or mimic acute myocardial infarction.
- However, serial ECGs may show dynamic ST segment changes during ischemia.
- A new LBBB is *always* pathological and can be a sign of myocardial infarction.

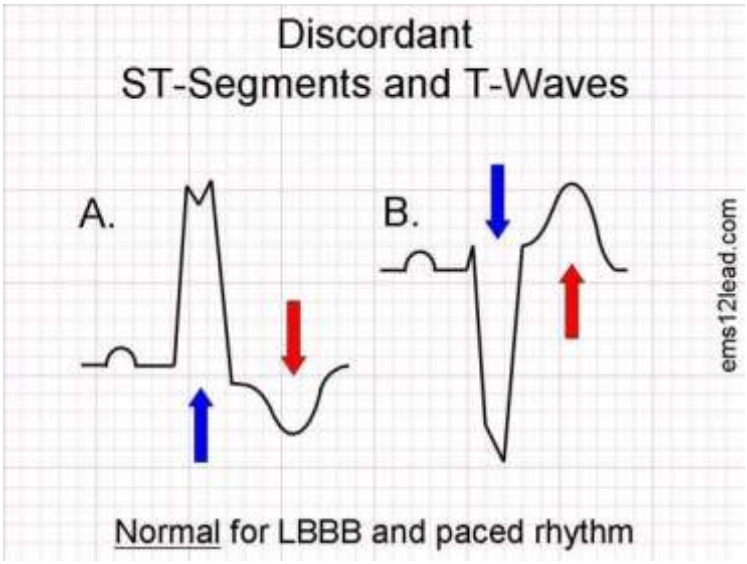


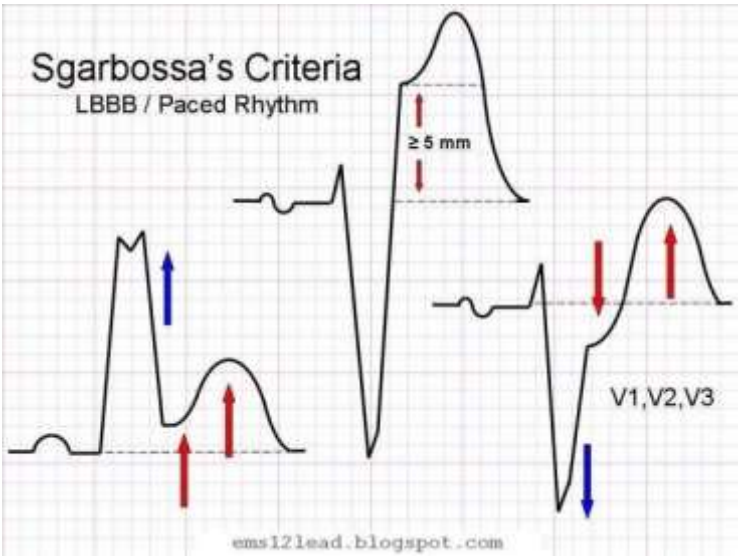
Image reproduced from ECGMedicalTraining.com

Original Sgarbossa Criteria

The original *three criteria* used to diagnose infarction in patients with LBBB are:

- Concordant ST elevation > 1mm in leads with a positive QRS complex (score 5)
- Concordant ST depression > 1 mm in V1-V3 (score 3)
- Excessively discordant ST elevation > 5 mm in leads with a -ve QRS complex (score 2).

These criteria are specific, but not sensitive for myocardial infarction. A total score of ≥ 3 is reported to have a specificity of 90% for diagnosing myocardial infarction.



Modified Sgarbossa Criteria:

- ≥ 1 lead with ≥1 mm of concordant ST elevation
- ≥ 1 lead of V1-V3 with ≥ 1 mm of concordant ST depression
- ≥ 1 lead anywhere with ≥ 1 mm STE and proportionally excessive discordant STE, as defined by ≥ 25% of the depth of the preceding S-wave.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Cardiogenic Pulmonary Oedema

Reference Number	CSOP 025a
Application	EMRTS Doctors and CCPs
Related SOPS	CSOP 034, CSOP 024, CSOP 025b

Author(s)	Owen McIntyre
Internal reviewer (current version)	
Sign off	COB

Introduction & Objectives

Cardiogenic Pulmonary Oedema is a life-threatening diagnosis, but one which is amenable to emergency medical treatment. The purpose of this CSOP is to:

1. Outline indications for transfer in patients with acute pulmonary oedema.
2. Describe treatments for such patients.

Patients appropriate for EMRTS deployment

Patients are likely to benefit from EMRTS involvement where:

1. Their condition has not responded to standard measures in the place of referral.
   - This is most likely to be in a hospital.
2. However, 999 crews may request EMRTS team, or an EMRTS response may be triggered as part of immediate or interrogated dispatch criteria.
3. Escalation of therapy is appropriate.
4. A specific therapy can be offered elsewhere.

EMRTS management (if not already initiated by a referring hospital or land crew)

Institution of the following measures will depend on the clinical context, but may include:

1. Reassure patient.
2. Sit patient up if possible. Patients may feel more comfortable with legs hanging over the edge of the bed. If there is a plan to transfer by air with patient sitting up, this must be discussed with the pilot. It may not be possible to have the patient sitting during take-off and landing. Road transfer may be considered here.
3. High flow oxygen.
4. Intravenous access.
5. Continuous ECG monitoring and pulse oximetry.
6. ECG and CXR.
7. Sublingual or buccal nitrates.
8. Frusemide 50mg IV (or double usual dose if on diuretics usually). May need to repeat after 1 hour.
9. Urinary catheterisation (if retrieval tasking, may be delegated to skilled HCP).
10. GTN Infusion – 50mg in 50ml, start at 1ml/hr and escalate rapidly (e.g. double every 5 mins – SBP target 100mmHg). Caution if patient known to have fixed cardiac output (e.g. aortic stenosis).
11. Opioids carefully titrated to alleviate respiratory distress.
12. CPAP: 10cmH20 if BP tolerates and patient is cooperative. Consider Non-Invasive Ventilation if elevated CO_2.
13. Consider arterial line in all patients for retrieval taskings. Avoid right radial if PCI a possibility.
14. Focused echocardiography if clinician can perform.
15. RSI. As a very last resort. Better to use NIV if tolerated
16. Coronary revascularisation. See Acute Coronary Syndrome SOP.

Note on RSI

1. Use stable induction agents and reduce dose.
2. Five minutes prior to RSI give a fluid bolus (e.g. 250ml crystalloid) and stop nitrates.
3. If patient hypotensive, start inotropic support (see inotropes SOP). Be aware that pure vasoconstriction can make the situation worse. If in hospital consider central line if inotropes needed. Peripheral metaraminol or noradrenaline/adrenaline infusions can used.

Hypotensive patients in this context have a very poor prognosis Transfer to hospital as soon as possible. If undertaking a secondary transfer attempt to assess comorbidities and ascertain patient wishes before committing to transfer. Ensure destination ICU have been involved in decision.

Disposition of patient

Patients should be assessed for potential PCI. If this is not indicated, then transfer to a hospital with cardiology support and ICU facilities.

References and Further Reading

Emergency Medical Retrieval Service. Pulmonary Oedema: Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. Accessed 1/12/2014.

National Institute for Health and Care Excellence. Acute heart failure: diagnosis and management. Available at http://nice.org.uk/guidance/cg187 Accessed 25/9/2017

2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC). Available at https://www.escardio.org/Guidelines/Clinical-Practice-Guidelines/Acute-and-Chronic-Heart-Failure Accessed 25/9/17

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Cardiogenic Shock

Reference Number	CSOP 025b
Application	EMRTS Doctors and CCPs
Related SOPS	CSOP 034, CSOP 024, CSOP 025a

Author	Own McIntyre
Internal reviewer	David Lockey
Sign off	COB

Introduction & Objectives

Cardiogenic shock is a life-threatening diagnosis, but one which may be amenable to emergency medical treatment. The purpose of this CSOP is to:

1. Outline indications for transfer in patients with cardiogenic shock.
2. Describe treatments for such patients.

Patients appropriate for EMRTS deployment

Patients are likely to benefit from EMRTS involvement where:

1. Their condition has not responded to standard measures in the place of referral.
   - This is most likely to be in a hospital.
   - However, 999 crews may request EMRTS team, or an EMRTS response may be triggered as part of immediate or interrogated dispatch criteria – see OSOP 008.
2. Escalation of therapy is appropriate.
3. A specific therapy can be offered elsewhere.

The mortality of cardiogenic shock has been reported as 60 to 90 percent. Decision to mobilise should thus be based on a realistic assessment of the patient's prognosis and likely response to treatment. Known predictors of 30-day survival for patients with cardiogenic shock complicating STEMI are:

1. Increasing age (OR 1.5 for each decade).
2. Prior MI.
3. Physical findings at diagnosis (e.g. reduced GCS, poor peripheral perfusion).
4. Oliguria.

(Source: GUSTO-1 Database)

Diagnostic Considerations

Acute cardiogenic shock most commonly occurs in the context of acute myocardial infarction. Other causes of the shock state should be considered, including:

1. 'Non-Cardiogenic': hypovolaemia, sepsis.
2. Arrythmias.
3. Mechanical or obstructive: pulmonary embolism, pericardial tamponade, tension pneumothorax, acute valvular dysfunction (e.g. secondary to valve rupture or to aortic dissection), ventricular rupture.

The prognosis of some the above conditions are much better than that of 'pure' pump failure, partly because specific therapies are available. They should not be missed. USS can be used to determine the cause of undifferentiated shock in conjunction with clinical assessment and available investigations.

EMRTS management (if not already initiated by a referring hospital or land crew)

Institution of the following measures will depend on the clinical context, but may include:

1. Oxygen.
2. Intravenous access.
3. Continuous ECG monitoring and pulse oximetry.
4. ECG and CXR.
5. Urinary Catheterisation (if in hospital prior to secondary transfer)
6. Optimisation of intravascular volume (e.g. cautious fluid challenge [100-250ml]).
7. Pharmacological support. See Inotropic Support SOP. Be aware that pure vasoconstriction may make the situation worse.
8. Coronary revascularisation. See Acute Coronary Syndrome SOP.
9. Consider arterial line in all patients (if in hospital prior to secondary transfer). Avoid right radial if PCI a possibility.
10. Focused echocardiography if clinician can perform.
11. Ventilatory Support including Non-Invasive Ventilation or RSI.

Note on RSI

1. Use stable induction agents and reduce dose.
2. Five minutes prior to RSI give a fluid bolus (e.g. 250ml crystalloid).
3. Start inotropic support (see CSOP inotropic support).

Hypotensive patients in this context have a very poor prognosis. For primary jobs transfer to ED as soon as possible. For transfers attempt to assess comorbidities and ascertain patient wishes before committing to transfer. Ensure destination ICU consultant has been involved in decision.

Disposition of patient

Patients should be assessed for potential PCI. If this is not indicated, then transfer to a hospital with cardiology support and ICU facilities and ideally balloon pump facilities.

Summary

The prognosis of cardiogenic shock in the absence of emergency revascularisation is poor. EMRTS priorities should be:

1. Ensure that the diagnosis is secure.
2. Identify patients suitable for PCI.
3. Identify patients who should not be transferred. Obtain opinions from the destination ITU consultant and the EMRTS top cover consultant if required.
4. Provide vasopressor/inotropic support.
5. Provide ventilatory support.

References and Further Reading

Emergency Medical Retrieval Service. Cardiogenic Pulmonary Oedema. Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. Accessed 1/12/2014.

Gaieski D. Shock in adults: Types, presentation and diagnostic approach. In: Uptodate, Post TW (Ed), Uptodate, Waltham, MA. (Accessed on 26th Dec 2014.)

Hasdai D, Holmes DR Jr, Califf RM *et al*. Cardiogenic shock complicating acute myocardial infarction: predictors of death. GUSTO Investigators. Global Utilization of Streptokinase and Tissue-Plasminogen Activator for Occluded Coronary Arteries. *Am Heart J* 1999; 138 (1): 21.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Medical Adult Cardiac Arrest

Reference Number	CSOP 026
Application	EMRTS Doctors and CCPs
Related SOPS	CSOP 004, CSOP 027, CSOP 028, OSOP 060

Author(s)	Dindi Gill
Internal reviewer(s)	David Lockey
External reviewer(s)	
Sign off	EMRTS Clinical and Operational Board

Introduction & Objectives

The functional outcome from medical cardiac arrest is improving through getting the basics right (i.e. early recognition, good quality CPR, early defibrillation and post resuscitation care). This is a common group of patients that the EMRTS attends. In summary the team is able to deliver the following:

1. Support the Emergency Services at cardiac arrests using ERC Guidelines.
2. Provide advanced equipment, skills and decision making to enhance the chances of return of spontaneous circulation (ROSC) and survival.
3. Recognition of Life Extinct (ROLE) outside JRCALC criteria thus avoiding an unnecessary transfer to hospital.
4. Provide recorded advice over the phone from crews requesting support – usually through the 'top cover' consultant.
5. Advanced post ROSC management and definitive triage – see CSOP 027.

This SOP should be read in conjunction with current JRCALC and ERC Guidelines. See algorithm in Appendix below. For all patients in established cardiac arrest EMRTS should carry a defibrillator/pacer and automated chest compression device to the scene.

Support the Emergencies Services at Cardiac Arrests

There are two possible scenarios that may arise here:

EMRTS team are first on scene or present at a witnessed arrest (rare):

- Confirm cardiac arrest. One operator to start uninterrupted chest compressions and BVM ventilation whilst the other applies defib pads to the patient. Check for rhythm and manage as per ALS guidelines. There should be no greater than 5 seconds off the chest to perform procedures.

- Request for a priority back up (preferably an Emergency Ambulance) if not already on route.

- Free one operator up by placing patient on automated chest compression device.

- Once able to prepare to intubate the patient and secure IV/IO access. Treat as per ALS guidelines.

EMRTS team arrive whilst Emergency Services already carrying out BLS/ALS (more likely):

- Prior to arrival request that ASD CCP or TCC give advice as stated in OSOP 060.

- Allocate roles prior to arrival on scene.

- Team to introduce themselves and take a brief handover from the team leader. It is essential that the team augment the resuscitation that has already started rather than take over the resuscitation.

- Confirm cardiac arrest and offer to take over CPR at the start of the next cycle whilst the other team member applies automated chest compression device. If not available check quality of CPR being performed and ensure personnel rotate through this role on each 2 minute cycle. Minimise interruptions and time off the chest.

- If TT/Supraglottic airway already inserted - check position by attaching waveform $ETCO_2$, look for chest wall movements and ausculate the chest. For an TT the length at the teeth should be noted (approx. 22cm in adult males and 20cm in adult females). For a Supraglottic airway check for a significant leak. $ETCO_2$ is mandatory in cardiac arrests for the above reason and also as an indirect marker of cardiac output. Patients with a ROSC will usually demonstrate a sudden increase in $ETCO_2$. Equally a persistently low $ETCO_2$ in presence of effective chest compressions can indicate a poor prognosis in medical arrests.

- Check the rate and timing of ventilations – 8-12 breaths per minute is sufficient. It is important to time ventilations with the recoil of the chest to avoid excessive ventilation pressures and impedance. Check that sufficient oxygen is available. Do not hyperventilate patient as this further reduces venous return to the heart.

- Secure IV/IO access (if not already placed) and administer drugs as per ALS protocols.

- Identify and treat potentially reversible causes (see below).

- Conduct an early physical examination and discussion with relatives/friends (if present) to establish events preceding arrest and past medical history (once full ALS underway). Offer relatives/family to be present at the resuscitation if they wish to be.

Provide Advanced Equipment, Skills and Decision Making

Airway and Ventilation

If a Supraglottic airway has already been inserted and the patient has adequate ventilation continue to use the device and ventilate at 8-12 breaths per minute. If the airway is unprotected then the EMRTS team

should proceed to intubation using the immediate RSI checklist. Frequently intubation is carried out on the floor and the view can be optimised by placing a blanket/pillow under patients head, or considering other operator positions (e.g. lying prone). Have suction readily to hand and always confirm TT position using wave form $ETCO_2$. Secure TT with a Thomas tube holder at the appropriate length.

In some instances the patient may still be breathing and/or have an intact gag reflex whilst in cardiac arrest making it difficult to intubate the patient. Intubation can be facilitated by giving a small dose of midazolam (e.g. 1mg as awareness is usually negligible) and rocuronium 50mg. The patient may take some time to relax due to poor perfusion. An RSI checklist and audit form must be completed in this context.

Potentially Reversible Causes

Reversible cause	Investigation and Treatment
Hypoxia	As above
Hypovolaemia	USS to exclude AAA Fluids and Blood Products (if bleeding)
Hyperkalaemia/Hypoglycaemia	Check K+ on blood gas – treat with 10ml 10% Calcium Chloride and 50ml 8.4% Sodium Bicarbonate if thought to be cause of arrest Check blood glucose – if low correct with 10% dextrose
Hypothermia	See CSOP 040
Tension pneumothorax	Clinical assessment and Transthoracic USS – finger thoracostomies should be performed (especially in an asthmatic arrest)
Tamponade	Subxiphoid USS and treat as appropriate
Toxic substances (including suspected)	TCA overdose - 50ml 8.4% Sodium Bicarbonate Calcium channel blocker overdose - 10ml 10% Calcium Chloride and Glucagon (repeated doses will be required)
Thromboembolism	Suspected PE (history, examination AND echo findings – RV hypokinesia, RV larger than LV and IVC dilatation with little collapse) – consider thrombolysis with Tenectaplase, be prepared for protracted CPR (see dosing regime) Suspected MI (history and pre-arrest ECG) – consider transfer in cardiac arrest to PPCI vs. thrombolysis on scene and onward transfer. Discussion with cardiology warranted here

Refractory/Persistent VF/VT

Administer amiodarone (300mg) after the third shock (post adrenaline). A further dose of 150mg may be given if the patient remains in VF/VT after the 5th shock. At this stage give magnesium intravenous dose of 2g (4 ml of 50% magnesium sulphate). Consider alternative pad positioning (e.g. anterior/posterior).

A subgroup of patients who are difficult to define may benefit from PPCI whilst in established cardiac arrest. This includes patients who are in refractory VF/VT caused by a suspected MI. Some of these patients may have had preceding chest pain and/or an ECG demonstrating ST elevation. A decision to transfer the patient in established cardiac arrest direct to a PCI centre vs thrombolysis then transfer requires careful coordination and early discussion with cardiology.

At UHW go direct to the cath lab following an intubated STEMI call response. Important to state that anaesthetic support will be required. At Morriston Hospital and Glan Clwyd Hospital take the patient to ED,

but at time of pre-alert ensure ED contact cardiology registrar to ask them to be available in resus at the time of patient arrival.

Effective CPR during transfer can be achieved through application of an automated chest compression device.

Blood gas analysis

To check for reversible causes (as stated above)

Ultrasound

As described above the EMRTS will be able to use focused Ultrasound to diagnose the cause of cardiac arrest (e.g. PE, hypovolaemia, pneumothorax, AAA etc). For focused echocardiography the integration of ultrasound into ALS should only be performed if interruptions to chest compressions are minimised. A sub-xiphoid probe position has been recommended. Placement of the probe just before chest compressions are paused for a planned rhythm assessment enables a well-trained operator to obtain views within 10 seconds. It is recommended that clinicians have undertaken 'Focussed Echocardiography in Emergency Life Support' (FEEL) accreditation and / or level one ultrasound accreditation if they are using echocardiography to guide therapy.

Recognition of Life Extinct (ROLE) outside JRCALC Criteria

As EMRTS is able to deliver advanced skills and decision making the team will be able to support Emergency Services recognise life extinct outside JRCALC criteria thus avoiding unnecessary transport to hospital under emergency conditions. For patients who would otherwise arrive dead at hospital this provides an opportunity for this process to occur in a more dignified manner. It is also an ideal opportunity for training and education whilst developing a good working relationship with road crews. In the vast majority of cases this must be done with the EMRTS team being tasked to the arrest and excellent communication with the patient's relatives/friends. See Death On Scene OSOP 028.

In-flight Cardiac Arrest Management

It is very rare for the EMRTS team to transfer a patient in established cardiac arrest as the team is able to deliver the skills and decision making that would normally occur in the ED at the scene. In addition any possibility of impending cardiac arrest prior to transfer should be considered and road transfer used instead. However in the event that this does happen and/or air transfer is necessary the following should occur:

1. Ensure automated chest compression device fitted prior to transfer if patient already unconscious. Manual CPR is ineffective during transfer. The pilot must be informed if CPR (manual or automated) is commenced.
2. Defibrillator pads attached pre-transfer. Inform pilot of situation prior to defibrillation.
3. Insert Supraglottic airway with airway pack readily accessible in flight and confirm effective ventilations with waveform $ETCO_2$.
4. Follow standard ALS guidance.
5. Update receiving unit of patient's condition prior to arrival and go to the ED as the default.

References and Further Reading

Joint Royal Colleges Ambulance Liaison Committee (JRCALC) - Cardiac Supplement 2010.

Resuscitation Council: Advanced Life Support (Edition 6). London: Resuscitation Council (UK), 2010.

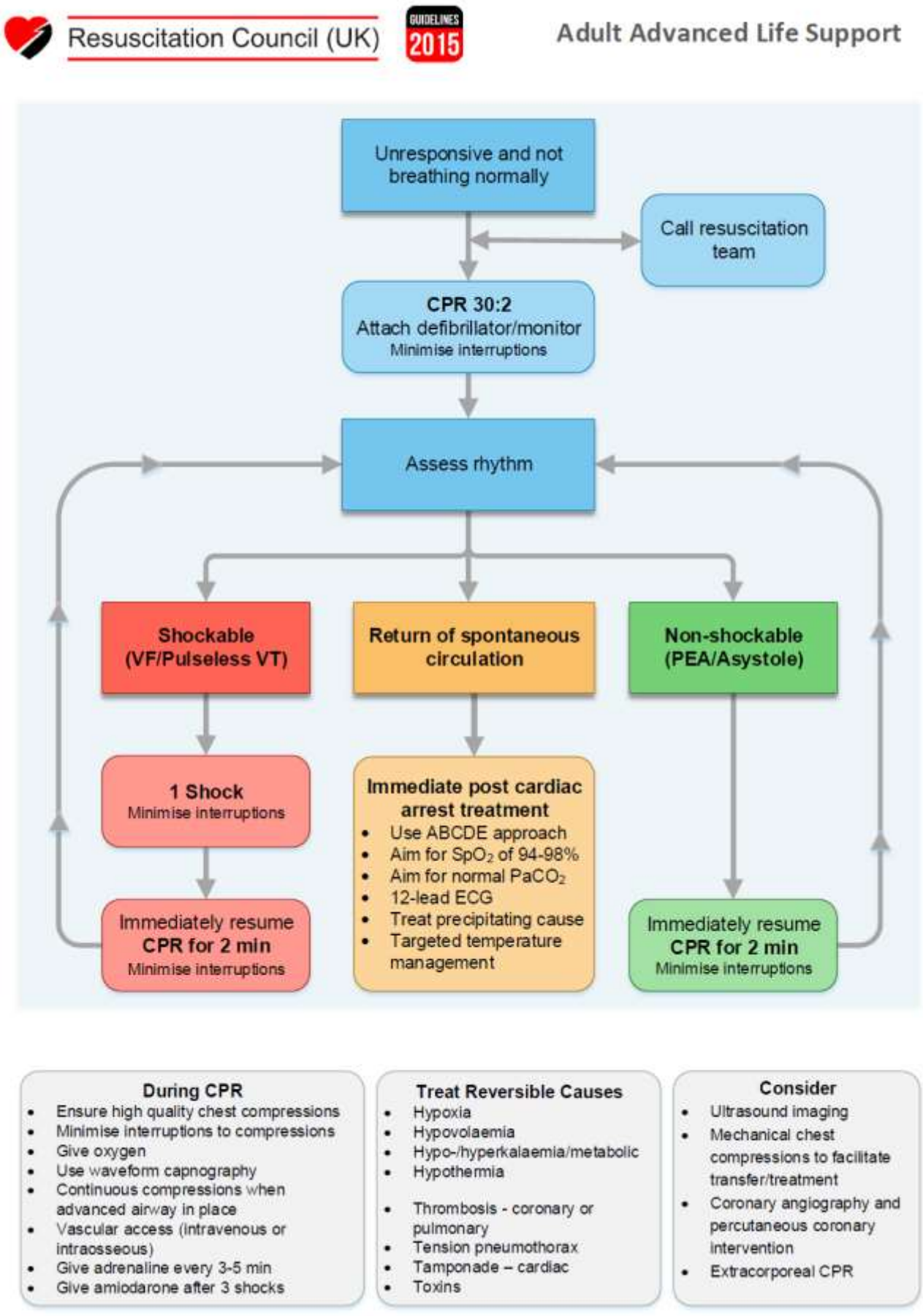
Rubertsson S, Lindgren E, Smekal D et al. Mechanical chest compressions and simultaneous defibrillation vs. conventional cardiopulmonary resuscitation in out-of-hospital cardiac arrest: the LINC randomized trial. JAMA 2014; 311(1): 53-61.

Bottinger BW, Arntz HR, Chamberlain DA et al. Thrombolysis during cardiac arrest. NEJM 2008; 359: 2651-2662.

Clayton BJ, Gribbin GM. PPCI for Refractory Cardiac Arrest. Ann Emerg Med 2013; 64(2): 192-194.

Breitreutz R, Price S, Steiger HV *et al*. Focused echocardiographic evaluation in life support and peri-resuscitation of emergency patients: a prospective trial. *Resuscitation* 2010: 81(11): 1527-1533.

Appendix 1 - Advanced Life Support Algorithm (Resuscitation Council, 2015)



Appendix 2 – Pre-Hospital Thrombolysis (PHT) for PE/MI

EMRTS carries – Tenectaplase 50mg (5mg/ml) – 10000U

PATIENT WEIGHT	<60 Kg <9st 6lb	60–69 Kg 9st 6lb–11st	70–79 Kg 11st 1lb-12st 8lb	80–89 Kg 12st 9lb-14st 2lb	>90 Kg >14st 2lb
DOSE	30mg (6000U)	35mg (7000U)	40mg (8000U)	45mg (9000U)	50mg (10000U)
VOLUME	6mls	7mls	8mls	9mls	10mls

Acknowledgements to EMRS Scotland

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Post Cardiac Arrest Management

Reference Number	CSOP 027
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 001, CSOP 002, CSOP 024, CSOP 026, CSOP 028

Author(s)	Jonathan Whelan
Internal reviewer(s)	Pete Williams
External reviewer(s)	
Sign off	EMRTS Clinical and Operational Board

Introduction & Objectives

The EMRTS has a key role to play in the critical care management of patients following cardiac arrest who have a return of spontaneous circulation (ROSC). This is relevant both in the pre-hospital environment and for time critical transfers. For patients in cardiac arrest please see CSOP 026. Post cardiac arrest patients represent a heterogenous group and deciding which group will benefit from specialist interventions is challenging. Therefore the EMRTS is able to provide senior decision making to ensure appropriate disposition of patients.

The Post Cardiac Arrest Syndrome:

Post cardiac arrest syndrome outlines a spectrum of organ dysfunction following ROSC. Its key features are:

1. Brain injury.
2. Myocardial Dysfunction.
3. Systemic reperfusion injury ("SIRS").
4. Precipitating pathology.

Several interventions have been shown to improve survival and neurological outcome by targeting/attenuating the above features.

Key critical care interventions

1. Airway protection and ventilation.
2. Controlled oxygenation and ventilation.

3. Haemodynamic stabilisation/optimisation.
4. Targeted Temperature management (TTM). The key here is to avoid hyperthermia.
5. Control of seizures.
6. Avoidance of hypoglycaemia.
7. Prompt management of the precipitating pathology.

This CSOP outlines the management of this patient group in 2 separate scenarios:

1. Critical care interventions and decision making for post cardiac arrest patients in the pre-hospital environment.
2. Critical care interventions and decision making for patients undergoing time critical transfer to another hospital for specialist intervention or investigation.

Pre-hospital

Prior to arrival request that ASD CCP or TCC give advice as stated in OSOP 060 if ROSC already achieved.

INTERVENTIONS	
AIRWAY	Secure definitive airway if low GCS, not obeying motor commands combative/agitated or persistent hypoxia/haemodynamic instability. Change Supraglottic airway for an TT. In both circumstances an RSI may be required. Do not attempt intubation without drugs if GCS>3.
BREATHING	Initiate controlled mechanical ventilation. Aim to titrate FiO_2 to achieve SpO_2 >94% (PaO_2 >10kPa) avoiding hyperoxia. Aim for $ETCO_2$ 3.0 – 4.5kPa ($PaCO_2$ is normally 1-1.5 kPa above $ETCO_2$). Blood gas analysis should be carried out provided that it doesn't delay transfer. Auscultate chest and ensure no evidence of pneumothorax from CPR. Use Transthoracic USS if concern on clinical assessment. Switch to EMRTS monitoring.

INTERVENTIONS	
CIRCULATION	Switch to EMRTS monitoring including defib pads. Set NIBP to 3 minute cycles. Aim for MAP>65mmHg using 250ml boluses of fluid. May require boluses adrenaline 10mcg/ml for short transfers to hospital. Otherwise peripheral metaraminol infusion. Obtain 12 lead ECG. Correct arrhythmias as per CSOP 028.

DISABILITY	Document best GCS prior to sedation and muscle relaxation, pupil responses and any focal neurology. Maintain anaesthesia as per emergency anaesthesia SOP. Ensure adequate muscle relaxation with rocuronium (may be given via IO route if IV access cannot be established) If hypoglycaemic correct with 10% dextrose. Head up 20 degrees and ensure Thomas tube holder is not tight.
EXPOSURE	Insert oesophageal temperature probe and record core temperature *en route* and on arrival at hospital. For patients with a core temperature >36 degrees: Avoid hyperthermia. - The EMRTS does not carry cold fluids as this modality is impractical in the pre-hospital environment. - In winter most patients cool down without the above interventions. For patients with a core temperature of 33-36 degrees: - No requirement to institute cooling.
OTHERS	In patients over 65yrs who have had a concurrent head injury selectively immobilise C-spine due to risk of occult cervical spine injuries. Leave automated chest compression device in place during transfer. In transferring patient by air ensure defib pads are left in place and inform pilot that patient may require defibrillation in flight.

Time critical transfers

Largely speaking the approach will be similar to the above, with the following additional considerations:

1. Blood gas analysis should be carried to target normocapnia.
2. If central line already inserted and MAP<65mmHg consider IV fluids and centrally administered vasopressors/inotropes (see CSOP 034). Always check correct positioning of line on CXR before use.
3. Consider placement of an arterial line. If inserting place preferentially in left wrist/groin (right side conventionally used for angiography).
4. Consider thrombolytic if suspicion of a MI is high.
5. Maintenance of sedation using a propofol infusion – bolus sedation not acceptable.
6. Control seizures with sedation. Patient may require anticonvulsant loading if persistent.

Otherwise follow the approach to time critical adult transfers – CSOP 002.

Disposition of patient

As discussed above post cardiac arrest patients represent a heterogenous group of patients and this makes it challenging to determine which group will most benefit from specialist care. By far the commonest

aetiology for cardiac arrests is cardiac pathology, so it is essential that those patients who will most benefit from specialist cardiac management are taken directly to cardiac centres.

Disposition will largely depend upon the receiving hospital:

<table>
<tr><th>UHW</th><th>MORRISTON</th><th>GLAN CLWYD HOSPITAL</th></tr>
<tr><td>Direct to the cath lab:

ST elevation on ECG

Direct to the cath lab on a case by case basis:

Preceding cardiac chest pain prior to arrest

VF/VT as the presenting rhythm

Cardiovascular instability post-ROSC and suspected cardiac cause

Bleep 5770 or call 02920 744343, state that this is an ‘intubated STEMI call,’ ask to speak to cardiology registrar/consultant and request anaesthetic support on arrival in cath lab, give accurate ETA for arrival in cath lab

All other post arrest patients to ED inc. LBBB on ECG</td><td>Direct to the cath lab

ST elevation on ECG

Contact CCU on 01792 703920 and state that this is an ‘intubated STEMI call,’ ask to speak to cardiology registrar/consultant and request anaesthetic support on arrival in cath lab, give accurate ETA, give accurate ETA for arrival in cath lab

To the ED and request availability of cardiology registrar:

LBBB on ECG

Preceding cardiac chest pain prior to arrest.

VF/VT as the presenting rhythm.

Cardiovascular instability post-ROSC.</td><td>All patients to the ED

ALL OTHER CARDIAC CENTRES

Discuss with cardiology via the numbers given in OSOP 24</td></tr>
</table>

The decision to transfer direct to the cath lab should be balanced against a number of other factors (inc. age and co morbid status). If doubt exists then a discussion with ‘top cover’ and/or cardiology will be warranted.

All other patients who achieve a ROSC should be transferred to their local hospital with an ICU (inc. suspected neurological insults). However the standard of critical care should be maintained as indicated above.

References and Further Reading

Nolan JL, Welch CA. Outcome following admission to UK intensive care units after cardiac arrest: a secondary analysis of the ICNARC Case Mix Programme Database. *Anaesthesia* 2007; 62: 1207-1216.

Intensive Care Society. Standards for the Management of Patients after Cardiac Arrest, 2008. http://www.ics.ac.uk/intensive_care_professional/standards_and_guidelines/standards_for_the_management_of_patients_after_cardiac_arrest_2008.pdf.

Resuscitation Guidelines – Resuscitation Council 2010. Chapter 7 Adult Advanced Life Support. http://www.resus.org.uk/pages/als.pdf.

Pell JP, Sirel JM, Marsden AK *et al*. Presentation, management, and outcome of out of hospital cardiopulmonary arrest: comparison by underlying aetiology. *Heart* 2003 89: 839-42.

Spaulding CM, Joly LM, Rosenberg A *et al*. Immediate coronary angiography in survivors of out-of-hospital cardiac arrest. *NEJM* 1997; 336: 1629-33.

Bendz B, Eritsland J, Nakstad AR *et al*. Long-term prognosis after out-hospital cardiac arrest and primary percutaneous coronary intervention. *Resuscitation* 2004; 63: 49-53.

O'Connor RE, Bossaert L, Arntz HR et al. Part 9: Acute Coronary Syndromes. 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations, 2009.
Resuscitation 81S e175-e212 http://www.resuscitationjournal.com/article/S0300-9572(10)00465-X/fulltext#sec0900

Nolan JP, Neumar RW, Adrie C *et al*. Post-cardiac arrest syndrome: epidemiology, path physiology, 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 Anaesthesia; the Council on Cardiopulmonary, Perioperative and Critical Care; the Council on Clinical Cardiology; the Council on Stroke. *Resuscitation* 2008; 79: 350-79

Perkins, G. D., Olasveengen, T. M., Maconochie, I., Soar, J., Wyllie, J., Greif, R., … Nolan, J. P. (2018). European Resuscitation Council Guidelines for Resuscitation: 2017 update. Resuscitation, 123, 43–50. https://doi.org/10.1016/j.resuscitation.2017.12.007

Hypothermia after Cardiac Arrest Study Group. Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest. *NEJM* 2002; 346: 549-56.

Bernard SA, Gray TW, Buist MD *et al*. Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia. *NEJM* 2002; 346: 557-63.

Nielsen N, Wetterslev J, Cronberg T *et al*. Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest. *NEJM* 2013. DOI:10.1056/NEJMoa1310519

ILCOR update: Targeted Temperature Management following cardiac arrest (2013).

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Arrhythmias and Transcutaneous Pacing

Reference Number	CSOP 028
Application	EMRTS Doctors and CCPs
Related SOPS	CSOP 024, CSOP 027

Author(s)	Hefin Llewellyn, John Glen, Amna Idries, Owen McIntyre
Internal reviewer	David Lockey
Sign off	COB

Introduction & Objectives

EMRTS may encounter patients with life-threatening cardiac arrhythmias in a variety of contexts. The purpose of this document is to outline an approach to arrhythmias in adult patients, based on ALS principles.

Bradycardia

Basic Principles

If the patient is compromised (low BP, reduced conscious level, chest pain) the priority for EMRTS will be to achieve an acceptable heart rate, while arranging for transfer to definitive care (e.g. cardiology unit for temporary or permanent pacing). Consider Acute Coronary Syndrome (ACS) in the differential, and follow the relevant SOP.

- Ensure basic ALS, including oxygen, iv access and monitoring.
- Address any underlying issues if possible:
    - Check potassium on blood gas. Treat hyperkalaemia (Calcium Chloride, Insulin/Dextrose, consider Salbutamol nebs/Bicarbonate).
    - Consider toxic ingestion. In particular, Calcium Channel Blocker toxicity may respond to Glucagon and Calcium.
    - Acute Coronary Syndrome (ACS).
- Use drugs: atropine up to 3mg; adrenaline as per Inotropic Support SOP.
- Obtain 12 lead ECG to exclude ACS.
- If travelling by air, ensure pilot is aware of potential for defib/pacing.
- Attach to defibrillator: position pads anteroposteriorly. Ensure good contact (dry skin, excess hair removed). Patient will also need to be attached to 3-lead ECG electrodes.

If patient has improved with initial treatment, set the machine to deliver standby pacing. Otherwise set to deliver fixed or demand pacing.

Pacing Setup

(See Equipment SOP for more detail).

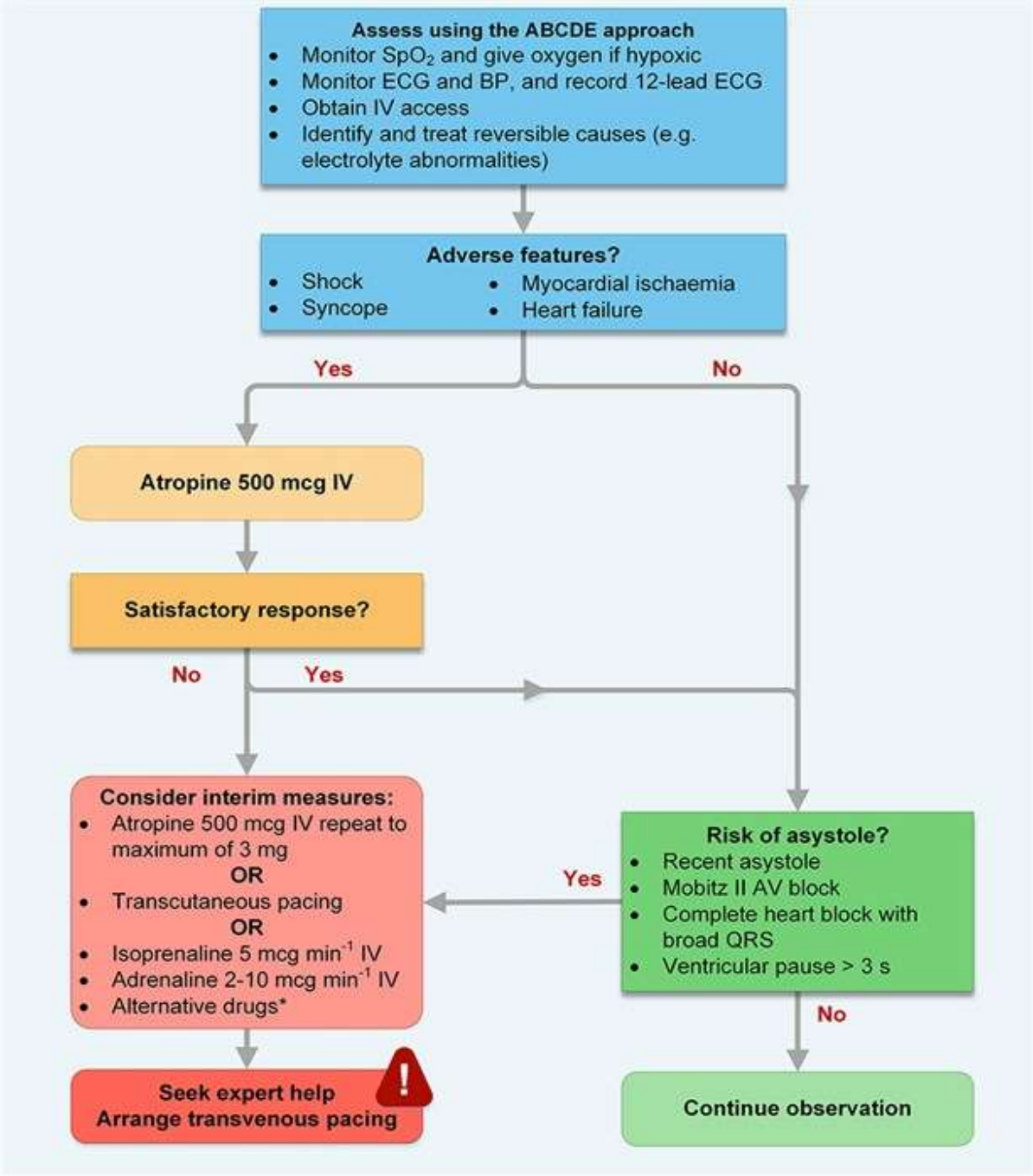
- Connect ECG cable and therapy pads to patient. Attach pads anteroposteriorly.
- Activate pacing module.
- Observe ECG rhythm. Confirm that a marker appears at each QRS complex, and not elsewhere. You may have to choose a different lead, move ECG position, or adjust ECG size. If the pacer cannot detect QRS reliably, use non-demand/fixed pacing.
- Select appropriate pacing rate.
- Select appropriate current.
    - If patient unconscious, start with a high current, work down until you lose capture, then go over by 10mA.

- If patient awake, start with a low current, work up to current capture threshold and then go over by 10mA.

- Start pacer and ensure mechanical capture.

- An awake patient will probably require small doses of sedation/analgesia to tolerate (See analgesia and procedural sedation CSOP 003).

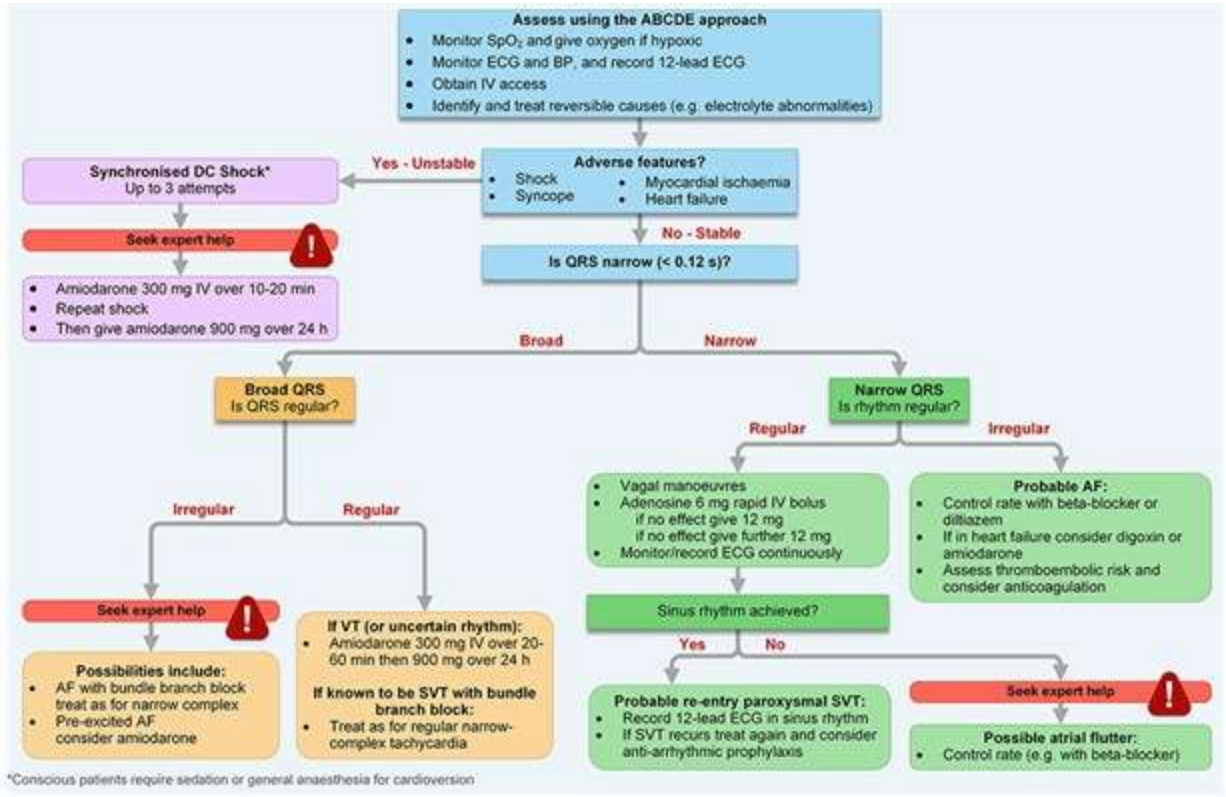
2015 Resuscitation Council Bradycardia Algorithm



*** Alternatives include:**
- Aminophylline
- Dopamine
- Glucagon (if bradycardia is caused by beta-blocker or calcium channel blocker)
- Glycopyrrolate (may be used instead of atropine)

Tachycardia

2015 Resuscitation Council Tachycardia Algorithm



Notes:

- Have a low threshold for sedation + synchronised DC shock particularly in patients with haemodynamic compromise. This will minimise time on scene, and reduces risk of deterioration during transport (see analgesia and procedural sedation CSOP 003). Aim for "conscious sedation" for amnesic purposes. The EMRTS team must be prepared for intubation with any patient sedated without airway protection. If patient intubated also ensure adequate anaesthesia.
- Addressing electrolyte abnormalities and giving Magnesium and Amiodarone will maximise chances of staying in sinus rhythm after cardioversion but beware of hypotension.
- Atrial fibrillation may be resistant to standard measures. If the patient is persistently tachycardic, shocked, and has not responded to DC cardioversion, then consider the following:
    1. Ensure adequately filled (i.e. fluid challenge until no response).
    2. Start noradrenaline to achieve acceptable MAP (65mmHg).
    3. Give metoprolol intravenously to control rate.

Drug Doses

Adenosine: 6mg then 12mg then 12mg. Ensure ECG printer running, and flush immediately with saline.

Adrenaline: 0.1mcg/kg/min then titrate. Can be given in 10-20mcg boluses. See Inotropic Support CSOP 034.

Amiodarone: 300mg in 250ml 5% Dextrose over 20-30 min.

Atropine: 500microgram boluses every couple of minutes up to maximum 3mg.

Magnesium: 2g (8mmol) in 100ml saline over 20-30 min.

Metoprolol: 2.5 - 5mg boluses every 2 minutes up to a maximum of 15mg: exercise caution.

Disposition of patient

If ACS suspected then transfer to facility providing PCI. Otherwise, the patient should be transported to a facility appropriate to their degree of illness. In the case of bradycardia, the unit must be capable of transvenous or permanent cardiac pacing.

References and Further Reading

Resuscitation Council (UK). Peri-arrest arrhythmias 2015 Guidelines. Available at https://www.resus.org.uk/resuscitation-guidelines/peri-arrest-arrhythmias Accessed 3/11/17

Somasunderam K, Ball J. Medical Emergencies: atrial fibrillation and myocardial infarction. Anaesthesia 2013; 68: 84-101.

Emergency Medical Retrieval Service. Narrow Complex Tachycardias. Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. Accessed 1/12/2014.

Emergency Medical Retrieval Service. Pacing. Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. Accessed 1/12/2014.

Electronic Medicines Compendium: Heparin Summary of Product Characteristics. www.medicines.org.uk. Accessed 27/12/2014.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

CSOP 029 - Anaphylaxis

Reference Number	CSOP 029
Application	EMRTS Consultants and CCP's
Related SOPS	CSOP 004a and 004b, CSOP 033, CSOP 034, CSOP 044

Author(s)	Tim Rogerson, Mark Knights
Internal reviewer(s)	Mike Greenway
External reviewer(s)	Peter Oakley (External Clinical Advisory Group)
Sign off	COB

Introduction & Objectives

Anaphylaxis is a severe, multisystem hypersensitivity reaction. It presents acutely, can progress rapidly and may be fatal. It can be reversed by rapid treatment.

The purpose of this CSOP is to outline a treatment algorithm for patients with suspected anaphylaxis.

Recognition

Anaphylaxis is a life-threatening, generalised hypersensitivity reaction. It is characterised by rapidly developing, life-threatening problems involving any or all of: the airway (pharyngeal or laryngeal oedema); breathing (bronchospasm with tachypnoea); circulation (hypotension and/or tachycardia). In some cases, there are associated skin and mucosal changes (urticartia, rash). Early features may include vomiting and abdominal pain.

Common triggers include drugs (including antibiotics, muscle relaxants, NSAIDS), foods (e.g. nuts, shellfish), hymenoptera stings and latex. In up to 20% of cases no trigger is identified.

Differential Diagnoses

Asthma, angioedema and vasovagal episode.

EMRTS Activation

EMRTS may be tasked to retrieve a patient with anaphylaxis, or the condition may occur iatrogenically during a mission. In general, EMRTS secondary taskings will be to patients who either have airway concerns, or who fail to respond to initial treatment.

Management

The key steps in the management of anaphylaxis are outlined in the algorithm below. The suspected allergen should be removed. The first line treatment is IM adrenaline. Carefully titrated IV adrenaline (1:100 000 pre draw) should be considered in adults for refractory hypotension or peri-arrest situations. ECG, NIBP and SpO2 monitoring is mandatory for all patients who have had adrenaline.

The paediatric dose can be either the age group dose as per the algorithm, or the 'APLS' dose by weight (10mcg/kg).

Investigation

(In addition to any investigations mandated by the patient's clinical condition).

Mast cell tryptase (yellow top) should be taken:

1. As soon as possible.
2. 1-2 hours post event.
3. A convalescent sample at 24 hours or at follow up.

Disposition

Nearest hospital with ICU facilities. Anaphylaxis may recur a few hours after initial treatment.

Management Algorithm (ERC 2015)

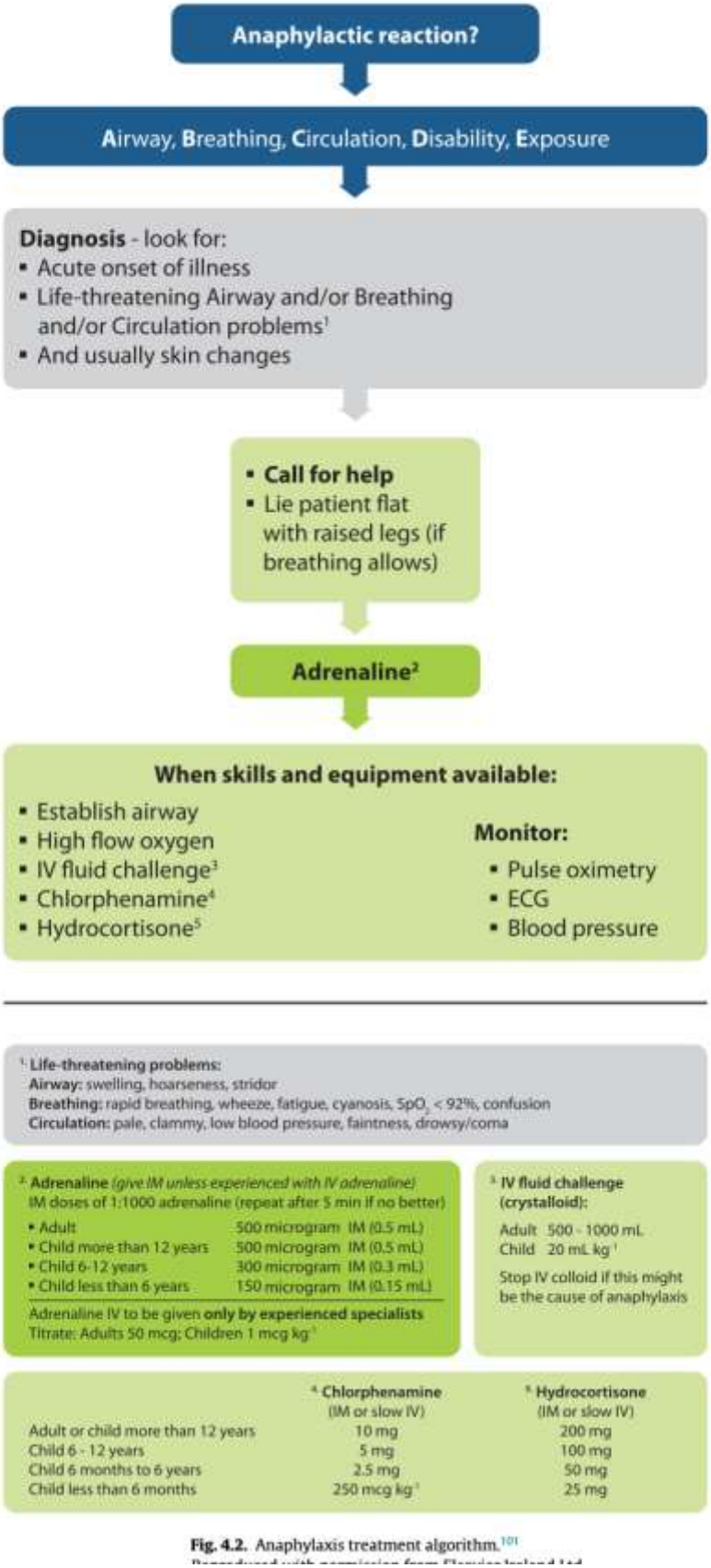


Fig. 4.2. Anaphylaxis treatment algorithm.[101]

References and Further Reading

NICE Clinical Guideline 134: Anaphylaxis.
http://www.nice.org.uk/guidance/cg134.

College of Emergency Medicine GemNet Guidance – Acute Allergic Reaction.
http://secure.collemergencymed.ac.uk/code/document.asp?ID=5072.

Emergency Medical Retrieval Service. Anaphylaxis. Standard Operating Procedure.
http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. (Accessed 28/12/2014).

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Respiratory – Asthma, COPD, Pneumonia

Reference Number	CSOP 030
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 004a and 004b, CSOP 032, CSOP 033

Author(s)	John Glen, Owen McIntyre
Internal reviewer(s)	
External reviewer(s)	
Sign off	COB

Introduction & Objectives

The commonest respiratory illnesses to which EMRTS will respond are Acute Severe Asthma, Acute Exacerbations of COPD, and Pneumonia. The purpose of this SOP is to outline the approach to these conditions within a pre-hospital and/or retrieval setting.

Asthma

The basic management of acute asthma is part of the armamentarium of any acute physician, but is rehearsed below as an aide-memoire. There is a relative lack of evidence for second-line/rescue therapies in this condition. EMRTS will mobilise where there are signs of severe or life-threatening asthma not responding to treatment, and where escalation of the patient's care requires transfer to another facility.

EMRTS management (if not already initiated by a referring hospital or land crew)

Institution of the following measures will depend on the clinical context, but may include:

1. High flow oxygen.

2. Nebulised salbutamol 5mg every 15 mins, driven by oxygen. If appropriate nebuliser available, continuous nebulisation at 10mg/hr may be more effective).
3. Steroid (Prednisolone 40mg PO or Hydrocortisone 200mg IV).
4. Magnesium 2g (8mmol) in 100ml saline IV over 20 mins.
5. CXR and ABG if available in patients with features of life-threatening asthma.
6. Rule out pneumothorax.
7. Intravenous salbutamol 250mcg over 5 mins, then infuse 5-20 mcg/min (5mg salbutamol in 50ml = 100mcg/ml: 6ml/h of this solution = 10mcg/min).
8. Add nebulised Ipratropium (500mcg) if not given already.
9. Consider antibiotics if evidence of infection.

Rescue therapies

1. Adrenaline: Can be nebulised (3mg), given subcutaneously (0.5ml of 1/1000 solution every 20 minutes), or intravenously at a dose of 0.25 – 3mcg/min. To achieve this, dilute a 10ml minijet of adrenaline in 40ml of saline to make 50ml. This contains 20mcg/ml, and can be infused at 1-10ml/h, titrated to response.
2. Lidocaine: Can be nebulised (10ml of 1%), or given IV (1.5mg/kg over 10 mins: 10ml for a 70kg patient).
3. IV Aminophylline: Make up 2 ampoules in 50ml (i.e. 500mg in 50ml). If the patient is not on theophylline at home, give a loading dose of 5mg/kg over 15 minutes, followed by 0.5mg/kg infusion. For a 70kg patient, this would mean 35ml at 140ml/hr, followed by a 3.5ml/hr infusion.
4. Sedation: Distressed patients have a markedly increased respiratory rate, which worsens ventilatory efficiency and contributes to dynamic hyperinflation. Cautious sedation may obviate this to an extent and avoid the need for intubation. Obviously the patient may worsen instead, so be ready to intubate. Avoid ketamine for conscious sedation – any beneficial effect on airway patency is likely to be offset by the bronchorrhoea associated with the drug. (Ketamine does remain suitable for RSI and post-intubation sedation however).

Non-invasive ventilation: May reduce work of breathing, offset intrinsic PEEP, and buy time for other treatments to work. May also facilitate preoxygenation. See CSOP 031.

Intubation

Although sometimes necessary, intubation in this setting may precipitate cardiovascular collapse and acute ventilatory crisis. In particular, in a marginal or deteriorating patient it is probably better to undertake RSI prior to transfer as attempting the procedure if the patient collapses on route will be challenging.

Notes on RSI/ventilation:

Avoid morphine – possible histamine release.

If patient arrests immediately after intubation:

Disconnect TT, and carry out ventilation-free CPR.

Give a fluid bolus.

If there is no response, carry out bilateral finger thoracostomies.

Keep patient well sedated/paralysed throughout transfer. This is not the time to experiment with ventilator triggers or intrinsic/extrinsic PEEP adjustments.

Risk of air trapping/breath stacking. To ameliorate/prevent this:

Start with low PEEP. This will maximise airflow from unobstructed lung units during expiration.

PEEP may need to be adjusted to optimise expiratory flow. Monitor flow-time curve and blood pressure carefully.

Look at flow-time curve on ventilator – it should show no flow at end of expiration.

Reduce minute volume, allowing hypercapnia.

Increase expiratory time by altering I:E ratio and respiratory rate.

In problematic hyperinflation, it may be necessary to manually deflate the chest. Disconnect ventilator, and press down on sternum for 20-30 seconds.

Pneumonia

Most patients with pneumonia will not require retrieval. For those who do, their presentation is likely to include sepsis. See Sepsis CSOP 033. Considerations in the retrieval environment are:

1. Is the diagnosis secure? In particular, could this be Influenza or other transmissible illness?
2. Appropriateness for activation: Comorbidities/prognosis and severity: A CURB-65 score of 4 or more mandates consideration for HDU/ICU care (Appendix).
3. Level of support required: It may be possible to manage these patients in the referring facility if there is no evidence of organ failure, and the clinical trajectory does not suggest acute deterioration. The level of care available at the referring facility should be taken into account when determining need for activation.

4. Need for RSI prior to transfer. If this is likely to be needed at the destination, it makes sense to RSI on scene.

5. Antibiotics. Ensure you have determined whether you are dealing with community-acquired or hospital-acquired pneumonia.

COPD

Patients with acute exacerbations of COPD are at high risk of death. Optimal management can, however be very effective, and may return the patient to their level of function prior to the acute episode.

Features of AECOPD include: worsening breathlessness (MRC scale), cyanosis, worsening peripheral oedema, reduced level of consciousness, acute confusion, SpO2 <90%, Arterial pH <7.35, PaO2 <7kPa.

NICE guidance is available on this topic, and is embodied in the advice below.

Decision Making

In the retrieval setting, the first consideration will be appropriateness for activation. In general, if patients are unsuitable for escalation to invasive ventilation, then it will be difficult to effect retrieval. Considerations around appropriateness for invasive ventilation include:

1. Patient's wishes.
2. FEV1.
3. Functional status.
4. BMI.
5. Requirement for oxygen when stable.
6. Co morbidities.
7. Previous admissions to ICU.

In patients unsuitable for escalation, a discussion should take place with the senior clinician at the referring centre, prior to activation, about what retrieval can offer, and whether moving the patient is in their best interests. This discussion should also involve the potential receiving unit, including ICU. It is possible to transfer on NIV, in specific circumstances, with clear plans in place. See NIV SOP.

If a patient is suitable for invasive ventilation, and is not improving on medical therapy, then the next decision is whether to trial NIV or not. In general, if the patient is markedly unwell, is hypercarbic with a pH <7.25 or has a reduced level of consciousness, then NIV is unlikely to turn the situation around sufficiently to avoid intubation, and will simply waste time. Proceed with RSI and transfer.

Medical Management of COPD exacerbation

- Titrate nasal oxygen to achieve SpO2 88-92%, or within an individualised target range.
- Give nebulised bronchodilators (Salbutamol 5mg + Ipratropium 500mcg).

- If the patient is hypercarbic, drive the nebuliser using air, if a device is available.

- Give prednisolone 30mg PO or 200mg hydrocortisone IV.
- Give antibiotic if patient has purulent sputum or signs of pneumonia. Follow local guidance on antibiotic choice.
- Intravenous aminophylline can be used if there is a poor response to nebulised therapy.

  - Draw up 2 ampoules of Aminophylline (250mg in 10ml each) to 50ml total volume in saline or D5W.
  - This contains 500mg in 50ml.
  - If patient DOES NOT normally take theophylline, give loading dose of 5mg/kg over 20 minutes.
  - Follow loading dose (if applicable) with maintenance 0.5mg/kg/hr.
  - (Elderly reduce maintenance dose to 0.3mg/kg/hr).
  - (Child under 12 years 1mg/kg/hr).

  - For a 70kg patient, this would regime mean set VTBI at 35ml and rate 105ml/hr, followed by a 3.5ml/hr infusion.

- CXR and ABG
- NIV (see CSOP 031) COPD with respiratory acidosis (PCO2>6kPa; pH 7.25-7.35) in whom maximal medical treatment has failed to produce a sufficient improvement.

Disposition of patient

This will be determined primarily by the degree of illness. In general, a hospital with respiratory physicians and ICU support will be appropriate.

References and Further Reading Guideline for emergency oxygen use in adult patients. British Thoracic Society 2008. Available at www.brit-thoracic.org.uk (accessed 28/12/2014).

Emergency Medical Retrieval Service. Non-invasive ventilation. Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. (Accessed 28/12/2014).

Guidelines for the management of community-acquired pneumonia. *British Thoracic Society* 2009. Thorax 64 (Supp III).

Chronic Obstructive Pulmonary Disease: Management in adults in primary and secondary care. NICE 2010 [CG101] available at: www.nice.org.uk (accessed 04/102017).

Asthma guideline. British Thoracic Society 2014. Available at www.brit-thoracic.org.uk (accessed 28/12/2014).

Guideline for emergency oxygen use in adult patients. British Thoracic Society 2008. Available at www.brit-thoracic.org.uk (accessed 28/12/2014).

Emergency Medical Retrieval Service. Asthma. Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops (Accessed 28/12/2014).

Emergency Medical Retrieval Service. Non-invasive ventilation. Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. (Accessed 28/12/2014).

Appendix: CURB-65 Score

1 point each for:

- Confusion
- Urea >7mmol/l
- Respiratory Rate >30
- Blood Pressure (SBP <90 or DBP <60 mmHg)
- Age >65

A score of 3 or above indicates severe pneumonia, with a risk of death of 15-40%. BTS recommends critical care referral if score is 4 or 5.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru
CLINICAL STANDARD OPERATING PROCEDURE (CSOP)
Respiratory – Asthma

Reference Number	CSOP 030a
Application	EMRTS Doctors and CCPs
Related SOPS	CSOP 004a and 004b, CSOP 032, CSOP 033

Authors	John Glen
Internal reviewer	James Chinnery
Sign off	COB

Introduction & Objectives

Acute severe asthma kills 3 patients in the U.K. per day. According to the RCEM, around 140 acute exacerbation patients present across the U.K. per day. The purpose of this SOP is to outline an approach to severe asthma in a pre-hospital and retrieval setting.

Basic management of acute asthma is part of the armamentarium of any acute physician, but is presented below as an aide-memoire. There is a relative lack of evidence for second-line/rescue therapies in this condition. EMRTS will mobilise where there are signs of severe or life-threatening asthma not responding to treatment, and where escalation of the patient's care requires transfer to another facility.

EMRTS management (if not already initiated by a referring hospital or land crew)

Institution of the following measures will depend on the clinical context, but may include:

1. High flow oxygen. Target Sp02 94-98%
2. Nebulised salbutamol 5mg every 15 mins, driven by oxygen. If appropriate nebuliser available, continuous nebulisation at 10mg/hr may be more effective).
3. Steroid (Prednisolone 40-50mg PO or Hydrocortisone 200mg IV).
4. Add nebulised Ipratropium (500mcg) to Nebulished salbutamol in those with acute severe or life-threatening asthma or those with a poor initial response to β2 agonist therapy.
5. Magnesium 2g (8mmol) in 50ml saline IV over 20 mins by infusion.

6. CXR and ABG if available in patients with features of life-threatening asthma. Consider arterial insertion if in retrieval setting.
7. Rule out pneumothorax using clinical examination and POCUS.
8. Consider Intravenous salbutamol:
   i) Draw up 500mcg in 1ml made up to 50ml with NaCl 0.9%. This gives 500mcg salbutamol in 50ml = 10mcg/ml.
   ii) Use pump to deliver slow bolus: 250mcg over 5 mins.
   iii) Set infusion pump rate to 300ml/hr AND set VTBI as 25ml to give 250mcg over 5mins.
   iv) Then infuse at 5-20 mcg/min (30ml/h of this solution = 5mcg/min).
   v) Monitor patient carefully as high dose salbutamol is associated with risk of hypokalaemia, worsening acidosis, and respiratory failure.
9. Consider antibiotics if evidence of infection.

Rescue therapies

1. Adrenaline: can be nebulised (3mg = 3ml of 1in1000 solution)

2. Adrenaline: Intramuscular route (dosing below)

   i) 500mcg = 0.5 ml of 1 in 1000 solution for Adult and Child 12-18 years
   ii) 300mcg = 0.3 ml of 1 in 1000 solution for Child 6 -12 years
   iii) 150mcg = 0.15ml of 1 in 1000 solution for Child under 6 years

Dose can be repeated several times if necessary at 5 minute intervals according to pulse and BP. Use a 1ml syringe for measuring small volumes.

3. Adrenaline infusion at a dose of 0.25 – 3mcg/min, titrated to response.
   i) Draw up 50ml of Adrenaline 1in100,000 (pre-draw bag).
   ii) This contains Adrenaline at 10mcg/ml.
   iii) Infused at 2-20ml/h, this gives 0.33 to 3.3 mcg/min.
4. Sedation: Patients with acute asthma SHOULD NOT be sedated unless this is to allow anaesthetic or intensive care procedures (e.g. preoxygenation pre-RSI).

5. Non-invasive ventilation: has limited published evidence of benefit in asthma. As such it is controversial. It may be considered in a pre-hospital critical care setting to reduce work of breathing, and facilitate preoxygenation pre-RSI. A Cochrane review on NIV in asthma showed one study with improved lung function and discharge rates from ED. See CSOP 031.

Intubation

RSI may be necessary in an acidotic, hypercapnic, hypoxic, exhausted, or obtunded patient. In this scenario it is better to undertake RSI prior to transfer, as attempting the procedure if the patient collapses on route will be challenging.

Induction of anaesthesia may precipitate cardiovascular collapse and arrest. Be prepared for this.

- Keep patient well sedated/paralysed throughout transfer.
- Morphine maintenance should be avoided due to possible histamine release.
- This is not the time to experiment with ventilator triggers or intrinsic/extrinsic PEEP adjustments.
- Risk of air trapping/breath stacking. To ameliorate/prevent this:
    - Start with low PEEP. This will maximise airflow from unobstructed lung units during expiration.
    - PEEP may need to be adjusted to optimise expiratory flow. Monitor flow-time curve and blood pressure carefully.
    - Look at flow-time curve on ventilator – it should show no flow at end of expiration.
    - Reduce minute volume, allowing hypercapnia.
    - Increase expiratory time by altering I:E ratio to lengthen expiratory time and reduce respiratory rate.
- In problematic hyperinflation, it may be necessary to manually deflate the chest. Disconnect ventilator, and press down on sternum for 10-20 seconds.

Cardiac Arrest

Acute severe/life threatening asthma patients arrest due to a triad of respiratory muscle exhaustion, respiratory acidosis, and impaired venous return due to increased thoracic pressure.

- If patient arrests
    - Intubate/complete intubation if not already.
    - Disconnect TT, and carry out ventilation-free CPR for 1minute to ensure decompression of dynamic hyperinflation.
    - Decompress suspected tension pneumothoraces with bilateral finger thoracostomies.
    - Give a 500ml NaCl 0.9% fluid bolus.
    - Give Adrenaline 1mg.
    - Ventilate at a low rate 8-10 breathes / min to minimize further dynamic hyperinflation
    - If ROSC not achieved consider EPOC / further dose of Magnesium.

References and Further Reading

Asthma guideline. British Thoracic Society 2016. Available at www.brit-thoracic.org.uk (accessed 04/10/2017).

Guideline for emergency oxygen use in adult patients. British Thoracic Society 2008. Available at www.brit-thoracic.org.uk (accessed 28/12/2014).

Emergency Medical Retrieval Service. Asthma. Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops (Accessed 04/10/2017).

Emergency Medical Retrieval Service. Non-invasive ventilation. Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. (Accessed 28/12/2014).

Arrest Asthma RCEM Learning Available at https://www.rcemlearning.co.uk/foamed/arrest-asthma/ (Accessed 3/12/2017).

http://www.cochrane.org/CD004360/AIRWAYS_non-invasive-positive-pressure-ventilation-for-treatment-of-respiratory-failure-due-to-severe-acute-exacerbations-of-asthma

Medical emergencies: pulmonary embolism and acute severe asthma. Somasundaram, K. Ball, J. Anaesthesia 2013, 68 (Suppl. 1), 102-116 https://doi.org/10.1111/anae.12051
(Accessed 15/07/18).

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Respiratory – COPD

Reference Number	CSOP 030b
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 004a and 004b, CSOP 032, CSOP 033

Authors	Hefin Llewellyn, John Glen
Internal reviewer (current)	James Chinery
Sign off	COB

Introduction & Objectives

Patients with acute exacerbations of COPD are at high risk of death. Optimal management can, however be very effective, and may return the patient to their level of function prior to the acute episode.

Features of AECOPD include: worsening breathlessness (MRC scale), cyanosis, worsening peripheral oedema, reduced level of consciousness, acute confusion, SpO2 <90%, Arterial pH <7.35, PaO2 <7kPa.

The purpose of this SOP is to outline an approach to the condition within a pre-hospital and/or retrieval setting.

NICE guidance is available on this topic, and is embodied in the advice below.

Decision Making

In the retrieval setting, the first consideration will be appropriateness for activation. In general, if patients are unsuitable for escalation to invasive ventilation, then it will be difficult to effect retrieval. Considerations around appropriateness for invasive ventilation include:

1. Patient's wishes.
2. FEV1.
3. Functional status.
4. BMI.
5. Requirement for oxygen when stable.
6. Co morbidities.
7. Previous admissions to ICU.

In patients unsuitable for escalation, a discussion should take place with the senior clinician at the referring centre, prior to activation, about what retrieval can offer, and whether moving the patient is in their best interests. This discussion should also involve the potential receiving unit, including ICU. It is possible to transfer on NIV, in specific circumstances, with clear plans in place. See NIV SOP.

If a patient is suitable for invasive ventilation, and is not improving on medical therapy, then the next decision is whether to trial NIV or not. In general, if the patient is markedly unwell, is hypercarbic with a pH <7.25 or has a reduced level of consciousness, then NIV is unlikely to turn the situation around sufficiently to avoid intubation, and will simply waste time. Proceed with RSI and transfer.

Medical Management of COPD exacerbation

- Titrate nasal oxygen to achieve SpO2 88-92%, or within an individualised target range.
- Give nebulised bronchodilators (Salbutamol 5mg + Ipratropium 500mcg).
    - If the patient is hypercarbic, drive the nebuliser using air, if a device is available.
- Give prednisolone 30mg PO or 200mg hydrocortisone IV.
- Give antibiotic if patient has purulent sputum or signs of pneumonia. Follow local guidance on antibiotic choice.
- Intravenous aminophylline can be used if there is a poor response to nebulised therapy.

    - Draw up 2 ampoules of Aminophylline (250mg in 10ml each) to 50ml total volume in saline or D5W.
    - This contains 500mg in 50ml.
    - If patient DOES NOT normally take theophylline, give loading dose of 5mg/kg over 20 minutes.
    - Follow loading dose (if applicable) with maintenance 0.5mg/kg/hr.
    - (Elderly reduce maintenance dose to 0.3mg/kg/hr).
    - (Child under 12 years 1mg/kg/hr).

    - For a 70kg patient, this would regime mean set VTBI at 35ml and rate 105ml/hr, followed by a 3.5ml/hr infusion.

- CXR and ABG

- NIV (see CSOP 031) COPD with respiratory acidosis (PCO2>6kPa; pH 7.25-7.35) in whom maximal medical treatment has failed to produce a sufficient improvement.

Disposition of patient

This will be determined primarily by the degree of illness. In general, a hospital with respiratory physicians and ICU support will be appropriate.

References and Further Reading

Chronic Obstructive Pulmonary Disease: Management in adults in primary and secondary care. NICE 2010 [CG101] available at: www.nice.org.uk (accessed 4/10/2017).

Guideline for emergency oxygen use in adult patients. British Thoracic Society 2008. Available at www.brit-thoracic.org.uk (accessed 28/12/2014).

Emergency Medical Retrieval Service. Non-invasive ventilation. Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. (Accessed 28/12/2014).

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Respiratory – Pneumonia

Reference Number	CSOP 030c
Application	EMRTS Doctors and CCPs
Related SOPS	CSOP 004a and 004b, CSOP 032, CSOP 033

Authors	Hefin Llewellyn, John Glen
Internal reviewer	James Chinnery
Sign off	COB

Introduction & Objectives

Most patients with pneumonia will not require retrieval. For those who do, their presentation is likely to include sepsis. See Sepsis CSOP 033.

Retrieval Considerations:

1. Is the diagnosis secure? In particular, could this be Influenza or other transmissible illness?
2. Appropriateness for activation:
   - Comorbidities/prognosis and severity: the CURB-65 score (confusion, urea >7mmol/l, resp rate >30; SBP <90 or DBP <60; Age >65) may be helpful. In general, a score of 3-5 is classed as high severity amd associated with risk of death of 15-40%.
   - With a score of 4-5, HDU-level or ICU care should be considered.
   - Level of support required: It may be possible to manage these patients in the referring facility if there is no evidence of organ failure, and the clinical trajectory does not suggest acute deterioration. The level of care available at the referring facility should be taken into account when determining need for activation.
     - CXR should be undertaken as soon as possible in hospital to confirm or refute the diagnosis of CAP.
   - Blood cultures should ideally be taken for all patients with mod-high severity CAP preferably before antibiotics.

Medical Management of Pneumonia

- Titrate oxygen to achieve Sp02 > 94%
- Ensure appropriate antibiotic given (follow local guidance on antibiotic choice)
- Oxygen therapy in patients at risk of acute hypercapnic respiratory failure should be guided by ABGs
- High severity pneumonia should be treated immediately after diagnosis with empiric IV antibiotics:
  - A combination of Co-Amoxiclav 1.2g and Clarithromycin 500mg is preferred.
  - For the PENCILLIN allergic patient, CEFOTAXIME OR CEFTRIAXONE and Clarithromycin can be used.
- Need for RSI prior transfer. If this is likely to be needed at the destination, it makes sense to RSI on scene.
- If a trial of CPAP NIV is to be considered in CAP, there must be expertise available to enable a rapid transition to invasive ventilation should it fail (see CSOP 031).

Disposition of patient

This will be determined primarily by the degree of illness. In general, a hospital with respiratory physicians and ICU support will be appropriate.

References and Further Reading

Annotated BTS Guidelines for the management of community-acquired pneumonia in adults. *British Thoracic Society* 2015. Available at www.brit-thoracic.org.uk (Accessed 6/1/2018)

BTS Guideline for emergency oxygen use in adult patients in healthcare and emergency settings. British Thoracic Society 2017. Available at www.brit-thoracic.org.uk (accessed 6/1/2018).

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Non-Invasive Ventilation (NIV)

Reference Number	EMRTS CSOP 031
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 030, Hamilton T1 ventilator manual/action card

Author(s)	Hefin Llewellyn, Kevin Rafferty, John Glen
Internal reviewer	James Chinnery
Sign off	COB

Introduction & Objectives

Non-Invasive Ventilation (NIV) is a well-established respiratory therapy, and is within the armamentarium of EMRTS. There are, however, special considerations for NIV in the retrieval setting. The purpose of this SOP is to:

1. Outline the settings in which EMRTS may consider use of NIV.
2. Provide clinical guidance for use of NIV in the retrieval context.

NIV within EMRTS

The use of NIV within a retrieval setting will likely fall into one of the following categories:

1. To improve gas exchange and pre-oxygenate prior to intubation.
2. To improve gas exchange and 'turn around' a patient with a view to transporting without ventilator support – this takes around 1 hour of therapy at scene.
3. To support patient during transfer where intubation is deemed potentially harmful or a ceiling of care has been previously discussed.

Category 3 carries significant risks, given the limitations to patient access in-flight in the event of deterioration. A decision to transport on NIV must be individualised and based on patient condition, prognosis, and distance to definitive care. Discuss the case with Top Cover Consultant. Most patients in this case would be transferred by road ambulance.

Within a retrieval setting, the timeline over which treatments are instituted/assessed must be assessed carefully: it is inappropriate for teams to be deployed at scene for hours at a time. This is reflected in the guidance below.

Indications

The 'classic' indication for NIV is acute hypercapnic acidaemia (i.e. pH <7.35 as well as elevated CO_2 plus dyspnoea) due to an exacerbation of COPD. In this context, NIV has been shown to reduce need for intubation, and may improve outcomes. Other indications include acute pulmonary

oedema as a form of 'advanced CPAP', and hypercapnic respiratory failure secondary to chest wall deformity or neuromuscular disease.

NIV is also used as a ceiling of therapy in patients with respiratory failure who are unsuitable for escalation to level 3 care (see below).

Although mentioned in the BTS guidelines, NIV is not a viable method of assisting ventilation in patients with chest injuries in a retrieval setting. Such patients are likely to require intubation for transport.

Contraindications

1. Facial burns/trauma/recent facial or upper airway surgery.
2. Fixed upper airway obstruction.
3. Undrained pneumothorax.
4. Upper gastrointestinal surgery/vomiting/bowel obstruction.
5. Patients with a pH of less than 7.26 (due to respiratory acidosis) may benefit from NIV but such patients have a higher risk of treatment failure.
6. Critical hypoxia.
7. Inability to protect airway.
8. Unconsiousness GCS <14.
9. Un-cooperative.
10. Excessive respiratory secretions.

Management Prior to Team Arrival

Baseline medical therapy should be instituted at the referring centre or by land crews: see relevant SOPs. In particular, targeted oxygen therapy should be given aiming for SpO_2 88-92% in patients with chronic respiratory illness. Where patient's usual SpO_2 is known, this should be the target.

Where facilities for NIV exist in the referring centre then this should be started prior to EMRTS arrival.

NIV Set-Up

1. Check baseline ABG on maximal medical therapy before starting. An arterial line will make repeated sampling easier, and can be inserted after NIV has commenced.
2. In hospital, ensure CXR performed prior starting to rule out pneumothorax.
3. Set the Hamilton T1 ventilator to NIV mode.
4. Start with IPAP (Psupport) to 10cms H_2O and EPAP (PEEP/CPAP) to 5cm H_2O.
5. Hold face mask with hands initially before securing head straps. Check the mask for size and fit.
    - Reassure and explain the process before applying the face mask. Talk the patient through each step of the process. If the patient cannot tolerate the mask, persistence will result in panic, worsening gas exchange and increased oxygen consumption. Be gentle and persuasive instead.

6. Titrate IPAP upwards, in 5cm increments every few minutes until you reach 20cm H_2O or until patient tolerability has been reached. Keep EPAP at 5cmH_2O.
7. Set FiO_2 to achieve SpO_2 of 88-92%.
8. Basic troubleshooting:
    a. Low PO_2 may respond to increase in FiO_2 or EPAP.
    b. High CO_2 may respond to increase in IPAP.
    c. Ensure a good seal, and check all connections.
    d. Look at the patient to see if respiratory efforts are coordinated with the ventilator. Consider changing the inspiratory trigger setting, expiratory trigger setting, and ramp to achieve better ventilator coordination.
9. If you are using NIV to enhance preoxygenation, then the initial setting of '5+5' is reasonable, with an FiO_2 of 1.0.
    a. Do not bother with head straps.
    b. Do not forget nasal cannulae for NO-DESAT technique.
    c. Keep patient sitting up until drugs are in.
    d. Ensure you are ready for a smooth changeover to bag/mask when patient loses consciousness.

Assessment of efficacy in referring facility

A decision has to be made about whether or not to transfer the patient on NIV. The success or otherwise of the therapy may be apparent within a few minutes. After a maximum of one hour on NIV, recheck ABGs. NIV can be considered to effective, assuming that there is:

1. Improvement in patient's clinical condition.
2. Tolerance of NIV.
3. Symptom control.
4. Improving blood gases.

For EMRTS purposes, a drop in CO_2 of at least 2kPa with associated clinical improvement should be the minimum acceptable improvement to justify persistence with the therapy.

If NIV is ineffective, or if the patient worsens,

1. Exclude pneumothorax if not already done using chest USS / CXR.
2. Do not persist with NIV.
3. Escalate if appropriate and RSI.

Patients Unsuitable for Escalation in Remote Facilities.

It may be that escalation to invasive ventilation is not in the patient's best interests, but the referring facility cannot offer NIV. This creates a difficult situation for the team. A risk/benefit discussion must take place between the referring clinician and Top Cover Consultant, to determine possible benefits of NIV versus risks to patient and team of transfer. In addition, the receiving hospital ICU should be aware of the planned transfer, as they may

be expected to manage the NIV. Ensure that maximal medical therapy has been applied without result. The patient's wishes must be taken into account, and there must be a reasonable prospect of response to therapy. If EMRTS do attend, the consultant should assess the patient and consider starting a trial of NIV. Reassess in one hour. If there has been an objective and significant response (above), the patient can potentially be transferred on NIV with a clear escalation policy in place. *Receiving physician in destination hospital must have accepted patient on this basis*.

If the trial of NIV proves unsuccessful, the team will leave the patient at the referring hospital. This will be a difficult time for all, as the situation is now likely to become one of palliation and end of life care. EMRTS clinicians must be cognisant of patient and family discussions which have already taken place, and endeavour to support the patient, family and referring team as best they can.

Disposition of patient

Ensure that destination hospital has accepted patient, is able to monitor and adjust NIV settings with ABG monitoring, and (if appropriate) that ICU in receiving facility have bed capacity and are aware of patient.

Summary

- NIV can be used to improve gas exchange and pre-oxygenation prior to RSI.
- Transfer on NIV can be done, but carries significant risk.
- An escalation plan should be in place.
- Ensure receiving medical team is able to manage NIV patient, and that ICU are involved.

References and Further Reading

British Thoracic Society. BTS/ICS Guidelines for the ventilatory management of acute hypercapnia respiratory failure in Adults. 2016. Available at https://www.brit-thoracic.org.uk/standards-of-care/guidelines/btsics-guidelines-for-the-ventilatory-management-of-acute-hypercapnic-respiratory-failure-in-adults/ Accessed 3/11/17

British Thoracic Society. The Use of Non-Invasive Ventilation in the management of patients with chronic obstructive pulmonary disease admitted to hospital with acute type II respiratory failure (With particular reference to bilevel positive pressure ventilation). Available at https://www.brit-thoracic.org.uk/guidelines-and-quality-standards/non-invasive-ventilation-(niv) Accessed 3/11/2017.

Emergency Medical Retrieval Service. Non-Invasive Ventilation Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. Accessed 1/12/2014.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Medical Neurological Emergencies (excluding trauma)

Reference Number	CSOP 032
Owner	Chris Hingston
Reviewer	Owen McIntyre, David Lockey
Sign Off	COB

Introduction & Objectives

Many medical neurological emergencies may be assessed and managed appropriately in the district general hospital. However, early identification and appropriate transfer of the comparatively few patients requiring timely tertiary intervention is desirable.

This CSOP aims to:

1. Provide a triage guideline for clinicians managing suspected stroke.

2. Describe the pre-hospital management of suspected stroke and status epilepticus.

Stroke

The majority of strokes (80%) are due to cerebral ischaemia secondary to thrombosis, embolism or systemic hypoperfusion. The remainder are accounted for by either intra-cerebral or subarachnoid haemorrhage (SAH). In the pre-hospital setting the management of all subtypes of stroke currently follow the same broad principles, with some important caveats. The main consideration is that the appropriate destination hospital may differ depending on the suspected aetiology, and triage guidance is provided below.

Airway

Advanced airway management will rarely be required, but the standard indications apply. Additionally, intubation may need to be considered in the context of significant agitation or if there is the potential for further neurological deterioration during transfer. The benefits of such intervention need to be carefully weighed against the particular risk of hypotension occurring during induction of anaesthesia. This may increase long term morbidity and mortality. If intubation is required the patient should be managed with the same principles as a traumatic brain injury to optimise cerebral perfusion. Following intubation, ventilation should be established aiming for:

1. PaO_2 > 10kPa (but avoiding excessive hyperoxia once established on ventilation).

2. $PaCO_2$ 4.5-5.0kPa ($EtCO_2$ 3.0-4.5kPa) – there is a 1-1.5 kPa difference between $ETCO_2$ and $PaCO_2$, greater in chest injuries.
3. Try to avoid high levels of PEEP if possible (may reduce cerebral perfusion pressure).

In a suspected ischaemic stroke avoid supplemental oxygen if SpO_2 >94% as hyperoxia can be detrimental.

Dysphagia is common post stroke and as such oral medications should generally be avoided until a formal swallowing assessment has been conducted.

Circulation

Intravenous access should be secured.

Hypotension (systolic <120mmHg) should be managed by lying the stretcher flat and administering a saline fluid bolus. Failure to achieve an adequate blood pressure should prompt the consideration of an alternative diagnosis (particularly myocardial infarction) and the use of vasopressors.

1. Tight and accurate BP control is essential – early invasive blood pressure monitoring should be instituted either prior to RSI (if feasible) or rapidly afterwards. This will usually be in context of an inter-hospital transfer.

2. Hypertension should generally be managed conservatively, unless systolic pressure is >220mmHg and there is evidence of acute cardiac ischaemia, heart failure, aortic dissection or hypertensive encephalopathy. The exception to this is the suspicion of a SAH, in which case aim for a systolic pressure of <160mmHg (Mean Arterial Blood Pressure 80-90mmHg).

Cardiac monitoring should be applied and a 12 lead ECG obtained, to exclude concomitant acute cardiac ischaemia, especially common in subarachnoid haemorrhage.

If intracranial haemorrhage is strongly suspected or confirmed in a patient taking warfarin or oral anticoagulants, then this should be reversed. See reversal of anticoagulation CSOP.

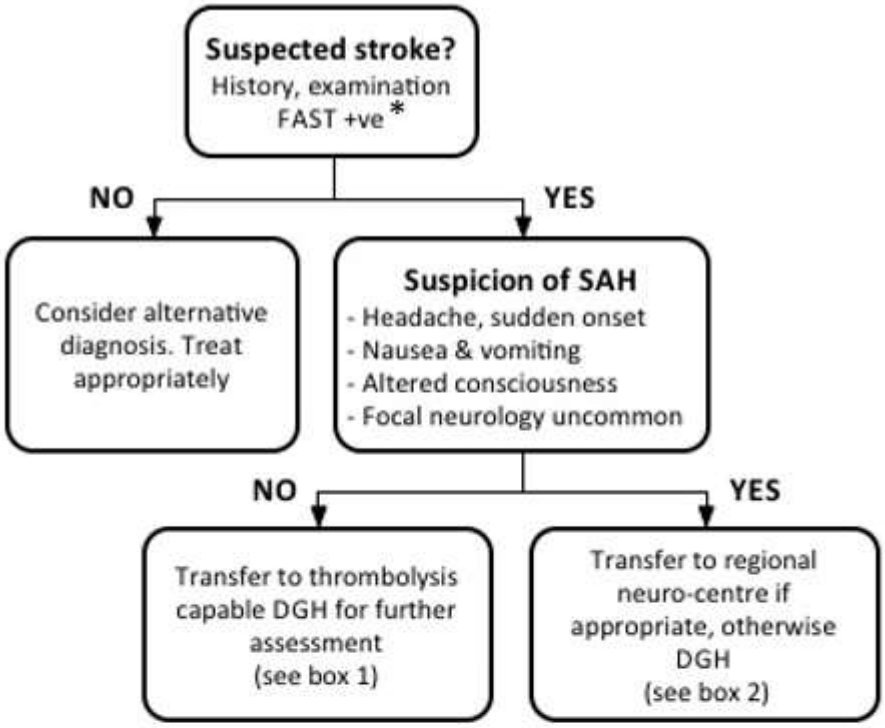
Differential diagnosis

It is especially important to exclude hypoglycaemia, and blood glucose should be determined in all such patients. The differential diagnosis of stroke is broad, and includes migraine aura, syncope (numerous aetiologies), metabolic derangement and tumours. A history of recent trauma (see CSOP 010) should raise the suspicion of a subdural haematoma. Subarachnoid haemorrhage should be considered if there is a history of sudden onset, severe headache (97% cases) that may or may not be associated with loss of consciousness, nausea and vomiting, meningism and exertion prior to symptoms (50%). In these alternative diagnoses lateralising signs are uncommon, as are seizures, which predict a poor outcome.

Inform the appropriate hospital of pending suspected stroke patient arrival so that they can prioritise assessment and potentially minimise time to thrombolysis, if appropriate.

Final disposition

Wales has a well-defined stroke pathway and the facility to offer full assessment and stroke thrombolysis in all major hospitals, 24 hours a day (except Neville Hall Hospital, Abergavenny after 1700hrs). Centres have the ability to seek advice from the University Hospital of Wales, via a telemedicine link. Unfortunately there is no reliable method of differentiating SAH from other forms of stroke, so clinical judgement will be required in considering transfer to a tertiary neuro-centre. Stroke thombectomy pathways are being introduced across Wales, and are accessed via stroke units.



BOX 1 **Welsh hospitals with stroke thrombolyis capability**

Ysbyty Gwynedd, Bangor
Wrexham Maelor, Wrexham
Withybush, Haverfordwest
Prince Philip, Llanelli
Prince Charles, Merthyr Tydfil
Princess of Wales, Bridgend
Royal Gwent, Newport
Glan Clwyd, Rhyl
Bronglais, Aberystwyth
Glangwili, Carmarthan
Morriston , Swansea
Royal Glamorgan, Llantrisant
University Hospital of Wales, Cardiff

Neville Hall Hospital, Abergavenny (not after 17:00h, use Royal Gwent, Newport)

BOX 2 **Considerations**

SAH is less likely over 65 years
Significant comorbidites/frailty
Significant premorbid dependency

*FAST = rapid screen for CVA:
"Face Arm Speech"

Status Epilepticus

Status epilepticus is a common life-threatening neurological emergency, which is defined as a state of prolonged seizure (>5 minutes) or failure to recover fully between successive seizures. It may occur as a first presentation of a seizure disorder, an exacerbation of a pre-existing disorder, or secondary to a trigger insult.

Seizures can be classified into convulsive and non-convulsive, the latter requiring an EEG for diagnosis. Both can be subdivided further in generalised or focal. This CSOP focuses on the management of Generalised Convulsive Status Epilepticus (GCSE), as prompt treatment reduces the risk of complications. Delay in treatment and thus increased duration of seizure, is associated with neuronal damage, refractory status epilepticus and increased mortality. Status epilepticus is itself associated with a mortality of around 10-20%.

Initial management

A standard ABCDE approach, with particular consideration of the following:

1. Hypoglycaemia must be specifically excluded.
2. Consider other precipitants (drugs/alcohol, infection, trauma, metabolic etc).
3. Children under the care of a specialist neurologist may have a defined management plan.
4. All are at risk of cardiovascular and respiratory compromise.

Pharmacological therapy

Benzodiazepines are the first line of treatment for GCSE, although treatment with a non-benzodiazepine anti-epileptic drug (AED) may be considered to prevent further recurrence, even if the convulsions have stopped.

EMRTS carries midazolam. If IV access is not immediately available, then midazolam has been shown to be useful in the pre-hospital setting given buccally or more recently IM. The management of refractory status epilepticus is shown in figure 2.

Drug doses

MIDAZOLAM

Buccal: Adult 10mg; Child up to 6months 300mcg/kg (max 2.5mg); 6months - 1 year 2.5mg; 1-5years 5mg; 5-10years 7.5mg; over 10 years 10mg. Can be repeated once after 10 minutes if required.
Intravenous/IO: 0.2mg/kg. If vascular access is unavailable it can be given
IM (over 13kg only): 13-40kg dose 5mg; >40kg dose 10mg.

LEVETIRACETAM (KEPPRA)

Intravenous. Put dose in 100ml saline and give over 15 minutes.

Dose: 30mg/kg to a maximum of 2g.

THIOPENTONE

Intravenous/IO 4mg/kg proceeded by paralysis and intubation/ventilation.

Injuries

It is well recognised that injuries may occur during seizure activity, despite efforts to protect the patient. Head and facial injuries and shoulder dislocation (posterior, bilateral) may occur. Particular attention should be paid to the tongue, where in rare cases airway obstruction has occurred as a result of biting.

Final disposition

Whilst most adult patients can be transferred to the nearest acute hospital the underlying aetiology needs to be considered. If trauma or a SAH is suspected, transfer to a neurosurgical centre is likely to be appropriate. Paediatric patients will warrant a low threshold for consideration of a paediatric centre, unless seizure activity resolves rapidly.

Summary

Most patients with medical neurological emergencies will be transferred to their local hospital for further assessment and management. The exceptions will be where trauma or SAH is suspected and there are no obvious contraindications to tertiary intervention. Protracted seizures in children, or those under the care of a specialist neurologist, will require careful consideration for transfer to a paediatric centre.

Audit Criteria

Transient complications at induction (hypotension or desaturation) in patients with non traumatic brain injury undergoing emergency anaesthesia – 10%.

Hypotension – SBP $\leq$90mmHg within 5mins of induction.

Desaturation – SpO2 $\leq$92% within 5mins of induction.

References and Further Reading

1. Jauch EC, Saver JL, Adams HP JR *et al.* Guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke* 2013; 44: 870-947.

2. Prabhakaran S, O'Neill K, Stein-Spencer L, Walter *et al*. Pre-hospital triage to primary stroke centres and rate of stroke thrombolysis. *JAMA Neurol* 2013; 70(9): 1126-1132.

3. Leonardi-Bee J, Bath PM, Phillips SJ *et al*. Blood pressure and clinical outcomes in the International Stroke Trial. IST Collaborative Group. *Stroke* 2002; 33(5): 1315-20.

4. Alldredge BK, Gelb AM, Isaacs SM *et al*. A comparison of lorazepam, diazepam, and placebo for the treatment of out-of-hospital status epilepticus. *N Engl J Med* 2001; 345(9): 631-7.

5. Silbergleit R, Durkalski V, Lowenstein D *et al*. Intramuscular versus intravenous therapy for prehospital status epilepticus. *N Engl J Med* 2012; 366(7): 591-600.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Sepsis

Reference Number	EMRTS CSOP 033
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 030, CSOP 034, CSOP 036, CSOP 044

Author(s)	Ian Bowler
Internal reviewer(s)	Owen McIntyre
External reviewer(s)	
Sign off	COB

Introduction & Objectives

Evidence shows that prehospital recognition of sepsis with appropriate destination selection and handover are associated with improved outcome. The purpose of this SOP is:

1. To outline terminology and concepts surrounding the subject.
2. To ensure teams are equipped to rapidly diagnose and manage adult patients with severe sepsis.

Sepsis – definitions and concepts

Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection.

Septic Shock is a subset of sepsis with circulatory and cellular/metabolic dysfunction. Essentially, the guideline emphasises that a patient with infection merits further assessment, and that any evidence of Red Flag Symptoms should trigger aggressive management:

Adult red flag symptoms

Responds only to voice or pain or unresponsive

SBP < 90mmHg or drop of >40 from normal

HR >130

RR > 25

Needs oxygen to maintain SpO_2 >92

Non-blanching rash / ashen / mottled / cyanosed

Not passed urine in last 18 hours

Lactate > 2mmol/l

Recent chemotherapy

For Red Flag criteria in children 0-5 and 5-11 yrs see UK sepsis trust action tools (refs)

The keys to managing sepsis are prompt recognition, administration of antibiotics, and source control, while attempting to restore tissue perfusion. This is expanded upon below.

EMRTS are unlikely to become involved in the management of sepsis, unless the patient has septic shock.

EMRTS management (if not already initiated by a referring hospital or land crew)

Institution of the following measures will depend on the clinical context.

For all patients:

1. Oxygen to target SpO2 of 94-98% (88-92% if COPD).
2. IV fluids.
3. Appropriate and timely antibiotics.
4. Check lactate.

In addition for retrieval from a hospital setting:

1. Take cultures including blood (before antibiotics).
2. Catheterise and measure Urine Output.

These measures are often termed the 'sepsis six' (with a slight change to reflect current O_2 guidelines).

The App 'MicroGuide' contains local guidance for antimicrobial selection: top cover should use this if referring centres require help on antimicrobial selection.

Further Management

In addition to standard management of the critically ill patient, ensure the following:

Adequate Resuscitation

Fluid

End point for fluid resuscitation will depend on the clinical scenario and clinician experience. In general, keep giving fluid boluses until there is no further haemodynamic improvement. Bedside echocardiography may be particularly useful here, in particular IVC collapsibility with respiration. Aim for MAP 65 mmHg

It is likely that at least 2 litres of fluid will be required (Sepsis 3 recommends 30ml/kg as initial bolus).

Use crystalloids for fluid resuscitation, re-assess with thorough clinical evaluation.

Vasoactive drugs

It is often clear from the outset that a patient will require vasoactive drugs. Site lines as rapidly as possible while fluid resuscitation is underway.

In the prehospital setting, peripheral lines may be used for vasoactive drugs.

In a retrieval setting, arterial/central line should be sited prior to transfer.

Noradrenaline is the first line choice and is primarily a vasoconstrictor. It is the initial drug of choice for sepsis.

This is made up using a standard EMRTS preparation. (see CCP drugs guide, guide to paediatric infusion and CSOP 034 inotropic support)

If there is suspicion of poor cardiac contractility based on clinical or echocardiographic grounds, adrenaline may be added.

End points of resuscitation from Sepsis 3 are MAP, CVP, Central Venous Oxygen Saturation, urine output, and lactate clearance. In reality, achieving haemodynamic stability will be a sufficient goal to enable safe transfer. A MAP of 65mmHg is adequate for transfer.

Bicarbonate is not recommended to improve haemodynamics in patients with hypo-perfusion induced lactic acidaemia with pH > 7.15

Blood transfusion is only recommended when Hb < 70g/L in adults in the absence of extenuating circumstances (myocardial ischaemia / severe hypoxaemia / acute haemorrhage), and Lyoplas is not recommended to be used in the absence of bleeding.

Ventilatory support

Institute based on standard practice. If patient intubated, use lung-protective ventilation strategy (6ml/kg, upper pressure limit 30 cm H_20).

Antibiotics/source control

Ensure appropriate and timely antibiotics have been given, and that this is documented (along with the time).

Use the Microguide all-Wales antibiotic app: There are recommendations for generalised sepsis, and for sepsis where the source is known. If in doubt, follow the generalised sepsis guidance.

Remove source of infection (e.g. lines, catheter,) where practical and safe.

Disposition of patient

All acute hospitals should be able to manage sepsis. However, the underlying diagnosis may mandate transfer to a site with appropriate expertise (e.g. neutropenic sepsis to a hospital with oncology support, acute abdomen to a site with acute general surgery).

Patients with severe sepsis/septic shock are managed in a critical care environment.

Ensure that the appropriate specialties are aware that the patient is coming, and that a consultant in the destination hospital has accepted the patient for ongoing care.

Summary

1. Give rapid initial IV resuscitation by bolus infusion
2. Give early, appropriate antibiotics.
3. Institute appropriate cardiorespiratory support.
4. Ensure liaison with critical care prior to arrival if organ support needed.
5. Ensure liaison with appropriate specialty for source control.

Audit Criteria

Appropriate intravenous antibiotics given within 1 hour of first EMRTS telephone contact (100%).

References and Further Reading

Surviving Sepsis Campaign. International Guidelines for Management of Severe Sepsis and Septic Shock. CCM 2012; 41(2): 580-637.

Emergency Medical Retrieval Service. Sepsis. (Standard Operating Procedure). Available at www.emrs.scot.uk (accessed 1/12/2014).

2016 NICE Clinical Guideline on Sepsis (NG51)

sepsistrust.org – toolkit: Prehospital management of sepsis in adults and young people – 2016

Sepsis 3 – JAMA 2016; 315:775-787

Appendices

Your logo

Prehospital Sepsis Screening and Action Tool

THE UK SEPSIS TRUST

To be applied to all non-pregnant adults with fever (or recent fever) symptoms

NB there is no systems substitute for clinical experience & acumen, but Red Flag Sepsis will help with early identification of children with systemic response to infection

1. Is the NEWS 3 or above?

AND/OR does patient look very sick?

Tick

N → Low risk of sepsis. **If concerned consider other diagnoses, transfer as required.** Use standard protocols. If not for transfer recommend contact GP/OOH/111 if concerned, or 999 if patient deteriorates rapidly

Y ↓

2. Is the history suggestive of infection?

Tick

- Yes, but source not obvious
- Pneumonia/ likely chest source
- Urinary Tract Infection
- Abdominal pain or distension
- Cellulitis/ septic arthritis/ infected wound
- Device-related infection
- Meningitis
- Other (specify: .....)

N → Give safety netting advice: call 999 if patient deteriorates rapidly, or call 111/ arrange to see GP if condition fails to improve or gradually worsens. Signpost to available resources as appropriate.

Y ↓

3. Is ONE Red Flag present?

Tick

- Responds only to voice or pain/ unresponsive
- Systolic B.P ≤ 90 mmHg (or drop >40 from normal)
- Heart rate > 130 per minute
- Respiratory rate ≥ 25 per minute
- Needs oxygen to keep SpO_2 ≥92%
- Non-blanching rash, mottled/ ashen/ cyanotic
- Not passed urine in last 18 hours
- Urine output less than 0.5 ml/kg/hr
- Lactate ≥2 mmol/l
- Recent chemotherapy

N → **4. Is any ONE Amber Flag present?**

Tick

- Relatives concerned about mental status
- Acute deterioration in functional ability
- Immunosuppressed
- Trauma/ surgery/ procedure in last 6 weeks
- Respiratory rate 21-24 OR breathing hard
- Systolic B.P 91-100 mmHg
- Heart rate 91-130 OR new arrhythmia
- Not passed urine in last 12-18 hours
- Temperature < 36°C
- Clinical signs of wound, device or skin infection

If immunosuppressed & under 18 treat as Red Flag Sepsis

Y ↓

Sepsis likely

Transfer to designated destination.

Communicate likelihood of sepsis at handover.

Y ↓

Red Flag Sepsis!

This is time-critical, immediate action is required!

Resuscitation:

Oxygen to maintain saturations >94% (88% in COPD)

Record lactate (if available)

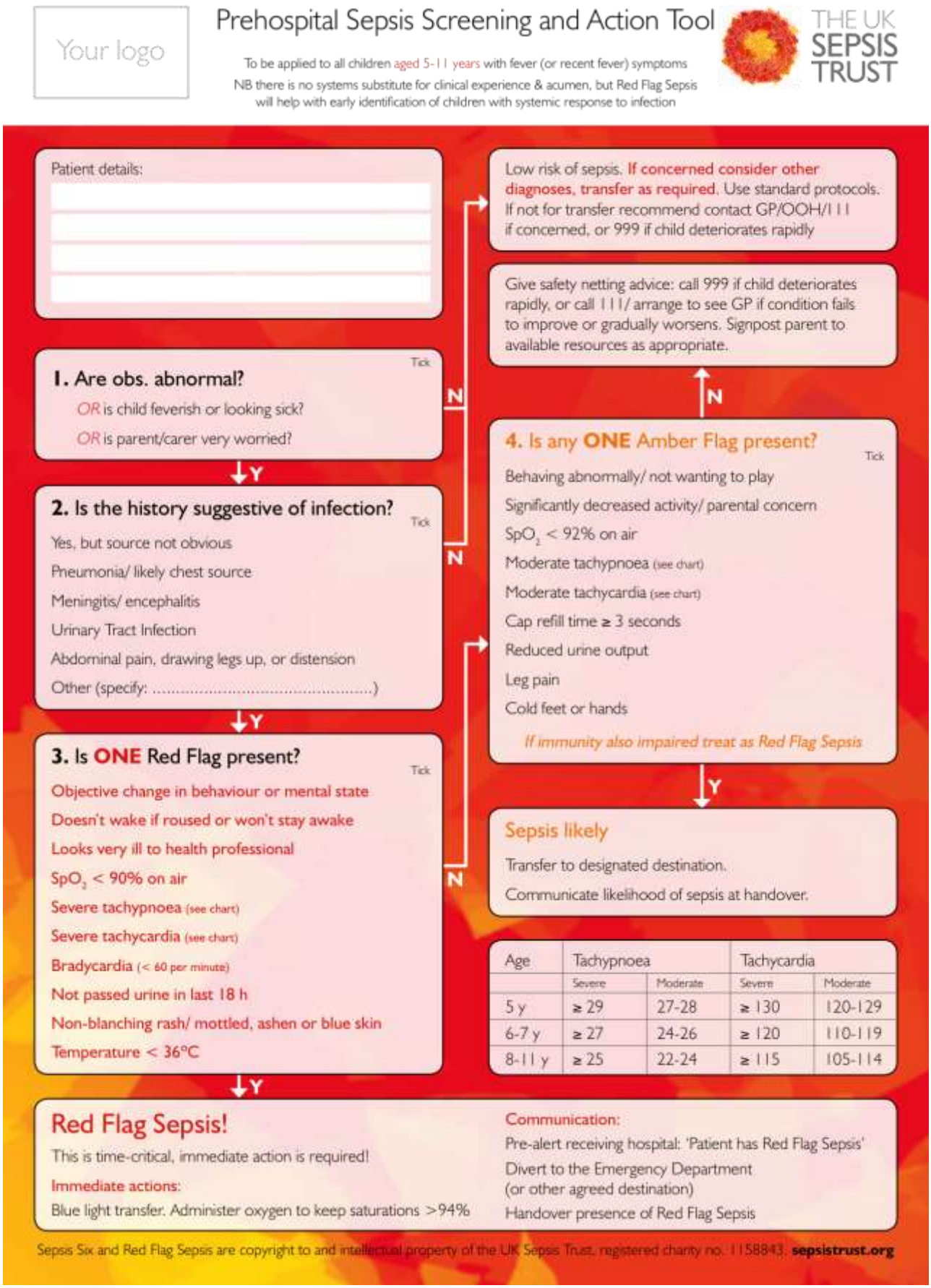
250ml boluses of Sodium Chloride: max 250mls if normotensive, max 2000ml if hypotensive/lactate > 2mmol/l

Communication:

Pre-alert receiving hospital: 'Patient has Red Flag Sepsis'

Divert to the Emergency Department (or other agreed destination)

Handover presence of Red Flag Sepsis


Your logo
Prehospital Sepsis Screening and Action Tool
To be applied to all children aged 5-11 years with fever (or recent fever) symptoms
NB there is no systems substitute for clinical experience & acumen, but Red Flag Sepsis will help with early identification of children with systemic response to infection
THE UK SEPSIS TRUST
Patient details:
1. Are obs. abnormal?
Tick
OR is child feverish or looking sick?
OR is parent/carer very worried?
N
Y
2. Is the history suggestive of infection?
Tick
Yes, but source not obvious
Pneumonia/ likely chest source
Meningitis/ encephalitis
Urinary Tract Infection
Abdominal pain, drawing legs up, or distension
Other (specify: .....)
N
Y
3. Is ONE Red Flag present?
Tick
Objective change in behaviour or mental state
Doesn't wake if roused or won't stay awake
Looks very ill to health professional
SpO2 < 90% on air
Severe tachypnoea (see chart)
Severe tachycardia (see chart)
Bradycardia (< 60 per minute)
Not passed urine in last 18 h
Non-blanching rash/ mottled, ashen or blue skin
Temperature < 36°C
N
Y
4. Is any ONE Amber Flag present?
Tick
Behaving abnormally/ not wanting to play
Significantly decreased activity/ parental concern
SpO2 < 92% on air
Moderate tachypnoea (see chart)
Moderate tachycardia (see chart)
Cap refill time ≥ 3 seconds
Reduced urine output
Leg pain
Cold feet or hands
If immunity also impaired treat as Red Flag Sepsis
N
Y
Low risk of sepsis. If concerned consider other diagnoses, transfer as required. Use standard protocols. If not for transfer recommend contact GP/OOH/111 if concerned, or 999 if child deteriorates rapidly
Give safety netting advice: call 999 if child deteriorates rapidly, or call 111/ arrange to see GP if condition fails to improve or gradually worsens. Signpost parent to available resources as appropriate.
Sepsis likely
Transfer to designated destination.
Communicate likelihood of sepsis at handover.
Age | Tachypnoea | | Tachycardia | |
| | Severe | Moderate | Severe | Moderate |
5 y | ≥ 29 | 27-28 | ≥ 130 | 120-129
6-7 y | ≥ 27 | 24-26 | ≥ 120 | 110-119
8-11 y | ≥ 25 | 22-24 | ≥ 115 | 105-114
Red Flag Sepsis!
This is time-critical, immediate action is required!
Immediate actions:
Blue light transfer. Administer oxygen to keep saturations >94%
Communication:
Pre-alert receiving hospital: 'Patient has Red Flag Sepsis'
Divert to the Emergency Department (or other agreed destination)
Handover presence of Red Flag Sepsis
Sepsis Six and Red Flag Sepsis are copyright to and intellectual property of the UK Sepsis Trust, registered charity no. 1158843. sepsistrust.org

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Inotropic Support

Reference Number	CSOP 034
Application	EMRTS Doctors and CCPs
Related SOPS	CSOP 010, CSOP 012, CSOP 25a/25b, CSOP 027, CSOP 033, CSOP 037

Authors	Matt Redmond, John Glen
Internal Reviewer	Stuart Gill
Sign off	COB

Introduction & Objectives

EMRTS responds to critically ill patients. A number of these patients will be haemodynamically unstable, and will require inotropic or vasopressor support both to facilitate safe transfer, and as part of their definitive care. The purpose of this SOP is to:

1. Outline situations when EMRTS may use inotropes/vasopressors (hereafter termed 'vasoactives').
2. Provide clinical guidance for the use of vasoactive support.
3. Define minimum monitoring required during use of vasoactives.

This CSOP is not intended to apply to trauma patients, the majority of whom will not benefit from inotropic support. Exceptions are brain and spinal injury, where achievement of MAP target may require vasoactive infusion.

Inotropes within EMRTS

EMRTS carries three vasoactives: metaraminol, adrenaline (epinephrine) and noradrenaline (norepinephrine). This is a compromise, since it is not feasible to carry a full range of vasoactive drugs.

Metaraminol

Indications: to reverse hypotension associated with anaesthesia and neurogenic shock.

Metaraminol is a vasopressor, with little other activity.

Noradrenaline

Indications: sepsis, undifferentiated shock, cardiogenic shock, neurogenic shock; hypotension related to anaesthesia.

Although classically considered a vasopressor, noradrenaline has some beta action and will increase cardiac output significantly.

Adrenaline

Indications: shock state where patient has not responded to noradrenaline; situations where predominantly inotropy (rather than vasoconstriction) is required; bradycardia and profound vasodilatation (e.g. anaphylaxis).

Adrenaline is associated with more arrhythmias than noradrenaline.

The EMRTS pre-draw adrenaline by diluting 1ml of 1:10,000 (minijet) with 9mls of saline, to give a 10mcg/ml solution. This can be given in 1-2ml boluses through a briskly running peripheral cannula. For anaphylaxis this can be increased to 50 mcg (5ml) or 1 mcg/kg for children (0.1 ml/kg).

Clinical Use of Metaraminol

1. Make up 1 ampoule (10mg) to a total of 20ml. This gives a 500mcg/ml solution.
2. Give 0.5-1ml as an IV bolus.
3. Alternatively, run as an infusion by making up 20mg in 40ml.
4. A reasonable starting dose is 5ml/hr. Follow the caveats below regarding dead space/priming.

Clinical Use of Adrenaline/Noradrenaline

1. Make up 1 ampoule (4mg) to a total of 40ml. This gives a 100mcg/ml solution.
    - An alternative *in extremis* is to simply load a minijet into the syringe driver. In this case, dosing will be approximate, and the syringe will run out quite quickly.
2. Prior to patient connection, ensure all slack is taken up in the line by priming via the pump.
3. A reasonable starting dose is 5ml/hour. This is equivalent to 0.1mcg/kg/min for an 80kg patient (see appendix).
4. Bear in mind that the dead space of a line (peripheral or central) may be anything from 0.2 to 0.5 ml. It will thus take up to 5 minutes before any drug reaches the circulation.
5. Titrate every few minutes according to response. There is little point infusing noradrenaline at a rate greater than 1mcg/kg/min (50ml/hour). Adrenaline infused at rates higher than 0.5mcg/kg/min will behave primarily like a vasoconstrictor.

6. MAP target of 65mmHg is reasonable in the retrieval setting, except in the context of head or spinal injury, where 80mmHg should be achieved.

Prior to starting a vasoactive, consider/ensure the following:

1. Adequate volume resuscitation guided by USS if possible. This provides a suitable start point for use of inotropes and or vasoconstrictors. Using vasoactive drugs on system that is under filled can lead to compromise. Adequate filling may avoid the use of vasoactive drugs entirely.
2. Secure intravenous access which has been tested and properly fixed. Loss of access is a disaster, with failure of inotropic therapy and the consequences of extravasation of potent vasoconstrictors.
3. A central line is the optimal means of delivering vasoactives. However, it is recognised that in certain circumstances (e.g. need for immediate resuscitation, major coagulopathy), a peripheral line is all that is available. In this case, the line should be dedicated to the vasoactive, visible/accessible throughout transfer, and well secured.
4. In the retrieval setting, it may not be possible to insert a central line according to WHAIP guidance. Receiving unit should be informed if this is the case.
5. Patient should have continuous SpO_2, ECG and invasive arterial blood-pressure monitoring prior to transfer. Again, it is recognised that in certain circumstances arterial access may be impossible. However, the reliability of non-invasive BP measurements, particularly in moving vehicles/rotary aircraft, is questionable. Consider discussing such cases with Top Cover Consultant.

Cautions/Contraindications

Vasoactives are powerful drugs with serious side effects. Since the alternative to their use is probable death, all contraindications are relative. It should, however, be borne in mind that vasoactives can worsen myocardial ischaemia, and precipitate arrhythmias.

Management prior to EMRTS arrival

Specific management will depend on diagnosis. Referring team should, at a minimum, optimise volume loading, and insert a urinary catheter. This can be guided by the Top Cover Consultant whilst the team are *en route* to save time.

Disposition of patient

Patients will need to be taken to a unit capable of level 3 support. Specific disposition will depend on underlying diagnosis: see relevant CSOPs.

References and Further Reading

Surviving sepsis campaign: International guidelines for management of severe sepsis and septic shock. *Critical Care Medicine.* 2008; 36: 296-327.

Rational use of inotropes. *Anaesthesia and intensive care medicine* 2006; 7: 326-330.

Association of Anaesthetists of Great Britain and Ireland. Recommendations for the safe transfer of patients with brain injury. AAGBI, London, 2006.

Manaker S. Use of Vasopressors and Inotropes. In: Uptodate, Post TW (Ed), Uptodate, Waltham, MA. (Accessed on 26th Dec 2014).

Emergency Treatment of Anaphylactic Reactions. Guideline for Healthcare Providers. Working Group of the Resuscitation Council UK. January 2008 (annotated with links to NICE guidance July 2012).

Emergency Medical Retrieval Service (Scotland). Inotropic Support Standard Operating Procedure, 2010. Available at www.emrs.scot.nhs.uk (Accessed 27/12/2014).

Appendix

Adrenaline/Noradrenaline infusion rates (mcg/kg/min) for a 100mcg/ml (i.e. 4mg in 40ml) solution.

	60kg	70kg	80kg	90kg	100kg
5ml/hr	0.15	0.12	0.1	0.1	0.1
10ml/hr	0.3	0.25	0.2	0.2	0.15
15ml/hr	0.4	0.35	0.3	0.3	0.25
20ml/h	0.6	0.5	0.4	0.35	0.3

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Poisoning

Reference Number	CSOP 035
Application	EMRTS Consultants and CCP's
Related SOPS	Nil

Toxbase username H1671 password 7SND23

National Poisons Helpline on 0844 8920111

Author(s)	Ami Jones
Internal reviewer(s)	Graham Mayers
Sign off	COB

Introduction & Objectives

This CSOP outlines the standard approach to known/potential poisoning with a brief overview of common presentations and antidotes carried by the EMRTS. It has been adapted to the group of patients that EMRTS are likely to be tasked to. These presentations are not exhaustive and in the vast majority of cases only supportive treatment is required prior arriving in the ED. Poisoning in context of a major incident or mass casualty event are considered separately (e.g. organophosphates)

General Approach

There are three key aspects to managing patients with a history of poisoning:

1. Identification that the patient may have accidently or intentionally been poisoned. This may not be immediately obvious and should be considered in the differential diagnosis of an unconscious patient.
2. Supportive treatment and specific antidote treatment in the pre-hospital environment including how to get additional information.
3. Issues pertaining to suicidal risk and mental capacity.

Prior to approaching a patient who may be combative and agitated ensure the police are involved where necessary. A significant amount of information can be gained from the environment in which the patient is found (e.g. used IV needles, empty medications packets etc.). Bystanders may be able to give clues as to what might have happened. Establish if there has been any suicidal intention.

Patients should have a thorough assessment using a standard ABCDE approach examining the patients for any classical presentations of poisoning and concurrent injuries (e.g. falls, hanging). Injuries should be managed according to related CSOPS.

Supportive Treatment

Supportive treatment will consist of the following:

Airway – Early intubation by RSI to protect the airway – Consider concurrent c-spine injury after falls and treat accordingly.

Breathing – Early respiratory support for oxygenation and ventilation as considered above.

Circulation – Full monitoring (inc. 12 lead ECG). IV access and fluid/vasopressor/inotropes if hypotensive. Judicious use of induction agent pre-RSI if hypotensive. Consider blood gas analysis and correct metabolic disturbance.

Disability – GCS, pupil and limb movement/tone. Always consider hypoglycaemia and opiate poisoning FIRST prior to RSI in an unconscious patient. If hypoglycaemic correct with 10% dextrose and give naloxone for suspected opiate poisoning (as indicated below). If no response, consider RSI. Consider pre-RSI sedation for combative and agitated patients.

Exposure – Check temperature, warm or cool depending upon underlying condition. For patient with a history of fever, muscle rigidity and seizures consider serotonin syndrome or neuroleptic malignant syndrome. Cool patient rapidly with Medicool system.

There are some specific treatments which need to be considered. It must be noted that many presentations are mixed and do not fall neatly into a category of a 'toxidrome.' In these cases supportive therapy is usually the key.

Specific Treatments

Specific Treatments			
Agent	**Presentation**	**Antidote(s)**	**Dose**
Opiates (inc. heroin, cocodamol, morphine/fentanyl)	Unconsciousness, respiratory depression, pinpoint pupils, hypotension	Naloxone	0.4-2.4mg IV (0.8mg IM/IN in heroin OD initially in case patient absconds)
Benzodiazepines	Unconsciousness, Respiratory depression, Hypotension	Flumazenil (for iatrogenic poisoning ONLY), avoid if mixed OD and dependent of benzodiazepines	0.1-0.2mg repeated up to 2mg to effect

Tricyclic Antidepressants (TCA's)	Unconsciousness, tachyarrhythmia's (broad complex tachycardia then VT), hypotension, dilated pupils	Sodium Bicarbonate	50ml 8.4 % (Give in patients with broad complex tachycardia, acidosis or cardiac arrest)
B-blockers	Bradycardia, hypotension, hypoglycaemia	Glucagon	3-5mg IV slowly (may cause nausea and vomiting) Consider atropine, pacing and adrenaline 10mcg/ml
Calcium channel blocker	Bradycardia, hypotension	Calcium chloride 10%	10ml repeated twice Consider atropine, pacing and adrenaline 10mcg/ml
Extra pyramidal effects of metaclopramide/cyclizine	Dystonic reaction	Procyclidine	10mg IV/IM
Carbon monoxide poisoning	Often no clear history of exposure – symptoms can be non-specific (e.g. headaches, tiredness, nausea, dizziness, confusion) High index of suspicion if others unwell	Oxygen therapy	If unconscious intubate patient Hyperbaric should be considered once diagnosis established if severe
Organophosphates	CBRN or agricultural exposure (e.g. pesticides) D&V, rhinorrhoea and bronchorrhoea, pinpoint pupils Reduced conscious level and arrhythmias	Atropine and Pralidoxime Magnesium and Sodium Bicarbonate for patients with prolonged QRS/QTc or tachyarrhythmias	Atropine 2mg repeated as necessary Pralidoxime in presence of rhinorrhoea and bronchorrhoea (Consider PPE)

EMRTS carries intralipid for local anaesthetic toxicity but it can also be used for some other overdoses e.g. TCA's and calcium channel blockers. Although good evidence is lacking, patients in cardiac arrest may benefit from early Lipid Rescue. 1.5ml/kg of a 20% solution (e.g. about 100ml for a 70kg patient) should be considered and repeated 1-2 times for patients in persistent cardiac arrest (e.g. at 5 minute intervals).

Further Information

In addition to the above additional information is rarely needed, however, if required Toxbase is available on line (Toxbase username H1671 password 7SND23). Alternatively call the National Poisons Helpline on 0844 8920111.

Suicidal risk and Mental Capacity

In the vast majority of cases the EMRTS will be managing patients who are unconscious from poisoning and as this group lacks mental capacity a best interest decision is made to treat them.

For those patients who pose a high suicidal risk (either an immediate danger to themselves or other people) in a public place then the police should be informed to take the patient to a place of safety under a section 136. In the vast majority of cases this will be an Emergency Department.

If the patient needs medical treatment but refuses, an assessment should be carried out as to whether the patient has mental capacity to make that decision and appropriate action taken accordingly.

Disposition

All patients managed by EMRTS should be taken to their nearest acute hospital if appropriate. Those whom are unconscious or with haemodynamic instability should be transferred to the nearest acute hospital with critical care facilities.

References and Further Reading

Wyatt JP et al. Oxford Handbook of Emergency Medicine (3rd Ed). Oxford: Oxford University Press, 2012.

Lipid Rescue Resuscitation. http://lipidrescue.org/.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Acute Abdomen

Reference Number	CSOP 036
Application	EMRTS Doctors and CCP's
Related SOPS	Multiple

Author(s)	Ian Bowler
Internal reviewer(s)	Camilla Waugh
External reviewer(s)	
Sign off	COB

Introduction

Intra-abdominal pathology is a common cause of mortality and morbidity. Patients with an acute abdomen may have a wide range of pathologies. Management should include appropriate system support and targeted resuscitation depending on the provisional diagnosis. Care in the primary setting is limited so focus should be on rapid transportation to hospital where appropriate investigations can be carried out including abdominal CT to ascertain the cause of the problem. Awareness required of potential delay when involving retrieval teams in context of time critical surgical abdomen. Patients to be transferred to the nearest surgical facility by fastest means possible when appropriate. A patient with an acute abdomen may be also encountered in the context of a time critical transfer.

Abdominal Assessment

Clinical examination of the abdomen is important but has limited value in the pre-hospital environment, although maybe helpful in the context of a transfer. PR examination has no benefit and should be left for a hospital surgical team to perform if required.

On scene examination should be carried out to determine two primary factors:

1. The presence of abdominal pathology.

2. Differentiation between sepsis OR a bleeding aneurysm for the hypotensive patient in order to guide therapy.

The abdomen should be assessed prior to intubation and ventilation. However, this should not delay initiation of ventilatory support. The ability to elicit an accurate abdominal assessment is significantly reduced once the patient is sedated and given muscle relaxant.

Gross findings including tenderness, significant organomegaly and obvious masses, if found, should be documented.

Ruptured or Dissecting Aneurysm

Severe new onset back pain should be assumed to be a vascular pathology until proven otherwise. Femoral pulses must always be checked to support the diagnosis as well as feeling for a pulsatile and expansile abdominal mass. These patients must be taken to a centre that can provide vascular surgical intervention.

Ultrasound

If the team has training and experience to perform an abdominal ultrasound then this may support diagnosis. However prolonged delays on scene in order to achieve good scan pictures must be avoided.

General management

Respiratory support

All critically ill patients should receive supplemental oxygen and if required, respiratory support. Abdominal pain can significantly reduce tidal volumes, minute ventilation and the ability to cough and clear secretions. As such analgesia is a priority.

Cardiovascular support

All hypotensive patients should receive targeted fluid resuscitation dependent on assumed pathology.

Patients with an acute abdomen and a clinical picture suggesting sepsis or SIRS should receive fluid boluses of a crystalloid (ideally Hartmann's solution) in order to achieve a mean arterial pressure of over 65 mmHg. Adults should receive 250ml boluses and children 20 ml/kg boluses. Should the patient remain hypotensive after 2000ml (or 40ml/kg in children) then vasoconstriction should be considered (peripheral in the primary setting or central in the transfer setting). *See CSOP 033 – Sepsis*.

Patients with a presumed bleed should receive blood and lyophilised plasma with the target being the presence of a radial pulse. Tranexamic acid must be given.

Arterial Blood Gases

Arterial blood gas analysis should be obtained in all patients with an acute abdomen and any of cardiovascular or respiratory compromise. The degree of metabolic acidosis may guide fluid management. Oxygenation can also be assessed and respiratory support tailored to need. If the patient is technically difficult then teams should not delay transfer in order to undertake repeat attempts at arterial blood sampling.

Pregnancy

Consider pregnancy related pathology in patients of childbearing age. Where suspected transfer must be

to a unit that can offer gynaecological and or obstetric support.

Antibiotics

Early appropriate antibiotics should be given in the context of suspected intra-abdominal sepsis.

Transfer to Hospital

The capabilities of destination hospital should reflect the presumed diagnosis.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Gastrointestinal Haemorrhage

Reference Number	CSOP 038
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 018, CSOP 019, ESOP – Oesophagogastric balloon tamponade

Author(s)	Chris Hingston
Internal reviewer(s)	Owen McIntyre
External reviewer(s)	
Sign off	COB

Introduction & Objectives

Gastrointestinal (GI) bleeding is a common medical emergency. While it can be divided into upper and lower GI bleeding, the principles of management are similar. The purpose of this CSOP is:

- To outline an approach to the management of both upper and lower GI bleeding.
- To provide a brief overview of transfer for liver disease.

Advice given in this CSOP is in line with both NICE and SIGN guidance.

Patients Suitable for EMRTS activation

Primary:

The Air Support Desk will activate a team to 'severe haemorrhage' of any sort.

Secondary:

Patients with GI haemorrhage who are unstable.

Patients with GI haemorrhage complicated by encephalopathy.

GI Haemorrhage: General Management Principles

Some or all of the following interventions may take place prior to team arrival.

- O_2 if indicated.
- 2 large bore cannulae (16G if possible) OR large bore central venous access.
- Resuscitate using blood products according to hypotensive resuscitation principles. See CSOP 019.
    - If blood products are available at referring facility, these can also be used.
    - Reverse warfarin if bleeding is severe (see reversal of anticoagulation SOP).
- Consider RSI if:
    - Severe uncontrolled variceal bleeding (airway protection; facilitates oesophagogastric tamponade).
    - Severe encephalopathy.
    - Ventilation failure.
    - Aspiration of gastric contents.
    - Concern that patient may aspirate gastric contents during transport.
        - Blood induces profound nausea.
        - Access to patient during transport will be difficult.
        - Risk/benefit decision.

      In all cases, ensure adequate resuscitation prior to RSI to avoid cardiovascular collapse.

If possible, a detailed history identifying any co-morbidities that may be implicated or exacerbated by the haemorrhage should be sought. A previous history of GI bleeding is relevant, since 60% of patients will bleed from the same lesion.

Upper Gastrointestinal Haemorrhage

Upper GI bleeding may be divided into variceal and non-variceal. Whilst the initial management is similar, there are differing treatment options available, some of which require transfer for specialist intervention.

Non-Variceal bleeding

Current guidance recommends deferring proton pump inhibitor (PPI) treatment until post endoscopy. However, if a transfer is likely to be delayed or prolonged and bleeding continues, there is some evidence that PPI therapy may promote haemostasis and thus should be considered. There is currently no proven role for tranexamic acid, although in the context of large ongoing blood losses and delay to endoscopy it could be considered.

Variceal bleeding

In contrast to non-variceal bleeding there are some specific therapies available in variceal haemorrhage:

1. Terlipressin 2mg IV should be given to all patients with suspected variceal bleeding. This should be repeated every 4 hours, and continued for 48 hours post endoscopy.

2. Balloon tamponade of uncontrolled variceal bleeding. See Oesophagogastric Tamponade Equipment SOP.
    - Patients requiring balloon tamponade need to be intubated first.
3. Ceftriaxone should be given to all non-allergic patients with suspected or confirmed variceal haemorrhage.

Oesophageal varices are generally managed with banding, while gastric varices are generally managed with sclerotherapy. This is of relevance to triage decision (below).

Uncontrollable variceal bleeding may respond to transjugular intrahepatic portosystemic shunt (TIPS) procedure. This may actually prompt mobilisation of the EMRTS, to facilitate an agreed transfer to a tertiary centre.

Hepatic encephalopathy is common in this group, and this may complicate plans for transfer

Lower gastrointestinal bleed

In 80-85% of cases bleeding will stop spontaneously. The remainder will require endoscopy. Massive upper GI bleeding may also present with lower GI symptoms of haematochezia.

Liver Disease

This may be acute or chronic with a wide differential diagnosis. If the aetiology is unknown personnel should be particularly vigilant in employing universal precautions. Particular factors to consider when transferring patients with liver failure are:

- Hypothermia – the patient may already be hypothermic and every effort should be made to attain and maintain normothermia during transfer.
- Hypoglycaemia – depending on stability of blood glucose may need to be checked hourly.
- Haemodynamics – patients with evolving acute liver failure can become hypotensive quite rapidly, necessitating a noradrenaline infusion on route.

Disposition

Upper GI Bleed: Patients should be taken to a facility capable of 24-hour endoscopy with band ligation and sclerotherapy. Destination facility should have ICU bed available if required.

Lower GI Bleed: Transfer to a facility with interventional radiology, and general surgery.

Liver disease: Secondary transfers for liver failure will be to a regional liver centre. Most prehospital cases will present with a complication of their illness, and immediate disposition will be driven by this.

References and Further Reading

1. Scottish Intercollegiate guidelines network (SIGN). Management of acute upper and lower gastrointestinal bleeding. A national clinical guideline. 2008

2. Acute upper gastrointestinal bleeding: Management. NICE guideline CG141

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Diabetic Emergencies

Reference Number	CSOP 039
Owner	Ami Jones
Reviewer	John Glen
Sign off	COB

Introduction & Objectives

To outline the initial management of Diabetic Emergencies (Diabetic Ketoacidosis (DKA), and Hyperosmolar Hyperglycaemic State (previously termed HONK)) and indications for EMRTS transfer.

Diabetic Ketoacidosis (DKA)

Background

DKA is a common and potentially life threatening emergency with a mortality of up to 5%. It usually occurs in known diabetics, but it is often the first presentation of Type 1 Diabetes, particularly in the young.

DKA is present when there is:

- Hyperglycaemia (blood glucose >11 mmol/l,
- Metabolic Acidosis (venous Bicarbonate <15, and/or venous pH <7.3)
- Ketosis (ketonuria/ketonaemia).

Clinicians should follow the guidance in the Joint British Diabetes Societies publication on this subject, to which the Welsh Endocrine Diabetes Society is a signatory. It is available at:

https://www.diabetes.org.uk/resources-s3/2017-09/Management-of-DKA-241013.pdf (DKA Guideline 2013)

The following is based on the JBDS guidance for the immediate management of DKA (the first 6 hours).

Activation

EMRTS will deploy to high risk patients in order to transfer them to higher level of care. These include those failing to respond to initial fluid and insulin therapy, and those with reduced conscious level, respiratory or circulatory compromise or signs of sepsis.

In addition, the presence of the following may indicate severe DKA requiring retrieval:

Blood Ketones >6mmol/l; Bicarbonate <5mmol/l; venous pH <7.1; Hypokalaemia; Anion Gap >16.

Management

Most patients respond to supportive therapy and insulin, +/- treatment of underlying condition. A small proportion will require invasive monitoring and HDU/ITU support.

Extreme caution should be exercised if intubation and ventilation is undertaken as the patient is likely to be generating an excessively high minute volume by means of respiratory compensation for their metabolic acidosis so will become profoundly acidotic if these volumes are not matched by mechanical ventilation

Initial approach includes standard ABCDE:

1. Assess severity (see above).
2. Establish IV access x2 (central line may be necessary).
3. Fluid resuscitation.
    - Restore circulating volume with fluid boluses if required.
    - Fluid replacement – see appendix for typical regimen.
    - Insert a urinary catheter and start a fluid balance chart (hospital only).
4. Start IV insulin if available (hospital only).
    - Fixed rate Intravenous Infusion of Insulin: 0.1 units/kg/hour.
    - May need to be adjusted later. Can be increased by 1 unit/h increments hourly.
    - Continue long-acting insulins (Lantus/Levemir).
5. Address underlying/precipitating cause:
    - Infective: antibiotics/source control: see sepsis SOP.
    - Myocardial Infarction.
    - Others: any major illness; drugs (e.g. cocaine, steroids).

After one hour, the patient should be reassessed clinically, and with blood tests. Ketones should be falling by at least 0.5 mmol/l/hr. Alternatively; a Bicarbonate rise of 3mmol/l/h and a glucose fall of 3mmol/l/h is acceptable. Utilise the referring hospital to measure blood ketones.

Notes

1. Do not give a bolus dose of insulin.
2. There is no evidence to support use of Bicarbonate.
3. If glucose falls below 14mmol/l, commence 10% dextrose at 125ml/h alongside the Sodium Chloride infusion.

Hyperosmolar Hyperglycaemic State

Background

HHS usually occurs in elderly patients with Type 2 Diabetes. It has an insidious onset causing hyperglycaemia and dehydration without ketosis, and has a higher mortality than DKA due to co-existing medical conditions.

Treatment Priorities

https://diabetes-resources-production.s3-eu-west-1.amazonaws.com/diabetes-storage/migration/pdf/JBDS-IP-HHS-Adults.pdf (HHS guideline 2012)

Identify high risk patients: those failing to respond to initial fluid and insulin therapy and those with reduced conscious level, respiratory or circulatory compromise, signs of sepsis or significant co-morbidities.

Initial approach includes standard ABC.

1. Airway support and ventilation as appropriate.
2. IV access and careful fluid resuscitation - CVP monitoring may be useful to guide fluid replacement.
3. Thromboprophylaxis sc if no contraindications (hospital only).
4. Insulin to obtain a fall in BM 2-3 mmol/hr (hospital only).

Disposition of Diabetic Emergencies

Ensure destination facility has HDU bed if transporting unventilated.

Ensure destination facility has diabetic team.

References and Further Reading

Emergency Medical Retrieval Service. Diabetic Emergencies: Standard Operating Procedure. Available at http://www.emrs.scot.nhs.uk/index.php/service-user-area/sop/clinical-sops. (Accessed 1/2/2015).

Kitabchi A. Diabetic Ketoacidosis and the Hyperosmolar Hyperglycaemic State in Adults. In: Uptodate, Post TW (Ed), Uptodate, Waltham, MA. (Accessed on 1st Nov 2017).

HHS guideline 2012 : https://diabetes-resources-production.s3-eu-west-1.amazonaws.com/diabetes-storage/migration/pdf/JBDS-IP-HHS-Adults.pdf

DKA Guideline 2013: https://www.diabetes.org.uk/resources-s3/2017-09/Management-of-DKA-241013.pdf

Appendix: Typical Sodium Chloride infusion rate (from JBDS guideline)

This is intended for a previously well 70kg adult, without signs of shock.

Fluid	Volume
0.9% sodium chloride 1L *	1000ml over 1st hour
0.9% sodium chloride 1L with potassium chloride	1000ml over next 2 hours
0.9% sodium chloride 1L with potassium chloride	1000ml over next 2 hours
0.9% sodium chloride 1L with potassium chloride	1000ml over next 4 hours
0.9% sodium chloride 1L with potassium chloride	1000ml over next 4 hours
0.9% sodium chloride 1L with potassium chloride	1000ml over next 6 hours
Re-assessment of cardiovascular status at 12 hours is mandatory, further fluid may be required	

*Potassium chloride may be required if more than 1 litre of sodium chloride has been given already to resuscitate hypotensive patients

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Severe Hypothermia and Cold Injury

Reference Number	CSOP 040
Application	EMRTS Consultants and CCP's
Related SOPS	CSOP 042

Author(s)	Jonathan Whelan
Internal reviewer(s)	John Glen
External reviewer(s)	
Sign off	COB

Introduction & Objectives

Patients with a core temperature below 32^{0}C have a mortality of almost 40%. However, European and Scandinavian experience has shown that good recoveries can be made from apparently hopeless situations, provided the fall in temperature has occurred rapidly. Hypothermia confers significant neuro-protection with brain metabolism falling by 6-10% every degree below 35^{o}C.

Patients have made full recoveries after hours of CPR, but only with the appropriate care. This includes extra-corporal circulation, either with ECMO (extracorporeal membrane oxygenation), or with cardiopulmonary bypass. ECMO is the current modality of choice, causing less trauma to blood and requiring less anti-coagulation. Transport to an ECMO centre will clearly be dependent clinical, logistical and aviation issues which will need to be considered by the EMRTS team.

Cold injury (frostbite) is a separate disease entity, and refers to localised tissue damage secondary to exposure to cold. It may co-exist with hypothermia.

The objectives of this SOP are:

1. To outline an approach to moderate (<32^{O}C) and severe (<28^{o}C) hypothermia.
2. To provide a brief outline of the approach to cold injury (frostbite).

Prehospital Management of Moderate/Severe Hypothermia

The key management elements are:

1. Accurate temperature measurement.
2. Approach to cardiac arrest.
    a. Diagnosis.
    b. Avoidance of repeated defibrillation attempts while hypothermic.
    c. Referral to ECMO centre or centre capable of performing bypass.
3. Approach to patients with a cardiac output
    a. Minimisation of handling.
    b. Rewarming.
4. Address underlying causes if possible.

These will be expanded on below.

1. Accurate temperature measurement.

Accurate temperature measurement is vital for accurate estimation of:

1. Likelihood of significant arrhythmia
2. Prognosis in cardiac arrest.

The rectal route is unreliable, while oesophageal probes can trigger arrythmia. Oral or tympanic thermometers are best.

2. Approach to cardiac arrest

a. Diagnosis. Above 32^{o}C cardiac arrest is not due to hypothermia and should be treated as per usual guidelines. Below 28^{o}C cardiac arrest is likely. In the absence of evidence of cardiac arrest before cooling every effort should be made to get the patient to ECLS or bypass with prolonged CPR if necessary. The duration of cerebral protection conferred by hypothermia is unknown, and the only contraindications to commencement of CPR are a frozen chest wall, and obviously lethal injuries. EMRTS carries the Lucas Mechanical Chest Compression device, and this should be used.

   Patients with severe hypothermia may have a cardiac output despite having a carotid pulse that is too weak to feel. Treating this situation as PEA with chest compressions may be harmful. True PEA is likely to be transient, and there is little downside to withholding CPR for a short time in this patient group. Thus, if there is an organised rhythm compatible with a cardiac output in a severely hypothermic patient, it is acceptable to withhold CPR and adrenaline. Echo in life support may be useful in this situation to demonstrate cardiac activity when a pulse cannot be felt.

b. Avoidance of repeated defibrillation. In patients below 30^{o}C, defibrillation is very unlikely to be successful. Repeated attempts are likely to damage the myocardium and should not be attempted. Management of cardiac arrest is otherwise in line with ALS principles. If a patient is in asystole, an improvement in rhythm is very unlikely until the heart is rewarmed.

c. Referral to ECMO or cardiac centre for cardiopulmonary bypass. This should be done at the earliest possible time as shown below. Discussion with 'top cover' consultant in equivocal cases.

3. Approach to patients with a cardiac output

a. Minimise Handling. Patients must be treated with utmost care. The smallest movement can precipitate VF. Never raise the legs as the sudden return of cold blood to the core can have the same effect. Airway management in the severely hypothermic casualty is problematic. Airway manipulation may precipitate cardiac arrest: take great care with the use of airway devices.

b. Pre-hospital warming. If mild, hypothermia should be treated aggressively with dry clothes/blankets, a warm environment and hot drinks. Blizzard heat blankets should be used. However at a temperature below 30^{O}C even the act of removing clothing could cause heart rhythm disturbance. Consideration should be made to moving patient as little as possible, leaving in wet clothing and considering transfer to ECMO unit or for cardiopulmonary bypass.

4. Address underlying causes

Hypothermia secondary to disease should be considered. This includes infection, hypoglycaemia, overdose, and endocrine disturbance.

Prehospital Management of Cold Injury

Cold Injury (frostbite) is a separate entity to hypothermia, but the two may coexist. In a patient with life-threatening hypothermia, management of hypothermia takes precedence.

The management of cold-induced cutaneous injuries (frostbite) is supportive. Provide analgesia, splint to protect from damage, and remove wet clothing. Do not rub frostbitten areas. Never rewarm unless warming can be maintained: freeze-thaw cycling is particularly damaging. If warming of a frostbitten extremity is attempted, be aware that the area may be insensate and susceptible to further damage. Body heat or warm (not hot) water can be used, but not e.g. stoves or fires.

Appendix: Contact numbers for ECMO Centres

North Wales:

Wythenshawe Hospital, Manchester. ECMO co-ordinator 07837541143 (helipad available).

South Wales

Cardiopulmonary bypass available at Morriston Hospital and UHW – pre-alert to ED and request attendance of perfusionist.

Reference

Mechem C. Accidental hypothermia in adults. In: Uptodate, Post TW (Ed), Uptodate, Waltham, MA. (Accessed on 6th Feb 2015).

Severe accidental hypothermia. BMJ 2014; 348 doi: http://dx.doi.org/10.1136/bmj.g1675 (Published 21 February 2014) Cite this as: BMJ 2014; 348: g1675.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Electrocution

Reference Number	CSOP 041
Application	All EMRTS Doctors and CCP's
Related SOPS	

Author(s)	Graham Mayers, Camilla Waugh
Internal reviewer(s)	Pete Williams
External reviewer(s)	
Sign off	COB

Introduction

Patients can come into contact with electricity in a variety of situations.

Examples are:

Commoner:

Domestic electrocution

Outside or industrial e.g. incidents involving pylons or electrical supplies to trains.

Less common:

Lightning strike.

Less obvious supplies e.g. RTC involving damage to the electrical supply of a street lamp

Deliberate: Conducted Electricity Weapon use (Taser)

There needs to be a high index of suspicion in order to both keep the team safe and effectively deal with the patient.

Voltage Definitions

Voltage sources are usually defined as being above or below 1000 Volts.

- Low voltage <1000 volts
    - Domestic property 230 V (-6%/+10%)
    - Electric / hybrid vehicle battery pack 100 V to 600 V.

- High voltage >1000 volts
    - Conducted electrical weapons (Taser) 5 kV
    - All overhead power cables 11 kV to 400 kV
    - Industrial sites / most areas outside a domestic setting

- Very high voltage
    - Lightning. Can be millions of volts.

Mechanism of Injury

Electrical current can cause injury by a variety of different mechanisms:

- Electrocution - This may occur through direct contact or arcing. This primarily causes tissue disruption and cardiac arrhythmias. It can also cause severe muscle spasm with respiratory arrest or fractures.
- Thermal Burns - Heat from an electrical arc may cause thermal burns without directly entering the body (flash burn) or ignite nearby material including clothing (flame burn)
- Blunt injury - current may throw a patient some distance. Lightening can cause concussive forces.

Alternating Current (AC) under 1000 volts
Tends to cause tetany. If the magnitude of current is above “let go” threshold the patient may grip the source significantly increasing contact time. This will increase injury severity. Associated with significant internal injury Usually seen in the domestic setting so is the commonest type of electrical injury in children. May cause loss of consciousness, respiratory arrest or cardiac arrest. VF is more likely with a domestic supply due to the AC frequency.

Alternating Current (AC) over 1000 volts
Seen in industrial settings. Usually causes devastating thermal burns. Does not usually cause loss of consciousness or arrest but when present is likely to be asystole.

Direct Current (DC)
Seen in hybrid vehicles and in the industrial or non-domestic setting. Usually causes a large single muscle contraction that throws the victim away resulting in a reduced contact time. Blunt injury is common. Usually does not cause a loss of consciousness.

Other Factors

Other factors that may contribute to injury type and severity are:

- Contact duration
- Current magnitude (Amperes)
- Body resistance (Ohms)
- Pathway of current
- Individual susceptibility

Scene Safety

Domestic Setting

Low Voltage <1000 V - Usually AC

- Do not approach the patient
- Advise anyone on scene to step away from the patient.
- Turn off power in domestic incidents at the distribution board (consumer unit). Beware in properties where the supply may have been tampered with or where equipment is faulty.
- Ensure a safeguard to prevent re-establishment of the source. E.g. a police officer stood next to the distribution board.
- Approach the patient when confirmed safe.
- Move the patient and team clear of the source where practical.

Electric or Hybrid Vehicle

Low Voltage <1000 V - Usually DC

- Liaise with fire and rescue to confirm electrical safety in electric / hybrid vehicles.
- Approach the vehicle with caution
- Visually check for and avoid electrical components and cabling – usually colour coded orange.
- Extricate the patient as soon as practical

Outside a Domestic Supply

High Voltage >1000 V - Either AC or DC

- Do not enter the scene.
- Advise anyone in the area to evacuate immediately
- Beware of electrical current arcing over a distance
- Overhead power lines are automatically reconnected after power transmission has been interrupted. There is a risk of lines becoming live again during a rescue/resuscitation.
- Watch for hidden dangers e.g. the vehicle that has come to a stop over disrupted cables feeding street lighting.

- Contact the Air Support Desk with appropriate information and location. The ASD will contact the relevant authority to switch off the supply.
- Approach the patient only when formal confirmation that the source of electricity has been turned off.
- Extricate the patient a clear distance from the area as soon as practical

Thunderstorms

Very high voltage - DC

- Lightning can strike up to 10 miles away from the rain shaft of a thunder storm
- In an on-going thunderstorm the patient should be moved indoors or into a vehicle as soon as possible.
- Stay away from the tallest trees or objects
- If you feel your hair stand on end or skin tingle crouch down, lower your head and wrap your arms around your knees. Minimise your body contact with the ground by balancing on the balls of your feet. Most lightning injuries are via an indirect ground route rather than a direct strike. Do not lie flat.

Clinical Management

Respiratory Support

Primary lung injuries are uncommon due to the poor conductance of lung tissues.

- Titrate oxygen to saturations
- Analgesia may be required for thermal injury to the chest.
- Blunt trauma after being thrown from a DC current may cause thoracic injury (rib fractures, haemopneumothorax and pulmonary contusion)
- Respiratory arrest can be caused by paralysis from respiratory muscle tetanic contraction or direct injury to the brain stem respiratory centres. The patient will need intubation and ventilation on scene prior to transfer.

Cardiovascular Support

All patients who receive an electrical injury must have an ECG and be continually monitored until handover. A cardiac arrest is usually caused by an electrical disturbance in an otherwise healthy patient. Therefore plan for a prolonged resuscitation. Use the LUCAS 2.

AC injury

- Due to the incidence of arrhythmia, cardiac arrest must be dealt with using standard ALS guidelines not trauma guidelines.
- Cardiovascular instability, after exclusion of arrhythmia and other injuries, should prompt treatment with intravenous fluid.
- Always warm fluids and titrate to cardiovascular response.

Significant internal tissue injury can lead to rhabdomyolysis and an acute kidney injury. If transferring a patient with a marked raised CK confirmed at the referring centre, consider the use of bicarbonate and furosemide.

DC injury

- Look for a injuries suggesting major trauma from being thrown.
- Hypotension and arrest may be due to deceleration forces and should be treated using a damage control resuscitative approach.
- Have a low threshold for using a pelvic binder and use a minimal handling approach.
- Tranexamic acid should be given if bleeding is suspected.

Always be aware that any electrical shock has the potential to cause life threatening arrhythmias.

Flash and Flame Injury

Though primarily caused by a high voltage AC shock any electrical injury has the potential to cause thermal injury.

- Assess burn size and look for a second point where there may been grounding of the electrical current.
- Cover burns with a sterile non-adherent dressing.
- Consider need for early intubation and ventilation with major airway burns.
- All electrical burns should be discussed with the closest burns centre.
- Thermal Burns should be treated as per burns CSOP.

Further Injury Management

Intense muscular spasm can lead to fractures. These must be identified and mechanically stabilised. Have a low threshold for spinal immobilisation.

Other injuries must be considered and if suspected treated as a major trauma. Visceral, vascular and cerebral injuries can occur due to high voltage current flow alone without any other traumatic mechanism.

Special Circumstances

Pregnancy

Particular consideration should be given in electrocution of a pregnant victim, fetal electrocution can occur due to the low resistance offered by the uterus and amniotic fluid. While the mother is the priority in terms of transfer destination with reference to burns and major trauma, a hospital with additional obstetric and neonatal capability is ideal. Fetal mortality is high.

Conducted Electrical Weapons

Conducted electrical weapons (e.g. the police Taser device) delivers neither a true AC or DC shock. Instead the device emits a series of low amplitude, high voltage DC shocks. There is no documented clinical evidence that the device causes cardiac arrhythmias or direct injury other than small puncture wounds from barbs. Any patient compromise will likely be secondary to subsequent trauma (falls after the weapon is discharged, injury due to physical restraint) or a concurrent medical issue (drugs / alcohol)

Lightning Injury

Lightning can cause a huge range of injuries from the trivial to the devastating. Direct and indirect strikes can affect the overall severity and pattern of the injury. Burns are not very common and are usually superficial due to the extremely short contact duration and flashover effects. Neurological and arrhythmogenic issues predominate the clinical presentation. ECG changes can be delayed for 24 hours. Anyone who is struck by lightning needs a period of observation and is transferred to hospital

Mild

- Superficial minor burns
- Loss of consciousness (secondary to concussive force or electrical disturbance)
- Amnesia
- Confusion
- Altered sensation (tingling, blindness, deafness)
- Chest pain
- Other non-specific symptoms

Usually require little support but need a period of observation prior to discharge.

Moderate

- Seizures
- Respiratory Arrest
- Asystole

In respiratory or cardiac arrest, resolution may be spontaneous as the respiratory centre and / or myocardium regains ability to depolarise. Therefore early and effective resuscitative support may lead to full recovery.

Other symptoms are the same as for mild injury though burns are more common and neurological symptoms may be permanent.

Severe

- Cardiac Arrest

Usually fatal unless there is immediate bystander CPR. ALS guidelines should be followed. Survivors will require multi-organ support.

Disposition of patient

The transfer destination of the patient will depend on the injuries assessed and the discussion with the burns centre.

A majority of major electrical burns should be transferred to a burns centre.

If major traumatic injuries are present other than burns then these patients must be transferred to a Major Trauma Centre.

If the patient is pregnant then the destination should ideally have obstetric facilities. However management of the mother takes priority.

References and Further Reading

Bailey B, Gaudreault P, Thivierge RL. Cardiac monitoring of high-risk patients after an electrical injury: a prospective multicentre study. *EMJ* 2007; 24: 348–352.

National Burn Care Referral Guidance. Version 1 February 2012. National Network for Burns Care.

Koumbourlis AC. Electrical injuries. *Crit Care Med* 2002; 30(11): S424-30.

Evelyne GSC Marques, Gerson A Pereira Júnior, Bruno F Muller Neto *et al*. Visceral injury in electrical shock trauma: proposed guideline for the management of abdominal electrocution and literature review. *Int J Burns Trauma* 2014; 4(1): 1–6.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Drowning/Diving Related Emergencies

Reference Number	CSOP 042
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 004a and 004b, CSOP 007, CSOP 026, CSOP 027, CSOP 040

Author(s)	Jonathan Whelan
Internal reviewer(s)	Ami Jones
External reviewer(s)	
Sign off	COB

Introduction & Objectives

Drowning refers to the process whereby a person is immersed in liquid resulting in asphyxiation. In the UK it is commonly associated with hypothermia. Consideration must also be given to the mechanism by which the victim entered the water, with the possibility of spinal injury being present.

A person may also suffer illness or injury during commercial diving or sport diving. These activities expose participants to significant changes in ambient pressure which may result in barotrauma or decompression illness.

The purpose of this CSOP is to outline an approach to the prehospital management of drowning and of common diving emergencies.

Drowning

Presentation

Following submersion injury, presentations may vary from cardiac arrest to an asymptomatic and apparently well patient – depending usually on the length of time for which submersion occurred.

Distinction is sometimes made between warm water and cold water drowning. For pre-hospital purposes, the greatest relevance of this is the incidence of hypothermia with exposure to colder water. Rapid cooling is associated with a higher incidence of survival and good neurological outcome, especially in paediatric patients.

Initial Management

Initial management priorities are safe rescue and supportive care:

1. Ensure personal safety during any rescue attempt. Seek specialist support from Coastguard, RNLI, HART and/or Fire & Rescue Service as appropriate.
2. Suspect cervical spine injury if there is a history of diving/jumping, water slide use, signs of injury, alcohol, or high speed / unknown mechanism – maintain standard precautions whenever possible.
3. Employ ABCDE supportive care with administration of 100% oxygen.
4. Check core body temperature (if severe hypothermia then a low reading tympanic or oesophageal probe if intubated is optimal) and re-warm as needed [see hypothermia CSOP].
5. Cardiac arrest should be managed as per ALS guidelines, with appropriate modifications to defibrillation & frequency of drug administration in the profoundly hypothermic patient.
6. Consider early intubation in cardiac arrest, or rapid sequence induction of anaesthesia in the non-alert patient, for purposes of optimal oxygenation and airway protection. This will also facilitate tracheal suctioning if required.
7. Consider nasogastric tube placement to decompress the stomach and reduce risk of regurgitation and aspiration.

Ongoing Management

Any patient requiring ongoing critical care or emergency treatment should be transferred to a hospital with appropriate critical care facilities, with pre-alert to the emergency department.

If patient is severely hypothermic, consider referral or transfer for ECMO (see hypothermia SOP).

Consideration should be given to conveying asymptomatic patients to hospital for a period of observation (usually 4-6 hours). Following a drowning incident, pulmonary oedema or acute lung injury may occur some hours following the event.

Diving Injuries/Illness

Risks of Diving

Specific risks to divers relate to the breathing of pressurised gas at greater than atmospheric pressure. This can result in a number of adverse effects:

Barotrauma: Occurs when an air space fails to equilibrate pressure with its surroundings. Generally more severe on ascent, due to gas expansion. Barotrauma can result in perforation of the tympanic membrane, dental injury, and sinus trauma, but the most serious form is pulmonary barotrauma due to alveolar rupture, which can cause pneumothorax, pneumomediastinum, or arterial gas embolism.

Decompression Sickness (DCS): Gas under pressure dissolves in body tissues, and may come out as microbubbles as the patient ascends. This results in a wide array of symptoms depending on the where the bubbles form, and on whether the patient has a patent foramen ovale or other right-to-left shunt. If the bubbles form in blood, the patient may suffer a venous or arterial gas embolism. See table.

Oxygen toxicity. May produce seizures at oxygen levels above 140kPa. In reality this is only a risk with deeper dives, or divers using non-air mixtures (such as Nitrox – with a higher percentage of oxygen).

Nitrogen toxicity There is risk of a confusional state above 300kPa ("nitrogen narcosis") which may affect judgement but resolves upon ascent as nitrogen levels decrease.

Carbon dioxide toxicity – a risk with poorly maintained 're-breather' devices.

Finally, divers may suffer injury or illness that are not directly related to the dive, such as animal bites or stings, medical illness due to exertion, or similar.

Risk Factors for DCI

1. Long Dives.
2. Repeated Dives.
3. Rapid or Emergency Ascent from Depth.
4. Inexperience.
5. Cold water environment.

Presentation

Condition	Presenting Symptoms and Signs
Decompression Sickness	Fatigue Itching & Blotching of Skin Joint Pains (usually sudden onset, not affected by movement) Dizziness or Vertigo Neurological Signs (weakness in limbs, numbness) Breathlessness Poor coordination Confusion or Drowsiness Coma

Arterial Gas Embolism	Visual Disturbance Drowsiness or Confusion Weakness of Numbness (Similar to Stroke presentation) Coma
Oxygen Toxicity *(only recognised at oxygen partial pressures above 140kPa)*	Seizures Drowsiness Coma
Carbon Dioxide Toxicity	Headache Drowsiness
Nitrogen Narcosis	Usually none (temporary effect relieved by surfacing)

Management of Suspected Diving Related Illness

Any symptoms presenting during or within the first 24 hours after diving should be considered as potentially diving related.

Suspected DCI (either DCS or AGE) should be treated with:

1. Standard supportive emergency care.
2. 100% oxygen (regardless of oxygen saturations) – to maximise concentration gradient for 'off gassing' of nitrogen.
3. Keep horizontal to minimise risk of migration of gas bubbles to the CNS.
4. Avoid Nitrous Oxide for analgesia.
5. IV fluids often indicated as most patients will be intravascularly deplete due to the physiological effects of the dive.

Patients with significantly reduced level of consciousness may require rapid sequence induction of anaesthesia and intubation. Positive pressure ventilation may exacerbate pneumothorax if present, so beware of this risk and consider finger thoracostomy if concerned.

Cardiac arrest should prompt bilateral thoracostomies due to the risk of tension pneumothorax.

Seizures due to oxygen toxicity are rare and usually stop with removal from a hyperbaric oxygen environment. If not then treatment is as per routine management of seizures.

Specialist Advice

Specialist Advice should be sought from either:

- Diving Diseases Research Centre – 01752 209999
- **British Hyperbaric Association – Emergency Helpline (24hrs) – 07831 151 523**

When calling, if possible, try to obtain some basic information related to the dive profile if the diver (or their buddy, or dive computer) can provide it:

1. Maximum depth.
2. Dive duration.
3. Previous dives in past 24 hours.

4. Type of dive equipment used (SCUBA, Re-Breather, Surface Supplied).
5. Condition of diving buddy.

Patient Disposition

All patients with diving related illness or injury will require hospital treatment, but consider seeking specialist advice at scene (especially for more seriously ill patients) as consideration may be given either to direct transfer, or rapid secondary transfer to a recompression chamber for specialist care. Not all hyperbaric units can provide ALS/critical care interventions: only a level 1 hyperbaric facility can provide critical care input on site.

The following level 1 hyperbaric sites can accommodate direct transfer to their hyperbaric unit on the advice of the DDRC or the British Hyperbasic Association:

Site	Address	Emergency Phone	Helipad	Time to Mobilise Chamber
Wirral *(North West Emergency Recompression Unit)*	Murray field Hospital Holmwood Drive Thingwall Wirral CH61 1AU	0151 648 8000	On Site	Within 30 mins
Plymouth *(The Hyperbaric Medical Centre, DDRC)*	Tamar Science Park Derriford Road Plymouth PL6 8BQ	01752 261 910	On Site	Within 20 mins
Poole *(Atlantic Enterprise UK Ltd, "Poole Hyperbaric Chamber")*	7 Parkstone Road Poole Dorset BH15 2NN	07770 423 637 (answer service – return call will be made)	5 min secondary transfer	Within 10 mins

It is **imperative** to contact the chamber before transfer to ensure they are able to accept the patient. Many sites have only one hyperbaric chamber and treatments often last several hours – so if the chamber is currently in use, there may be a significant delay in providing emergency treatment, depending on the capability of the chamber to introduce new patients during a recompression sequence.

It is not necessary to take the patient's dive equipment to hospital or the hyperbaric chamber, but if possible try to bring the dive computer (usually a large wrist watch) as this provides useful information on the detail of the dive profile.

Patient Transfer

Any significant altitude may worsen DCI. This may be a consideration for air transfer or road transfer, if the latter involves significant changes in atmospheric pressure (e.g. travel over mountains).

For air transfer, liaise with the pilot and aim for the lowest altitude that is achievable safely. In pressurised aircraft it is possible to request a 'sea level cabin'.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Heat Related Illness

Reference Number	EMRST CSOP 043
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 001

Author(s)	Scott Farmery
Internal reviewer(s)	Tracy Phipps
External reviewer(s)	
Sign off	COB

Introduction & Objectives

Heat related illness is an important cause of preventable death and, although relatively uncommon in the UK, may present clinicians with significant challenges.

Heat related illness occurs when the body's ability to thermo-regulate fails, and core temperature rises above normal. The terminology surrounding this subject is extensive, debated, and will be largely ignored here.

The purpose of this CSOP is to outline the management of heat stroke in adults. Milder forms of heat illness can be managed without professional help.

This CSOP is not intended to cover Fever, Malignant Hyperthermia, Neuroleptic Malignant Syndrome, or hyperpyrexia related to recreational drug ingestion.

Heat Stroke

Heat stroke is a multisystem disease, and is diagnosed by two criteria: core temperature >40^{0}C, and a change in mental status. It is life-threatening, and is accompanied by varying degrees of end-organ damage. Where the patient is neurologically normal, the condition can be termed heat injury. Management is the same.

There are 2 forms of heat stroke; exertional and non-exertional (classic):

1. **Exertional Heat Stroke:** Occurs during strenuous physical exercise in high environmental temperatures and/or high humidity. Usually affects young, healthy adults (e.g. endurance athletes, firefighters, manual recruits, military recruits). Diagnosis is usually straightforward.
2. **Non-Exertional Heat Stroke:** Occurs during high environmental temperatures and often during heat waves. Pre-disposing factors include: elderly, very young, chronically ill, lack of acclimatisation, dehydration, obesity, alcohol, cardiovascular disease, skin conditions, hyperthyroidism, phaeochromocytoma, and certain drugs. Diagnosis may be more challenging.

Additional clinical features:

1. Respiratory Failure including pulmonary oedema or ARDS.
2. Tachycardia and hypotension (common).
3. Vomiting and diarrhoea.
4. Lethargy, weakness, headache, irritability, seizures, altered GCS including coma.
5. Cutaneous vasodilatation. Skin may be wet or dry, contrary to some texts.
6. Electrolyte disturbances of almost any sort.
7. Acute kidney injury (usually associated with rhabdomyolysis).
8. Hepatic injury.
9. Disseminated Intravascular Coagulation.

Management

Prognosis depends on how rapidly cooling can be instituted: The critical threshold is approx. 40.5^{0}C, and the time in minutes spent above this can almost be converted into a percentage mortality. There are few studies on the best method of cooling, but whatever is done should be rapid and thorough.

1. Measure temperature. While rectal is the ‘gold standard’, it may not be practical. Tympanic is acceptable in a conscious patient, but be aware that the patient’s temperature may be even higher than indicated. If patient is intubated, use oesophageal probe.
2. Cool the patient. Depending on the exact circumstances, this may involve:

- Removal to a cool(er) environment

- Removal of clothing

- Cold IV fluids if available

- Water misting and fanning techniques if available - the latent heat of vaporisation cools 88 times more effectively than simply cooling with water therefore it is important to maximise the wetted area and use airflow to remove the vapour to allow ongoing evaporation.

- Cooling packs and blankets (e.g. Laerdal Medicool system) These should be applied to skin where major blood vessels lie near by - the neck, axillae and groins.

- Cold water immersion for 15-20 mins. NB More appropriate in exertional heat stroke. Only if conscious and otherwise stable. Do not use in the elderly.

3. Support physiology. Vasodilated patients are relatively hypovolaemic even before dehydration occurs therefore fluid is frequently required to support blood pressure and to permit more effective thermoregulation. In severe cases further measures such as ventilation, vasoactive drugs, seizure control, and correction of electrolyte abnormalities may be required. EPOC may be of use to check ABG and potassium. If cardiac arrest occurs manage as normal and instigate therapeutic hypothermia as early as possible. If patient does require RSI, consider:

    - Pre-RSI sedation if needed to facilitate preoxygenation.

        - Volume loading pre-induction.

        - Reduced dose of ketamine for induction. Use rocuronium for muscle relaxation.

        - Be aware that muscle relaxation will mask seizures.

4. Do not transport until temperature is below 39^{0}C.

    - If safe to do so transport with windows and vents open. Adjust ventilators to blow on to wet skin of patient.

5. Do not use antipyretic drugs (paracetamol, NSAIDs, dantrolene).

Differential Diagnosis

Collapse during exertion may have multiple aetiologies. Consider cardiac events/ severe dehydration/ hyponatraemia/ hypoglycaemia as all may present with altered mental status. NB acute hyponatraemia may be treated rapidly - pontine demyelination is mainly a risk in correcting chronic hyponatraemia too rapidly.

In elderly, comorbid patients, consider other causes of an elevated temperature (e.g. sepsis).

Summary

The key in treating heat stroke is to cool the patient rapidly to a safe temperature, while supporting deranged physiology, particularly seizures.

References and Further Reading

Joint Royal Colleges Ambulance Liaison Committee. (2013) UK Ambulance Services Clinical Practice Guidelines.

Climatic Illness and injury in the Armed Forces: Force protection and initial medical treatment. 2012 (accessed 09/10/14). Available from: UK HEMS Standard Operating Procedures: Heat Related Illness. Accessed 09/10/14. Available from: http://www.ukhems.co.uk/30%20UKHEMS%20CP%20Heat-Related%20illness.pdf

Soar J, Perkins GD, Abbas G, Alfonso A, Barelli A, Bierens JJLM, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 8: Cardiac Arrest in special circumstances: electrolyte abnormalities, poisoning, drowning, accidental hypothermia, hyperthermia, asthma, anaphylaxis, cardiac surgery, trauma, pregnancy, electrocution.

Australian Resuscitation Council: Guideline 9.3.4 Heat Induced Illness (Hyperthermia). 2008 (accessed 09/10/14). Available from: http://www.resus.org.au/policy/guidelines/section9/guideline-9-3-4nov08.pdf

Patient.co.uk: Heat Related Illness. 2014. (Accessed 09/10/14). Available from: https://www.patient.co.uk/doctor/heat-related-illness.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Paediatrics

Reference Number	CSOP 044
Application	EMRTS Doctors and CCP's
Related SOPS	Multiple

Author	Graham Mayers, Camilla Waugh
Internal reviewer(s)	Pete Williams
External reviewer(s)	
Sign off	COB

Introduction & Objectives

The management of children can be challenging in the pre-hospital environment. Weight and size factors increase the complexity of drug dose and equipment choices, small anatomy can be a technical challenge and the situation may be emotionally charged with anxious bystanders and parents.

This CSOP has been written to provide an overview of patient management. Refer to the relevant CSOP for management of specific clinical situations.

Preparation for Paediatric Care

Equipment Governance

Paediatric equipment will be used less often than adult equipment. As such care should be taken when checking and packing equipment, including appropriate paediatric monitoring, prior to the shift.

Pre Mission Planning

When information becomes available that the mission may involve the care of a child, teams should try to ascertain the age of the child and plan the following usually on route to the tasking:

1. Estimated weight.
2. Resuscitation drug doses.
3. Doses for other drugs likely to be used based on the nature of the job.
4. Hospital options based on weather, distance, hospital capabilities.

Age and Weight

Information on the age of the child may be inaccurate especially estimated by a bystander. Teams must be prepared to recalculate weight, drug doses and equipment sizes quickly should the information change.

If the age is unknown then it can often be ascertained from the labels on the child's clothing This will give age that is appropriate to the child's size and weight for calculation purposes.

Up to date paediatric weight formula should be used:

1 to 12 months: (0.5 x age in months) + 4

1 to 5 years: (2 x age in years) + 8

6 to 12 years: (3 x age in years) + 7

Teenagers should be given adult doses however care must be taken if the teenager appears small, pre pubescent and estimated to be less than 50 kg.

Drugs preparation

Drug doses should be calculated carefully, ideally before reaching the patient. Two person checking is recommended and must be done if the workload on scene allows. The EMRTS APP is recommended for primary dose calculations or checking mental dose calculations.

When drawing up doses clinicians should stick to whatever method they are most familiar with in order to avoid error. However in small children it is highly advisable to use small syringes (1 and 2.5 ml) of drugs at their standard concentration rather than used diluted drugs. This reduces the risk of error when preparing drugs by taking a step out of the preparation and avoids large volumes in very small neonates.

Never attempt to give a small volume from large syringes. If a small volume is required the drug should be moved to an appropriately sized syringe in order to accurately give that volume. When drugs are prepared they must be labelled correctly and all team members must know the concentration of the preparation.

Control of the Child

It is vitally important that teams do the upmost to keep a conscious child calm and compliant with treatment. This will facilitate the delivery treatment as well as improve the safety of transfer.

Reassurance

All children should be reassured in a way that is appropriate to their age. If possible, involve the parent at every stage.

Distraction

Distraction therapy is essential part of paediatric clinical management. This involves getting on a level with the child in order to engage in conversation while at the same time keeping a professional control of the situation. Each aircraft will carry a teddy bear that can be used for small children and must be checked like every other piece of medical equipment. If a child has a toy on scene then it may be worth bringing it on the transfer if practical. Distraction therapy should be appropriate to the age of the child. It is worth noting that when an older child is frightened they revert to a younger mentality

Analgesia

There must be a strong emphasis on pharmacogical and non pharmacological methods of analgesia. A child in pain is difficult to control and pain will compromise physiology.

Tailoring Approach

It is generally accepted by clinicians dealing with children that initiating some therapies can be detrimental if a child is uncooperative. An example would be spinal control in a combative child who calms and can be transferred in the parent's arms. This may require compromise in some aspects of care in order to facilitate care that is more important, like transfer to hospital. A careful balance of risks should be carried out in order to keep the child as safe as possible within a given situation.

Parents

Parents should be involved as much as possible during the treatment of the child. As well as reassuring the child, parents themselves should be reassured and kept informed.

If the child is awake then a parent should be taken on flight transfer, as they will play an important role in the control of the child. However this assumes that they are a benefit and not a risk. A parent who is hysterical or who is potentially violent is and clear risk in flight must not be conveyed (see OSOP 016 Passengers and Passenger Briefing). The decision must involve the pilot and must take into account HEMS exemption (see OSOP 014 Helicopter Response Procedures). A similar risk assessment should be carried out for a road transfers.

Critical illness and injury

Critically ill or injured children should be taken to a specialist centre for further care with hospital bypass if appropriate. However, in certain situations it may be safer to travel to the nearest local hospital in order to initiate care in a more controlled environment. For example a predicted difficult airway needing RSI. EMRTS can stay involved and facilitate expedited transfer onwards to a tertiary referral centre as one continuous job.

Death of a Child

In general most paediatric resuscitations should be performed during simultaneous packaging and transfer. It is generally accepted that resuscitation attempts are ended in hospital not on scene. This allows an appropriate group decision, which will re-enforce the fact that the decision to stop is appropriate. This protects EMRTS teams form subsequent criticism and provides support for the decision to stop.

If recognition of life extinct on scene is appropriate then the body must be transferred to the nearest emergency department and not a mortuary. This is an official agreement between the ambulance service and the police as it allows an immediate examination by a trained paediatrician specifically looking for non accidental causes. In circumstances where this is not practical, for example decomposition, then the child should be taken to the mortuary and the police informed of the reasons for the decision. If there is unequivocal evidence of homicide then the body should be left in place. Liaison with the police and documentation is vital (see OSOP 028)

Non Accidental Injury

Teams should be vigilant for evidence of non-accidental injury and signs of abuse when dealing with children. An rapid assessment of the overall appearance of the scene should be made. After a mission it may be advisable to document the scene appearance in the EMRTS notes as this may be required in any subsequent investigation. While on scene the safety of the child is a priority. It may be better to transfer the child to hospital for non-clinical reasons in order to get them to a place of safety. If non accidental injury or abuse is suspected in any case then it should be clearly handed over to the hospital team (see CSOP 045 Non Accidental Injury and Child Abuse)

Specific Critical Situations (see related CSOPs for further details)

Airway control

Paediatric anaesthesia can carry an increased risk when compared to anaesthesia in an adult. An appropriate risk vs benefit assessment should be carried out for all rapid sequence inductions. - All paediatric RSI's (i.e. age less than 16yrs) should be discussed with the top cover consultant before proceeding unless there is an immediate indication for RSI (rare).

All children should be intubated using cuffed or micro-cuffed tracheal tubes. Very premature neonates requiring a 2.5 or 2 mm ID tube should be intubated using an un-cuffed tube.

In the can't intubate, can't ventilate situation in children, a needle cricothyroidotomy should be performed using a 2mm Quicktrach OR a stiff cannula and needle (14G) for children under 10 years old. A surgical cricothyroidomomy should be performed in children 10 years and older or if a needle airway fails to oxygenate a child under 10 year old. Largely speaking the cricothyroid membrane will be more prominent after this age.

Upper airway obstruction is often due to infective causes. Avoid upsetting the child and use nebulised adrenaline.

Cardiac Arrest and Arrhythmias

Medical cardiac arrests should follow the appropriate guidelines with an emphasis on rescue/inflation breaths at the beginning.

Children under 21 days should be resuscitated using neonatal life support guidelines.

Traumatic cardiac arrests should be dealt with as per adults with an emphasis on fluid, oxygen and chest decompression.

The most common cause of bradycardia in an unwell child is hypoxia. Emphasis should be placed on re-oxygenation as a primary treatment rather than using atropine first line.

Management of other clinical situations

Refer to the relevant CSOP with appropriate modification to approach, equipment sizes, drug doses and risk/benefit analysis.

References and Further Reading

Advanced Peadiatric Life Support Guidelines. Advanced Life Support Group (UK).

Newborn Life Support Guidelines. Resuscitation Council (UK).

Public Health Wales Procedural Response to Unexpected Deaths in Childhood (PRUDiC) 2014.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Non-accidental injury (NAI) and Safeguarding

Reference Number	CSOP 045
Application	EMRTS Doctors, CCPs and HTPs
Related SOPS	Multiple

Author(s)	Owen McIntyre (ABM ULHB - Anaesthetics), Dr Stephan Clements
Internal reviewer(s)	Pete Williams
External reviewer(s)	
Sign off	COB

This SOP should be used in conjunction with the All Wales NHS Safeguarding procedure.

Introduction & Objectives

Safeguarding is everyone's responsibility.

The abuse or neglect of a child or young person can lead to serious injury or death and have a long term impact on their health and well being.

The incident may be a one off event or part of an ongoing pattern. The vigilance of health care professionals and the quality of their response is paramount in ensuring adequate safeguarding and protection to children and young people.

Thus, when any child with an injury is seen in a professional capacity, non-accidental causes should be considered as part of the differential diagnosis.

This document is guidance for EMRTS staff to facilitate their social and legal obligation to ensure that children and young people are protected from further non-accidental injury and abuse.

Definitions

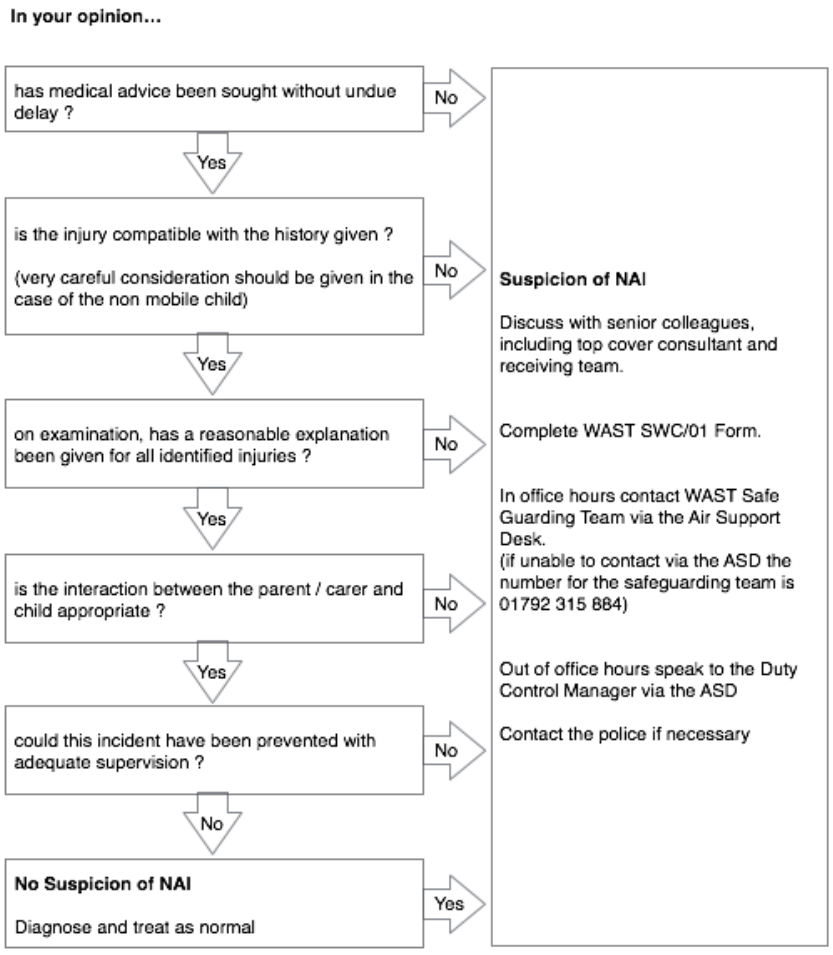
Children and Young People: Anyone who has not yet reached their 18th birthday (21st birthday if disabled or in Local Authority Care). Issues of neglect as defined in the All Wales child protection procedures, 2008, can apply to the unborn baby.

Safeguarding Concerns: Concerns indicating that a child or young person may not achieve the 5 outcomes in Every Child Matters (Be Healthy; Stay Safe; Enjoy and Achieve; Make a positive Contribution; Achieve Economic Well-being) without support and services being provided.

Child Protection Concerns: Suspicion that a child is at risk of, or has experienced, significant harm, neglect or abuse.

Assessment of suspicion of NAI

The following sequence of questions should <u>always</u> form a part of the assessment of an injured child.



1. It is best practice to discuss and explain to the parent(s) or carer(s) that a referral to the safeguarding team, social service and or police, has been made. However, if the clinician feels that there is a risk of potential harm to the child; parental consent is not a requirement.

2. Ensure clear documentation of your concerns, assessment and that a referral has been made. Use the Welsh Ambulance Service SWC/01 form.
   There is specific guidance for this in the WAST document- Safeguarding the Welfare of Children Operational Guidance & Procedure.

3. Patient documentation must include clear documentation of any injuries noted (including colour, shape and size – with accurate dimensions), any interventions performed (including any unsuccessful attempts at insertion of lines or urinary catheters), information given to parents, names of the responsible clinicians conducting the initial assessments, and names (and contact details) of those spoken to in social services and/or police.

4. The majority of children seen by an EMRTS team will be conveyed to hospital thus it is essential for clinicians and practitioners to communicate and collaborate effectively. Early referral to the safeguarding team ensures that timely investigations can take place and prevents the loss of vital information.

5. If a child with safeguarding concerns is being admitted to hospital there should be an EMRTS Consultant to receiving Emergency or Paediatric Consultant handover to ensure continuity of care within the receiving Health Board. This should be clearly documented in the EMRTS patient care record.

Good Practice Checklist

The following is a checklist providing EMRTS members with a good practice prompt:

Have you been able to speak to the child alone? Can you still do so? (Listen patiently, but do not t interrogate. Do not ask them to repeat their account of the incident.)	
Is there further information you do have about the child and their family?	
Is the child at immediate risk of harm (Physical, Sexual, Neglect, Emotional)	
Are there other children (siblings, peers) who could be at risk from harm?	
Is there a parent or carer at risk of harm?	
Does the parent or carer and the children have a safety plan?	
Is it safe to discuss your concerns with the child's parents or will doing so put the child at greater risk of harm? (Never accuse a parent or carer of child abuse)	
Is there a need to inform the police because a crime may have been committed?	
Is there a reason that makes it likely that a child will resist efforts to safeguard him/her (need for drugs)?	
Have you recorded everything that has been said to you by the child?	
Have you recorded everything that has been said by the parent/family and other professionals?	

Have you recorded everything that you have said to others?	
Have you completed a SWC/01 form?	

Adapted from NWTS: Transport document 2013

References and Further Reading

HM Government. Working together to Safeguard Children. March 2015 Ref: DFE-00130-2015 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/592101/Working_Together_to_Safeguard_Children_20170213.pdf

Welsh Ambulance Service: Safeguarding the welfare of children, operational guidance and procedure 2013.

North Wales & North West Paediatric Transport Service (NWTS): Transport document 2013.

Childrens Act 2004.

NICE Clinical Guideline 89: When to suspect child maltreatment.

All Wales child protection procedures 2008: www.awcpp.org.uk.

BCUHB Paediatric Injury Flow Chart: BCUHB website.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Neonatal Emergencies

Reference Number	EMRTS CSOP 047a
Application	EMRTS Doctors and CCPs
Related SOPS	Neonatal procedures – CSOP 048 Neonatal Intubation – CSOP 047b Paediatrics – CSOP 044 Non-accidental injury and child abuse – CSOP 045 Approach to time-critical paediatric retrieval – CSOP 046 Obstetric emergencies – CSOP 049 Perimortem caesarean section – CSOP 050

Author(s)	Pete Williams (BCUHB - Emergency Department), John Glen
Internal reviewer(s)	
External reviewer(s)	
Sign off	Clinical and Operational Board, EMRTS

Introduction & Objectives

EMRTS is primarily an adult service, but will deliver care to neonates in certain situations. The objectives of this SOP are:

1. To provide an approach to Newborn Life Support based on national guidelines.
2. To provide an approach to the treatment of the sick neonate in the pre-hospital environment and midwife-led maternity unit (MLU), where a basic level of resuscitation has already been provided.
3. To describe how to interface with neonatal services in Wales.

NOTE: EMRTS do not undertake neonatal intensive care retrieval, but rather enhance the pre-hospital response to a neonate at home, or at an MLU. Few MLU's are covered by existing neonatal transfer services, meaning that such cases currently prompt a standard emergency services response. The baby is stabilised and transferred to the nearest neonatal unit by a paramedic and midwife, in line with guidance from the British Association of Perinatal Medicine. It is increasingly recognised that a level of enhanced care is needed, and this is within the capabilities of EMRTS.

Approach to Neonatal Care – General

1. For the purposes of this CSOP a neonate is considered a child of less than 28 days of age.

2. Prior to mobilisation, consider whether EMRTS involvement will delay the baby's access to specialist care. If ambulance arrival at child is imminent, and the baby can be in the receiving unit within a similar timeframe to your arrival, then it may be best to allow the 999 response to proceed without EMRTS intervention. On the other hand EMRTS will be able to provide a higher quality response than a 999 because of its superior equipment and medical personnel and this may be the preferred option.

3. CHANTS provide neonatal transfer between neonatal units in South Wales. Teams operate on a weekly rotational basis from Singleton Hospital, UHW and Royal Gwent Hospital. It is a twelve hour service and there is always a consultant on duty from 8 am to 8 pm. The rota and contact numbers are given at the end of this document, and in the app.

   For South Wales cases first line neonatal advice is available for EMRTS via the CHANTS consultant on duty. The Air Support Desk (ASD) should hold CHANTS rota, which neonatal consultant is on call for a particular day, and full contact details. This information is conveyed to each base. EMRTS should contact the duty CHANTS consultant by mobile, at hospital or on the CHANTS ambulance (note if the team is out there may be difficulty accessing them because of poor mobile coverage in some areas). If this consultant is tied up with a difficult case or unobtainable, then contact the nearest of the three units and speak to the neonatologist on call. ASD should receive on a daily basis the cot locators for North and South Wales to enable them to identify a suitable likely empty cot. ALL neonatal cases should be discussed with a neonatal consultant after assessment, to guide management and correct disposition. Ensure EMRTS Top Cover Consultant is also aware.

For North-Wales cases, information and advice is accessible from the neonatal consultant on duty for Glan Clwyd Hospital.

4. For specific procedures, see Neonatal Procedures and Neonatal Intubation CSOPS – 048 and 049b.

5. Ensure that parent(s) are kept informed and facilitate early parental contact with baby.

6. Repeated fluid boluses (in addition to dextrose bolus and infusion) are seldom required. If there is a strong suspicion of hypovolaemia then a fluid bolus of 10ml/kg crystalloid (e.g. normal saline) is reasonable.

Newborn Life Support

If you are present at the birth, follow the newborn life support algorithm below.

Notes:

1. If the baby is not compromised, delay clamping the cord for one minute after delivery. Baby should be kept at the same height as the mother.

2. Place the pulse oximeter on the right wrist to obtain pre-ductal SpO_2 and heart rate.

3. There is often a delay in obtaining a reliable SpO_2 reading: heart rate response is the best guide to effectiveness of initial resuscitation.

4. For term infants, with perceived normal lungs, use air for initial resuscitation add oxygen according to saturation limits quoted in NLS algorithm, using blender on EMRTS neonatal incubator. See relevant equipment SOP.

Referral of Neonate from Midwife-Led Maternity Unit (MLU)

There are 11 MLUs in South Wales, delivering approximately 1000 infants per year (see appendix). There are currently no MLUs in North Wales.

Babies born in MLUs should be low risk: that is, they are at term, and no congenital abnormality has been diagnosed prenatally. There is, however, the small possibility that a congenital problem has been missed, or that the birth results from a 'walk-in' with either a) premature labour or b) undisclosed pregnancy.

Whatever the underlying cause of the problem, the likely situations you will face are:

1. Collapsed term infant at birth, usually due to perinatal hypoxic-ischaemic birth insult. There may also be meconium. If there is meconium present in the mouth or nasopharynx, suck it out under direct vision.

2. Respiratory distress syndrome. This can occur even in more mature infants. Differential includes sepsis and metabolic problems.

3. Prematurity.

4. Congenital abnormality (commonly cleft)

The main difference in your management plan will be the institution of cooling where there is the likelihood of hypoxic-ischaemic encephalopathy in a baby >36 weeks gestation. Otherwise your approach to all neonates should be the same, and driven by the algorithm below. The goal is not to provide a definitive diagnosis or definitive care, but to institute a level of cardiorespiratory support which will enable safe and optimal transfer, whilst addressing likely pathologies. As mentioned above, all cases should be discussed with a consultant neonatologist after you have assessed the baby.

Most babies in trouble have respiratory compromise. A variety of therapeutic options are available.

Continuous Positive Airway Pressure (CPAP)

CPAP can be delivered by the Hamilton T1 ventilator in n-CPAP mode. It should be considered in any neonate with:

1. Laboured work of breathing at any time once airway is clear.
2. Requiring supplemental oxygen to keep SPO_2 above 90% at 10 mins after birth.
3. Requiring $FiO_2 \geq 0.4$ to keep SpO_2 above 95% at 15 mins after birth.
4. pH $\leq$7.25 after initial resuscitation.
5. Plan for therapeutic hypothermia. (Discuss with Neonatal Consultant first)

In preterm neonates, the threshold for starting CPAP should be very low, as these babies have little reserve and cannot compensate by (e.g. grunting). Once CPAP is started, adjust the FiO_2 to achieve suitable SPO_2:

1. 91-95% for babies less than 34 weeks gestation.
   - This means you may be starting CPAP on a preterm baby even though the initial SPO_2 is already 91-95%.
2. 95-99% for term neonates.

Avoid saturations of 100% in all babies if you can (as the PO_2 may then be very high, and this can be harmful, particularly in the preterm infant).

Do not worry if you need to use high concentrations of oxygen, or if saturations go higher than target for a short time.

CPAP will often provide sufficient respiratory support to enable safe transfer of the baby. However, if the baby is *in extremis*, markedly hypoxic, apnoeic or unresponsive, CPAP will not work. In these cases consider intubation first line. See separate neonatal procedures CSOP 048 for method of applying CPAP.

Prematurity

The EMRTS approach to the premature or low birth weight neonate will be the same as the approach to term neonates, with two exceptions:

1. RSI of premature babies is not part of the core EMRTS skill set.

   - In a low birth weight or premature neonate it is not appropriate to attempt RSI, unless you routinely intubate neonates as part of your practice. For the purposes of EMRTS, the 'cut off' lies at 2kg. This is because your backup option should intubation fail (a size one igel) is only recommended

for babies >2kg AND >34 weeks gestation. If a smaller baby requires ventilatory support, then non-invasive CPAP is probably the most suitable option.

However, an emergency intubation without drugs may be attempted for any neonate that is apnoeic or has arrested, especially where manual ventilation is difficult/impossible.

2. Therapeutic Hypothermia is not used in babies less than 36 weeks gestation.

   Keeping babies warm will be the main challenge. Consider use of neowrap plastic sheet (similar to a foodbag), together with hats, blankets and Ready Heat blanket. EMRTS carries an incubator.

Seizures

If a baby is fitting, they may require intubation, cooling, and anticonvulsant treatment. Rule out hypoglycaemia by checking glucose level (acceptable level 3.5 mmol/L). Give dextrose bolus if required and infusion as per algorithm. All of these cases should be discussed with a consultant neonatologist, who will advise on how to proceed. Give phenobarbitone 20mg/kg over 20 minutes as initial anticonvulsant.

Pneumothorax

Pneumothoraces in neonates are often iatrogenic, due to overdistension during facemask ventilation. Avoid this by ensuring a pressure limiting device on the inspiratory circuit.

There are two likely situations where EMRTS will address pneumothorax:

1. Arrested baby, all other measures failed. In these circumstances, an attempt to decompress both sides of the chest is justified, on the grounds that there is nothing to lose.
2. Pneumothorax clinically suspected. This situation is slightly more difficult. Attempt to confirm the diagnosis. This could involve ultrasound if you have the skill. Attempt transillumination of the chest (below). Ensure that the TT has not migrated down a main bronchus.

Transillumination

1. Darken the room, or the immediate environment of the baby, e.g. by using a blanket.
2. Apply a cold light to the chest, and watch for a glow around it. Compare with the other side. A Petzl head torch is as good as anything else for providing cold light.

Bear in mind that transillumination works best in premature babies, and may not be reliable in large term neonates.

Treatment of pneumothorax

Use of a butterfly needle is not appropriate here, as it cannot be maintained during transport. Instead, use a blue intravenous cannula, at the traditional landmark of the midclavicular line, 2nd intercostal space. Do not insert the needle too far: as soon as you breach the pleura, feed the cannula off the needle. Aspirate air if possible. In a ventilated baby the cannula can be left open to the air. Otherwise cap it off, and re-aspirate if needed.

Disposition of Patient

Unexpected delivery during retrieval (including Perimortem C-section)

1. If you were undertaking an in-utero transfer to a facility with neonatal expertise, then proceed as originally planned.

2. If the delivery came 'out of the blue', then proceed to the nearest hospital with a neonatal unit:

    a. South Wales: Swansea, Cardiff, Newport, Carmarthen, Bridgend, Royal Glam, Methyr, Abergavenny.

    b. North Wales: Bangor, Glan Clwyd, or Wrexham.

Midwife-led Unit

Discuss with CHANTS consultant on call, who will find a cot for you. If the CHANTS consultant is unavailable, contact the nearest of the three main neonatal units for advice (Swansea, Cardiff, Newport. See introduction. Road transfer may be the best way to retrieve these patients due to the unavailability of HLS at Neonatal Centres.

Parental Considerations

There will not be room in EMRTS transport platforms for parents to accompany their baby. They should be given the opportunity to photograph their baby, and given details of the receiving unit. Where there is a possibility of death in transit, this must be honestly discussed.

Where both mother and child require hospital care, it is important that, where possible, both are transferred to the same facility. This will require good communication among EMRTS, CHANTS and Obstetrics. See also Obstetric Emergencies CSOP 049.

Neonatal Death/Stillbirth

Discontinuing Resuscitation

Consider discontinuing resuscitation if after at least 20 minutes of effective resuscitation you are sure there is no heart rate (Consider using ultrasound). This is a traumatic time for all concerned. If stopping resuscitation, focus efforts on comfort and dignity.

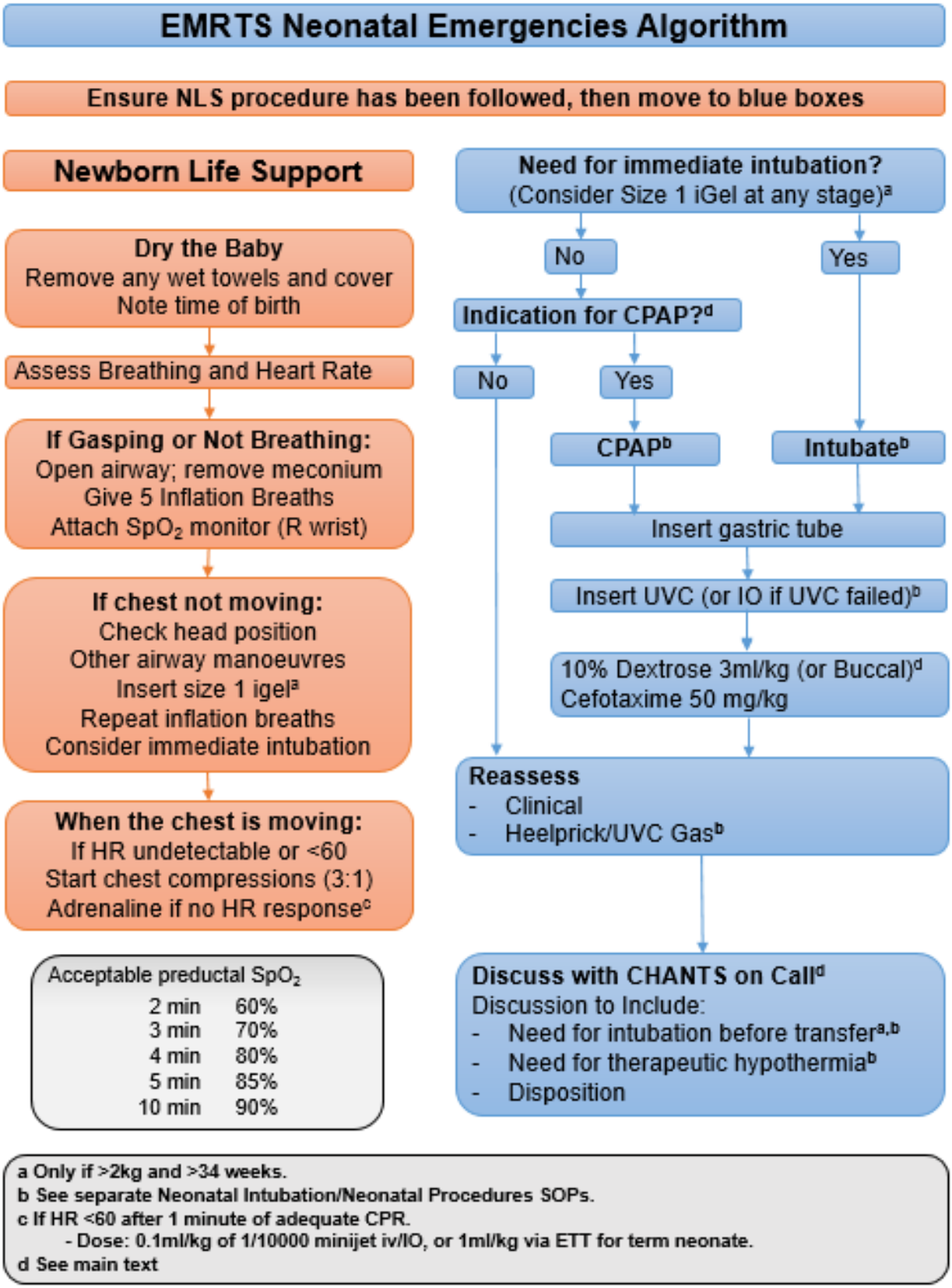
Midwives at MLUs have well-established procedures in place for dealing with stillbirth.

If a baby has shown signs of life but then dies in the MLU while you are present, phone consultant from affiliated neonatal unit how best to proceed. Ensure clear documentation.

Death in Transit

Continue to destination. Returning to MLU is not the best option because parents will already be on their way to the neonatal facility. Attempts to pass messages to parents in transit to tell them to return to the MLU are likely to result in confusion and upset.

Neonatal Emergencies: Algorithm



a Only if >2kg and >34 weeks.
b See separate Neonatal Intubation/Neonatal Procedures SOPs.
c If HR <60 after 1 minute of adequate CPR.
- Dose: 0.1ml/kg of 1/10000 minijet iv/IO, or 1ml/kg via ETT for term neonate.
d See main text

Management Following Initial Stabilisation Period

Once the baby is stabilised, the priority is to mobilise. The following should also be considered:

1. Run a dextrose infusion (10% dextrose, 3ml/kg/hr). Glucostop (40% dextrose gel) can be used in an emergency: see neonatal procedures CSOP 048.
2. Run a morphine infusion (5-20 mcg/kg/hr) for intubated or cooled baby. For more detailed dosing information, see appendix.
3. Ensure appropriate temperature management.
4. Parents informed of destination and plan, have had a chance to see their baby, and have a photo.

Packaging

See Neonatal Procedures CSOP 048, and Neonatal Packaging CSOP 047c

Interface with Neonatal Retrieval Services in Wales

EMRTS may be asked to assist the neonatal team from a transfer perspective. Usually this will mean providing a transport platform so that the neonatal team can attend a referring hospital urgently. If we do receive a request to help in this way, the procedure outlined in OSOP 010 should be observed.

Summary

The EMRTS response to neonatal emergencies recognises the fact that the majority of its clinicians are not paediatricians. The response is algorithm driven, and aims to provide an acceptable level of cardiorespiratory support to the neonate, while addressing some important pathology including sepsis, hypoglycaemia, and hypoxic-ischaemic encephalopathy.

Audit Criteria

- Infants of 34 or more weeks' gestation who arrive at receiving centre with Sp02 95 – 99% Target 100%
- Infants less than 34 weeks' gestation who arrive at receiving centre with Sp02 91 – 95% -Target 100%
- Infants outside cooling criteria who arrive with temperature within target range 36.5 ^{o}C – 37.5 ^{o}C – Target 100%
- Infants for whom consultant neonatologist has recommended cooling, who arrive at receiving centre with core temperature 33 ^{o}C to 34 ^{o}C – Target 100%
- % patients where antibiotics administered within 1 hour of team arrival at MLU - 100%
- % patients where dextrose administered within 1 hour of team arrival at MLU - 100%
- Neonatal cases attended by EMRTS discussed with neonatal transfer consultant – 100%
- Neonatal taskings formally debriefed at EMRTS governance days within 3mths – 100%

References and Further Reading

1. Royal College of Paediatrics and Child Health. Standards for children and young people in emergency settings. London; 2012 [accessed 26th Oct 2014]. Available from: http://www.ukpics.org.uk/documents/TRANSPORT/Intercollegiate%20Emegency%20Standards%202012%20FINAL%20WEB.pdf.

2. Paediatric Intensive Care Society. Standards for the Care of Critically Ill Children, 4th ed. London; 2010 [accessed 26th Oct 2014]. Available from: http://www.ukpics.org.uk/documents/PICS_standards.pdf.

3. Royal College of Anaesthetists. Guidelines for the provision of paediatric anaesthetic services. London; 2009 [accessed 26th Oct 2014]. Available from: http://www.rcoa.ac.uk/docs/GPAS-Paeds.pdf.

4. Vidacare Corporation. The Science and Fundamentals of Intraosseous Vascular Access. 2013 [accessed 26th Oct 2014] Available at: http://www.arrowezio.com/.

5. Hamilton Medical. Hamilton T1 brochure. 2014. [Accessed 26th Oct 2014]. Available at: http://www.hamilton-medical.com/products/hamilton-t1.html.

6. Cymru Inter-hospital Neonatal Transfer Service. Microsite. 2014 [accessed 26th Oct 2014]. Available at: https://www.wales.nhs.uk/sites3/home.cfm?orgid=942.

7. North West and North Wales Paediatric Transport Service. Clinical Guidelines. 2014 [accessed 26th Oct 2014]. Available at: http://www.nwts.nhs.uk/clinicalguidelines.

8. Wyllie J, Bruinenberg J, Roehr CC, Rüdiger M, Trevisanuto D, Urlesberger B. European Resuscitation Council Guidelines for Resuscitation 2015: Section 7. Resuscitation and support of transition of babies at birth. Resuscitation. 2015 Oct;95:249-63.

Appendix 1: Competencies to be "signed off" prior to independent practice

All of the following competencies should be "signed off" by the EMRTS team before independent practice. This defines the minimum standards of training required to maintain skill base. All trainees (inc. PHEM) must be supervised by an EMRTS consultant AND CCP at all times on neonatal taskings. The standards will be reviewed on a regular basis to ensure that they are appropriate.

Attend a 2 day practical course to cover the following: **Newborn Resuscitation:** **-** Neonatal Life Support - Basic Airway Skills - Intubation and LMA use - EZ-IO and arrest drugs - Resuscitation scenarios **Neonatal Stabilisation:** - Incubator use and keeping babies warm - Ventilator use and adjustments - CPAP and NG tubes - Monitoring of baby - Therapeutic hypothermia - Hypoxic-ischaemic encephalopathy/ - PPHN/meconium - Preterm with respiratory distress syndrome - Surgical problems - Neonatal death - Inter-relations between EMRTS and CHANTS
Initial self directed learning: All EMRTS team members to attend one day at their local SCUBU or NICU to familiarise themselves with neonates. Further exposure to procedures including keeping baby warm, heel prick blood gas sampling and NG tubes.
Maintenance of skills: **-** Attend NICU / SURNICC every six months to refresh skills. - Formally review every neonatal case at EMRTS clinical governance days within 3mths (audit standard).

Appendix 2 - CHANTS locations and pick-up points

See EMRTS APP.

Appendix 3 – Contact details for CHANTS Team (Ambulance and Unit)

See also EMRTS App.

Hours of Duty 8.00 a.m. – 8.00 p.m.

Change over on Monday 8.00 a.m.

Transport dedicated Telephone/ Mobile numbers:

Swansea Team	01792 285278	Mob: 07791441895
Cardiff Team	02920 742680	Mob: 07854952662
Newport Team	01633 234844	Mob: 07791487084

CHANTS Ambulance Mobile: 07970699103

Appendix 4 - MLUs in Wales

There are a number of MLU's across Wales that EMRTS support. Most are accessible by day on a HEMS response as this will not require a dedicated helicopter landing site. However work is in progress to survey nearby helicopter landing sites for night landing and the provision of lighting/windsocks to assist with this. The units will a highest number of deliveries are shown below:

Unit	Approx Deliveries/year
Welshpool	40
Newtown	40
Llandrindod Wells	10
Llanidloes	20
Knighton	20
Brecon	40
Dolgellau	5
Neath Port Talbot	350
Ysbyty Ystrad Fawr	350
Ebbw Vale	20
Withybush	New – estimate 200

Appendix 5 - Morphine dosing

Dilution

Make up 10mg in 10ml saline, and then take 1 ml of this solution and make up to 20ml to give a 50 microgram per ml solution.

Loading Dose

50mcg/kg as a slow bolus (i.e. 1ml/kg) for unintubated baby.
100mcg/kg 3 minutes prior to intubating baby.

Infusion rate

5-20 mcg/kg/hr (i.e. 0.1ml-0.4ml/kg/hr). See Table.

Morphine Infusion 50mcg/ml			
Baby's weight	**5 mcg/kg/hr**	**10mcg/kg/hr**	**20mcg/kg/hr**
2.0 kg	0.2 ml/hr	0.4 ml/hr	0.8 ml/hr
2.5 kg	0.25 ml/hr	0.5 ml/hr	1.0 ml/hr
3.0 kg	0.3 ml/hr	0.6 ml/hr	1.2 ml/hr
3.5 kg	0.35 ml/hr	0.7 ml/hr	1.4 ml/hr
4.0 kg	0.4 ml/hr	0.8 ml/hr	1.6 ml/hr

Appendix 6 – Guide to tube sizes and drug doses

Table of neonatal sizes and doses. This table contains round figures intended for gross error checking. Ideally the neonate should be weighed, and doses calculated accurately.

	Calculation	Term Baby 38 weeks	Preterm Baby 32-37 weeks	Very Preterm 28-32 weeks	Extreme Preterm <28 weeks
Weight		3000	2000	1000	500
Uncuffed Tube		3.5	3	3	2.5
Suction Catheter		6	6	6	6
ET Tube length at lips (cm)		9cm	8cm	7cm	6cm
NG Tube size		6	6	6	6
Fluid bolus	10ml/kg	30ml	20ml	10ml	5ml
Blood bolus	20ml/kg	60ml	30ml	20ml	10ml
Adrenaline (1/100,000 = 10mcg/ml) (i.e. minijet diluted 1 in 10)	10mcg/kg	3ml	2ml	1ml	0.5ml
Atropine (3mg/10ml = 300mcg/ml)	20mcg/kg	0.2ml	0.2ml	0.1ml	0.1ml
Bicarbonate 8.4% (Dilute 50/50 with water)	2ml/kg	6ml (plus 6ml Water)	4ml (plus 4ml water)	2ml (plus 2ml water)	1ml (plus 1ml water)
Cefotaxime	50mg/kg	150mg	100mg	50mg	25mg
Dextrose 10% bolus	3ml/kg	9ml	6ml	3ml	1.5ml
Dextrose 10% infusion	3ml/kg/h	9ml/h	6ml/h	3ml/h	1.5ml/h
Fentanyl 50mcg/ml	1mcg/kg				
Glucostop	0.5ml/kg	1.5ml	1ml	0.5ml	0.5ml
Morphine bolus (50mcg/ml)	50 or 100mcg/kg	3 or 6 ml	2 or 4 ml	1ml	0.5 ml
Morphine Infusion (50mcg/ml)	10mcg/kg/h	0.6ml/h	0.4ml/h	0.2ml/h	0.1ml/h
Phenobarbitone	20mg/kg	60mg	40mg	20mg	10mg
Rocuronium 10mg/ml	1mg/kg	0.3ml	0.2ml	0.1ml	0.1ml

Appendix 7 Neonatal Therapies available for babies born in Wales

	Nitric oxide	Cooling	Surgery	Oscillation	Full NICU all gestations
Swansea	√	√	x	√	√
Cardiff	√	√	√	√	√
Newport	√	√	x	√	√
Wrexham	x	√	x	√	28 weeks+
Glan clwyd	x	√	x	√	28 weeks+
Arrow park	√	√	x	√	√

All other units in Wales – Carmarthen, Princess of Wales (Bridgend), Prince Charles (Merthyr), Royal Glamorgan (Llantrisant) , Abergavenny and Bangor are special care units. Network guidelines are that these units should not provide long term ventilation but can stabilise babies who require intensive care, pending retrieval. These units can provide CPAP, but not cooling, nitric oxide or oscillation

Babies of mothers in labour at less than 32 weeks in South Wales should wherever possible be born in a unit with an associated NICU (Cardiff, Swansea or Newport).

Babies born at less than 28 weeks gestation to mothers resident in North Wales should wherever possible be born in Arrow Park.

Babies born between 28 -31+6 to mothers whose nearest unit is Bangor would ideally be born in Glan Clwyd.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Neonatal Intubation

Reference Number	EMRTS CSOP 047b
Application	EMRTS Consultants and CCP's
Related SOPS	Neonatal Emergencies – CSOP 047a Neonatal Intubation – CSOP 047b Paediatrics – CSOP 044 Non-accidental injury and child abuse – CSOP 045 Approach to time-critical paediatric retrieval – CSOP 046 Obstetric emergencies – CSOP 049 Perimortem caesarean section – CSOP 050

Author(s)	Pete Williams (BCUHB - Emergency Department) , John Glen
Internal reviewer(s)	
External reviewer(s)	
Sign off	EMRTS Clinical and Operational Board

Introduction & Objectives

EMRTS is primarily a pre-hospital and adult retrieval service, but will deliver care to neonates in certain situations. The objective of this CSOP is to outline one method of safely intubating a term (or near-term) neonate in a midwife-led unit (MLU) in Wales.

Notes

1. This CSOP does not cover prehospital trauma or illness – please use relevant CSOPS instead.
2. This CSOP should be used in conjunction with the Neonatal Procedures and Neonatal Emergencies CSOPs.

Approach to Neonatal Intubation – General Principles

1. Emergency Intubation (for apnoea, or in an arrested baby) should be distinguished from neonatal RSI. The former does not require drugs, can be carried out in any neonate, and may be life-saving. The latter is subject to the contraindications below.
2. In most situations, there will be time to discuss the case with a consultant from CHANTS. Ideally all cases should be discussed pre-intubation.
3. CPAP will often provide an adequate level of respiratory support to enable safe transfer. Alternatively it may temporise the situation, giving time for equipment preparation and discussion with a CHANTS consultants.
4. In a collapsed neonate over 2kg and 34 weeks, a size 1 igel can be used at any time.
5. Following intubation, adjust FiO_2 to achieve SPO_2 95-99%. Use appropriate oxygen levels to achieve this. Do not worry if you have to use high concentrations of oxygen. However, try to avoid saturations of 100% if you can, as the PO_2 may then be very high and this may be harmful.

Neonatal RSI - Indications

1. Failure of CPAP. If CPAP is instituted, the baby should be reviewed after 20mins clinically and with heel prick blood gas. Indications to consider intubation will include:
    a. Worsening respiratory distress despite CPAP. Look at the work of breathing - indrawing, grunting, RR > 60 per min are indications that the baby needs additional help.
    b. Failure of Oxygenation: i.e SpO_2 <90% despite CPAP in high oxygen concentrations (i.e. FiO_2 >0.3 in the preterm, or >0.4 if over 37 weeks gestation).
    c. Poor capillary gases despite CPAP. In general a pH < 7.25 may need intervention (if due to respiratory failure) and a CO_2 of 8kPa or more needs intervention.
2. Trial of nasal CPAP inappropriate:
    a. Baby *in extremis.*
    b. Marked hypoxia or acidaemia.
    c. Airway problems.

Neonatal RSI – Contraindications

1. Prematurity – RSI of premature babies is not part of the core EMRTS skill set. Unless you routinely intubate neonates as part of your practice, it is not appropriate to attempt RSI in this patient group. For the purposes of EMRTS, the 'cut off' lies at 2kg. This is because your backup option should intubation fail (a size one igel) is only recommended for babies >2kg AND >34 weeks gestation. If a smaller baby requires ventilatory support, then non-invasive CPAP is the most suitable option (see separate CSOP).

   However, as indicated above, an emergency intubation without drugs may be attempted for any neonate that is apnoeic or has arrested, especially where manual ventilation is difficult/impossible.

2. Predicted difficult intubation - In the MLU environment, this will consist of babies with rare syndromes or facial deformities (e.g. Pierre Robin, Down's syndrome). Again, non-invasive CPAP using a nasopharyngeal prong is the most suitable option here.

Neonatal Rapid Sequence Intubation- Notes

Patient Size: Weight is the most accurate guide – gestation is only used if weight is unknown.

Pre-oxygenation: Administration of 100% O_2, for 3 minutes immediately prior to intubation, switching to controlled oxygen as soon as the tube is confirmed. Use oxygen saturations to guide you after this.

Induction:

Fentanyl 2mcg/kg, 1 min prior to intubation, or **Morphine** - 100micrograms/kg, 3 minutes prior to intubation.
Atropine - 20micrograms/kg, immediately before intubation.

Paralysis: Is usually not required. If the baby clearly needs paralysis to facilitate intubation, use:

Rocuronium - 1mg/kg, one minute before intubation.

Cricoid Pressure: Laryngeal manipulation may help with visualisation of the larynx, but cricoid pressure for the prevention of regurgitation is not necessary in this patient group.

Patient Position: ensure neutral head position. This can be achieved by aligning the tragus of the ear with the sternal notch.

Blade: Miller blade (size 1 term, size 0 prem) is most commonly used, with a backup Mac 1 or 2 for larger babies.

Surgical airway: In this group, surgical airways are to be avoided as they are technically difficult and usually fail. Efforts are better spent in improving oxygenation 'from above': igel, neutral head position with shoulder roll, appropriately sized guedel airway, 2-person ventilation.

Gastric tube: should be in place if CPAP or ventilation is ongoing. Ensure it has been aspirated and is left on free drainage.

Neonatal introducer: inserted prior to intubation to stiffen the tube. Take care that the end does not protrude from the TT, but is at the tip of the TT.

EMRTS Neonatal Intubation Checklist: see separate document

Final Note. Please take great care when inserting the laryngoscope. It is easy to damage the frenulum, gums, or back of nasopharynx, especially in small infants. The larynx in the neonate is at level of C2-3 and can be accessed relatively easily with a straight neonatal laryngoscope blade.

Summary

The EMRTS approach to neonatal intubation recognises the fact that the majority of its clinicians are not paediatricians. The protocol is simple, and emphasises key aspects of the procedure to enable safe intubation, while recognising the extra demands on operator bandwidth in this challenging patient group.

References and Further Reading

1. Royal College of Paediatrics and Child Health. Standards for children and young people in emergency settings. London; 2012 [accessed 26th Oct 2014]. Available from: http://www.ukpics.org.uk/documents/TRANSPORT/Intercollegiate%20Emegency%20Standards%202012%20FINAL%20WEB.pdf.

2. Paediatric Intensive Care Society. Standards for the Care of Critically Ill Children, 4th ed. London; 2010 [accessed 26th Oct 2014]. Available from: http://www.ukpics.org.uk/documents/PICS_standards.pdf.

3. Royal College of Anaesthetists. Guidelines for the provision of paediatric anaesthetic services. London; 2009 [accessed 26th Oct 2014]. Available from: http://www.rcoa.ac.uk/docs/GPAS-Paeds.pdf.

4. Vidacare Corporation. The Science and Fundamentals of Intraosseous Vascular Access. 2013 [accessed 26th Oct 2014] Available at: http://www.arrowezio.com/.

5. Hamilton Medical. Hamilton T1 brochure. 2014. [Accessed 26th Oct 2014]. Available at: http://www.hamilton-medical.com/products/hamilton-t1.html.

6. Cymru Inter-hospital Neonatal Transfer Service. Microsite. 2014 [accessed 26th Oct 2014]. Available at: https://www.wales.nhs.uk/sites3/home.cfm?orgid=942.

7. North West and North Wales Paediatric Transport Service. Clinical Guidelines. 2014 [accessed 26th Oct 2014]. Available at: http://www.nwts.nhs.uk/clinicalguidelines.

8. Advanced resuscitation of the newborn infant. Resuscitation Council (highly recommended)

Appendix A: Morphine dosing

Dilution

Make up 10mg in 10ml saline, and then take 1 ml of this solution and make up to 20ml to give a 50 microgram per ml solution

Loading Dose

100mcg/kg as a slow bolus (i.e. 2ml/kg)

Infusion rate

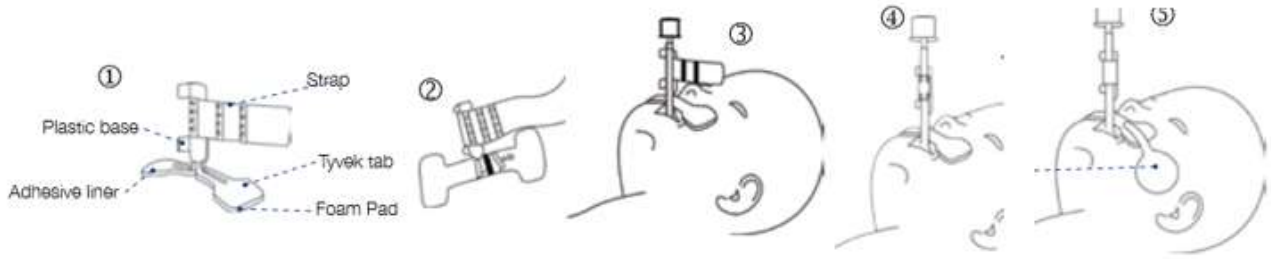
5-20 micrograms per kilo per hour (i.e. 0.1ml-0.4ml per kilo per hour). See Table.

Morphine Infusion 50mcg/ml			
Baby's weight	**5 mcg/kg/hr**	**10mcg/kg/hr**	**20mcg/kg/hr**
2.0 kg	0.2 ml/hr	0.4 ml/hr	0.8 ml/hr
2.5 kg	0.25 ml/hr	0.5 ml/hr	1.0 ml/hr
3.0 kg	0.3 ml/hr	0.6 ml/hr	1.2 ml/hr
3.5 kg	0.35 ml/hr	0.7 ml/hr	1.4 ml/hr
4.0 kg	0.4 ml/hr	0.8 ml/hr	1.6 ml/hr

Appendix B: Securing ET tube with Neofit device.

(See figure)

1. Trial fit on baby. Adhesive pad should not overlap mouth or eyes.
2. Remove adhesive liners from the bottom of the adhesive pads.
3. Fix device to patient.
4. Wrap the tube holder snugly around the TT. Secure using the attached Velcro.
5. Use the extra adhesive tape provided for additional security, if needed.



Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Babypod System

Reference Number	EMRTS CSOP 047c
Application	EMRTS Consultants, CCPs and Pilots.
Related SOPS	Neonatal Emergencies – CSOP 047a Neonatal Intubation – CSOP 047b Neonatal Procedures – CSOP 048

Author(s)	Pete Williams (BCUHB - Emergency Department), John Glen
Internal reviewer(s)	
External Reviewer(s)	
Sign off	EMRTS Clinical and Operational Board

Introduction & Objectives

This SOP describes how to package and transfer a neonate using the Babypod system into an ambulance, on both the H135 and H145 aircraft. The system should NOT be used to convey a neonate in the EMRTS Rapid Response Vehicle (RRV), although the RRV can be used to transport the system to an incident which may require its use.

Babypod System

The system consists of the following:

- The Babypod (containing 1 Transwarmer mattress, 3 clean towels, 2 lengths of tube tie and 3 Ferno straps for ambulance conveyance). Ensure metal frame is *in situ* at the head end of the Babypod for securing ventilator tubing. Contents should be checked daily.
- The Base plate and aircraft conversion system.

1: Deployment

As mentioned, the Babypod portable incubator has the ability to be carried safely in both the H135 and H145 aircraft.

Aircraft – H135

This process needs to be practiced if you are to get off the ground within a reasonable time. It can be done inside four minutes from alert to helicopter start-up.

1. CCP takes job details.
2. Pilot and Doc go to kit room and collect Babypod and base plate.
3. Doc: enter right side of aircraft, remove red response bag from the stretcher and strap it into spare seat.
4. Pilot: on left side of aircraft, pull out sled and remove everything else (i.e. blue response bag, US scanner, Lucas device) from scoop, then remove scoop as well.
5. As far to the rear as possible, replace: blue bag; US scanner; syringe drivers. Strap them in. The remaining loose stretcher harnesses can lie on the stretcher itself – there is room under the Babypod baseplate for them.
6. Undo 2 small Velcro straps: one on each side of the stretcher.
7. Load the base plate first, then load the Babypod on top. This requires practice.
8. Start-up as usual.

Fig 1a/b/c: Base plate – loading onto stretcher requires practice due to asymmetric fixation method.

Fig 1d: Undo Velcro on aerolite stretcher to make room for base plate latching

Aircraft – H145

For positioning into the H145 there are two parts, the lower section (Fig1e) and the upper section (Fig1f).

Fig 1e: Lower Section.

Fig 1f: Upper section

The upper section “captures” the Babypod and the lower section attaches to the Bucher stretcher, and then the two sections fix together. This design allows for quick and easy installation onto the Bucher stretcher system.

Installation of Lower Section onto the Bucher Stretcher

To install the Babypod lower section onto the Bucher stretcher, proceed as follows:

- Ensure that the Bucher stretcher is positioned outside the aircraft with the wheels locked/stretcher immobilised.
- Remove the stretcher mattress and then fasten the harness and straps tightly on top of the stretcher with all buckles flat.
- Ensure that all of the fasteners on the lower section are in their respective open positions (FWD fasteners pointing FWD, and AFT fasteners pointing AFT). Hold Above the stretcher as shown in Figures (1g/h).

Figure 1g:

Figure 1h:

- Place the lower section onto the stretcher, ensuring that the side locking blocks (Figure 1i) fit into the stretcher side relief holes. The corner blocks should fully engage onto the stretcher rails.

Figure 1i:

- Turn the quarter turn fasteners on the underside of the corner blocks inwards to their closed position (as shown in Figure 1j).

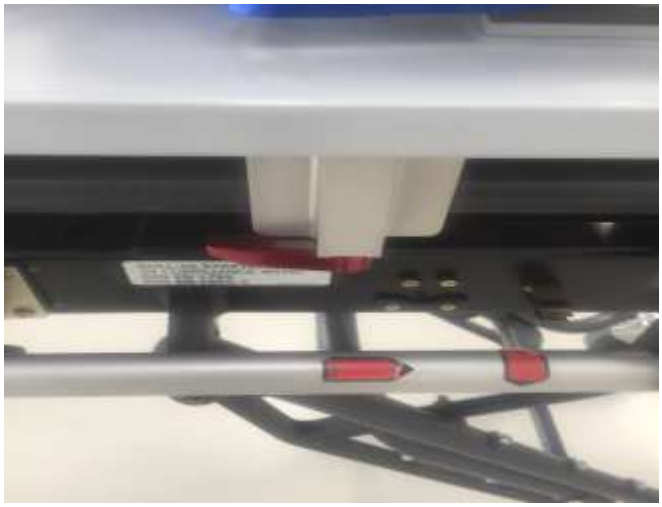
Figure 1j:

The lower section is now fixed into place, ready for the upper section to be attached.

Installation of the Upper section to the lower section on the stretcher.

- Ensure that the fasteners on the underside of the Upper section are in the open position.
- Hook the Upper section onto the right hand side of the Lower section, making sure that the contacts/grips sit within the flanges on the tube of the Lower section.
- Lower the left-hand side of the Upper section onto the Lower section and ensure the contacts sit within the tube of the Lower section.
- Turn the quarter turn fasteners/retainers to the “lock” position, both facing inwards, as shown in Figure 1k.

Figure 1k:



Installation of the Babypod onto the Upper section

In order to secure the Babypod into the storage system, carry out the following:

- Flip up the Rear Cage Assembly through 90° to the upright position
- Slide the Babypod along the nylon runners on the storage system to meet the Rear cage assembly, and pass the foot end restrain buckle through the gap as shown in Figure (1l).

Figure 1l:

- Flip up the Fwd Cage Assembly to meet the Fwd end of the Baby pod until the front cruciform straps "capture" the front/nose end of the Babypod unit.
- Buckle-up and tighten the side straps and double check that the Babypod is held firmly and securely into place.

2. Positioning a baby into the Babypod

1. The Babypod should always used in conjunction with a Transwarmer mattress.
2. Firmly press the built-in trigger to activate the Transwarmer mattress and place in the Babypod with the white fabric surface facing upwards. The Transwarmer mattress takes approx. 90 seconds to warm up.
3. The baby's skin can be placed directly in contact with the white fabric surface of the Transwarmer mattress. Babies with a low birth weight should be left in a Neowrap occlusive wrap that has been placed at the start of the resuscitation. All neonates should be wearing a hat.
4. The Babypod is labelled with direction of baby's head and travel.
5. A paediatric Redi heat blanket (which has ideally been warm up from the start of the resuscitation) should be sandwiched between a folded towel to avoid direct skin contact. The towel should be placed over the baby with the blue side of the Redi heat blanket facing towards the baby's skin. A further towel can be placed over this as appropriate.
6. The lid of the Babypod should be labelled to indicate where the ventilator tubing and monitor cabling emerge from the system.
7. The baby's head should be turned slightly to the left and the ventilator tubing should come out of the head end, on the baby's left.
8. The monitor cabling comes out at the feet end, on the baby's left in close proximity to the monitor when positioned in the aircraft.
9. Both ventilator tubing and monitor cabling should be placed in hosing to help prevent disconnection.
10. Syringe drivers should be carefully placed inside the Babypod, to the baby's left and adjacent to the hatch to allow access.
11. The umbilical catheter should have a triple octopus on it. The syringe driver is attached to one arm. Attach a flushed extension set to another arm, with a 3-way-tap on the proximal end, and leave it near the hatch at the baby's left, nearest the head. This will be your IV access in flight.
12. Place mini muffs (ear protection) over the baby's ears. Do not deflate the vacuum mattress.
13. Secure the ventilator tubing to the metal frame using tube tie. Tie it tight.

14. Close the lid. Secure the lid at the head end only.

Fig 2a/b/c: Transwarmer under baby; Redi heat sandwiched in towel over baby (note blue facing down); further towel

Fig 2d/e/f: Arrangement for intubated baby; position of skin temp probe away from Redi heat; tube tie around metal bar to secure ventilator tubing

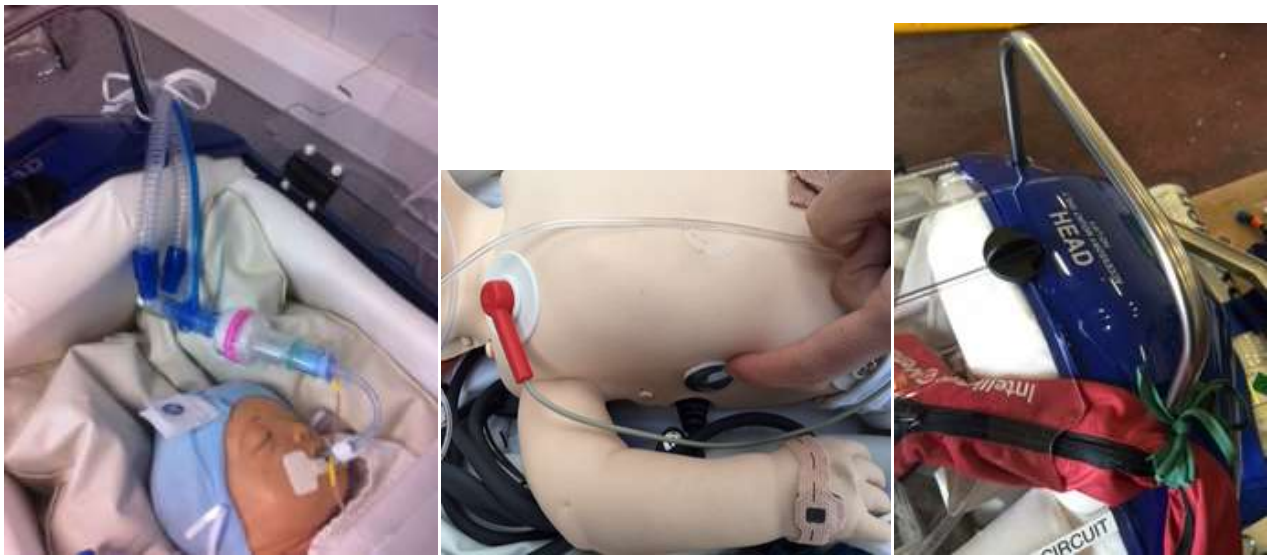


Fig 2g/h: Ventilator tubing top left, monitor cable bottom left, syringe driver

3. Moving Babypod into the aircraft

1. This takes 3 people: two to carry baby plus monitor/vent, and one to carry the oxygen cylinder.
    a. Person on baby's right carries monitor.
    b. Person on baby's left carries ventilator.
2. Care must be exercised in performing the manoeuvre to avoid accidental displacement of ventilator tubing and monitor cables.
3. Place Babypod on its base plate. Secure it using the side and top straps.
4. One person gets in to helicopter from the right hand side, and then takes monitor inside.
5. Monitor can now be attached to helicopter bracket.
6. Start moving the stretcher inside. Once it has travelled far enough, connect ventilator oxygen hose to helicopter, and then transfer ventilator to its bracket.

Fig 3a/b: Carrying Babypod – note that a third person is needed to carry the oxygen cylinder

Fig 3c/d: Move monitor to bracket, then start sliding stretcher home. Ventilator/oxygen has shorter tubing, so has to follow Babypod until stretcher far enough in to transfer vent/O2 to helicopter.

Fig 3e: Final position. Note short ventilator tubing.

Ambulance

1. The packaging of the baby in the Babypod should proceed as indicated above but the ventilator tubing, monitoring cables and IV lines should come out of the head end on the right.
2. The ventilator tubing should be tightly secured to the metal bar using tube tie.
3. The bridge system should be mounted on top of a Ferno XL scoop one position higher than its usual position for packaging an adult patient. This will house all electrical equipment.
4. Place the Babypod (without the base plate) over the lower part of the scoop with the head end facing towards the top of the scoop.
5. Attach the ventilator, monitor, syringe driver(s) and suction unit to the bridge system.
6. Secure the Babypod to the scoop using 3 Ferno straps either side of the hatches. These must be quick release to allow rapid access to the Babypod if needed.
7. Using a 4 person technique lift the scoop onto an ambulance stretcher, lift the cot sides up and place 3 straps either side of the hatches to secure the system to the trolley. Place a strap across the head end to secure the scoop to the ambulance stretcher.
8. During transfer access to the baby can be undertaken through the hatches either side. If greater access is required the vehicle should be stopped, the straps undone and the lid lifted up. The system must be re-secured before resuming the journey.

Fig 4a: Ventilator tubing, monitoring and IV lines top right (note ventilator tubing secured to metal bar with tube tie)

Fig 4b/c: Final position of Babypod and bridge on scoop (with ventilator, monitor using bracket, syringe driver(s) and suction unit in final position); detail of positioning of straps in relation to hatches

Fig 5a/b: Position on ambulance stretcher; position of ambulance stretcher straps in relation to hatches

Bridge Systems.

Within the service, each base has two purpose built bridge systems that should be utilised for the safe storage and carriage of medical equipment. Each bridge system is specific to aircraft type (H135 and 145), and will fit directly onto the aircraft and scoop stretcher.

Please refer directly to the H135 and H145 bridge system action cards for further guidance on use/assembly.

Please ensure that the appropriate bridge system is carried upon each specific aircraft type, and that it is removed for use if a transfer is to be undertaken by ambulance.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

CSOP 048 Neonatal Procedures

Reference Number	CSOP 048
Version	10.0
Review date	19/01/2024
Related SOPS	Neonatal Emergencies – CSOP 047a Neonatal Intubation – CSOP 047b Paediatrics – CSOP 044 Non-accidental injury and child abuse – CSOP 045 Approach to time-critical paediatric retrieval – CSOP 046 Obstetric emergencies – CSOP 049 Perimortem caesarean section – CSOP 050
Author(s)	Pete Williams (BCUHB - Emergency Department), John Glen, Jason Hughes

Introduction & Objectives

The purpose of this SOP is to give indications for, and brief guides to, the procedures which EMRTS are likely to perform on neonates. Procedures should follow a logical 'ABC' approach.

The procedures are:

1. Neonatal Ventilation.
2. Nasal Continuous Positive Airway Pressure (n-CPAP).
3. Insertion of iGel.
4. Use of T-Piece.
5. Intraosseous access.
6. Heel prick blood sampling.
7. Use of Glucostop (dextrose gel).
8. Therapeutic hypothermia, including temperature measurement.
9. Gastric tube insertion.
10. Keeping baby warm, including use of ready heat blanket.
11. Packaging for air and road transfer, including incubator.

Intubation is covered in a separate SOP. (CSOP 047b)

Neonatal Ventilation

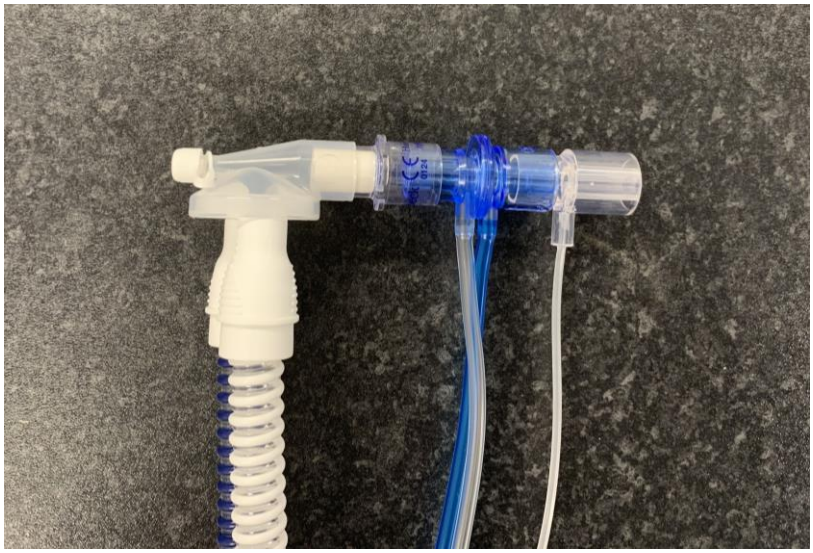
When using the T1 for formal ventilation, perform the following procedure.

1. Change to neonatal valve
2. Put HME filter on inspiratory and expiratory limbs
3. Connect the blue/clear pressure lines to their blue/white housing

4. Connect the dual tubing to the swivel “T” piece connector. Insert mini HMEF between connector and flow sensor

5. Perform the calibration using the neonatal adapter, this will require you to reverse the flow sensor when prompted

6. After the flow sensor attach the ETCO2 sensor and connect directly to ETT



7. Select 'NEONATAL' ventilation.

8. Enter the weight.

Initial Settings

The following tables give approximate INITIAL ventilator settings for babies. The settings can then be adjusted to obtain optimal chest movement, FIO_2 and blood gas results. Adjust the FIO_2, aiming for saturations of 95% – 99% in babies > 34 weeks and 91-95% in babies less than 34 weeks, and set the appropriate alarm limits. A simplified version of the below is given in the app.

Term Baby – Initial Settings

	Normal Lung	Abnormal Lung (e.g. meconium aspiration, poor compliance)
Mode	PSIMV+	PCV+
Rate	40-50	60
Inspiratory Time	0.3-0.4 sec	0.4-0.5
Pressures	16/6 (i.e. peak 22)	22/6 (i.e. peak 28)
Trigger	0.1 L/min	0.1 L/min
Initial FiO_2	0.21	Based on SPO_2

Preterm Baby – Initial Settings

	Normal Lung	Abnormal Lung (e.g. meconium aspiration, poor compliance)
Mode	PCV+	PCV+
Rate	50	60
Inspiratory Time	0.3 sec	0.4
Pressures	14/6 (i.e. peak 20)	22/6 (i.e. peak 28)
Trigger	0.1 L/min	0.1 L/min
Initial FiO_2	Based on SPO_2	Based on SPO_2

Notes:

1. Because neonatal ET tubes are not cuffed, there is a variable leak around the ET tube during ventilation. This can make ventilation using set tidal volume unpredictable. This is the reason for using Pressure Limited ventilation rather than a volume mode.
2. Please take care when calculating the amount of oxygen required for the journey. Check the percentage leak and take this into account.

1. Nasal Continuous Positive Airway Pressure (CPAP)

Background:

CPAP can be easily delivered by the Hamilton T1 ventilator, and in most cases will provide an adequate level of respiratory support to enable safe transfer to definitive care. However, in the markedly hypoxic or poorly responsive baby it is unlikely to rescue the situation. In that case, consider intubation first line, after discussing with the CHANTS consultant if time allows.

Indications: Neonate with any of the following:

- Laboured work of breathing at any time once airway is clear.
- Requiring supplemental Oxygen to keep SPO_2 above 90% at 10 mins after birth.
- Requiring FiO_2 >0.4 to keep SpO_2 above 95% at 15 mins after birth.
- pH <7.25 after initial resuscitation.
- Plan for therapeutic hypothermia.
- Any preterm baby less than 34 weeks gestation (rationale: this may aid alveolar expansion and prevent collapse due to surfactant deficiency). CPAP may be applied from birth and can be done using the BabySafe prior to setting up the Hamilton ventilator for CPAP.

In preterm neonates, the threshold for starting CPAP should be very low, as these babies have little reserve and cannot compensate by e.g. grunting. Once CPAP is started, adjust the FiO_2 to achieve suitable SPO_2:

- 91-95% for babies less than 34 weeks gestation.
    - This means you may be starting CPAP on a preterm baby even though the initial SpO_2 is already 91-95%.
- 95-99% for term neonates.

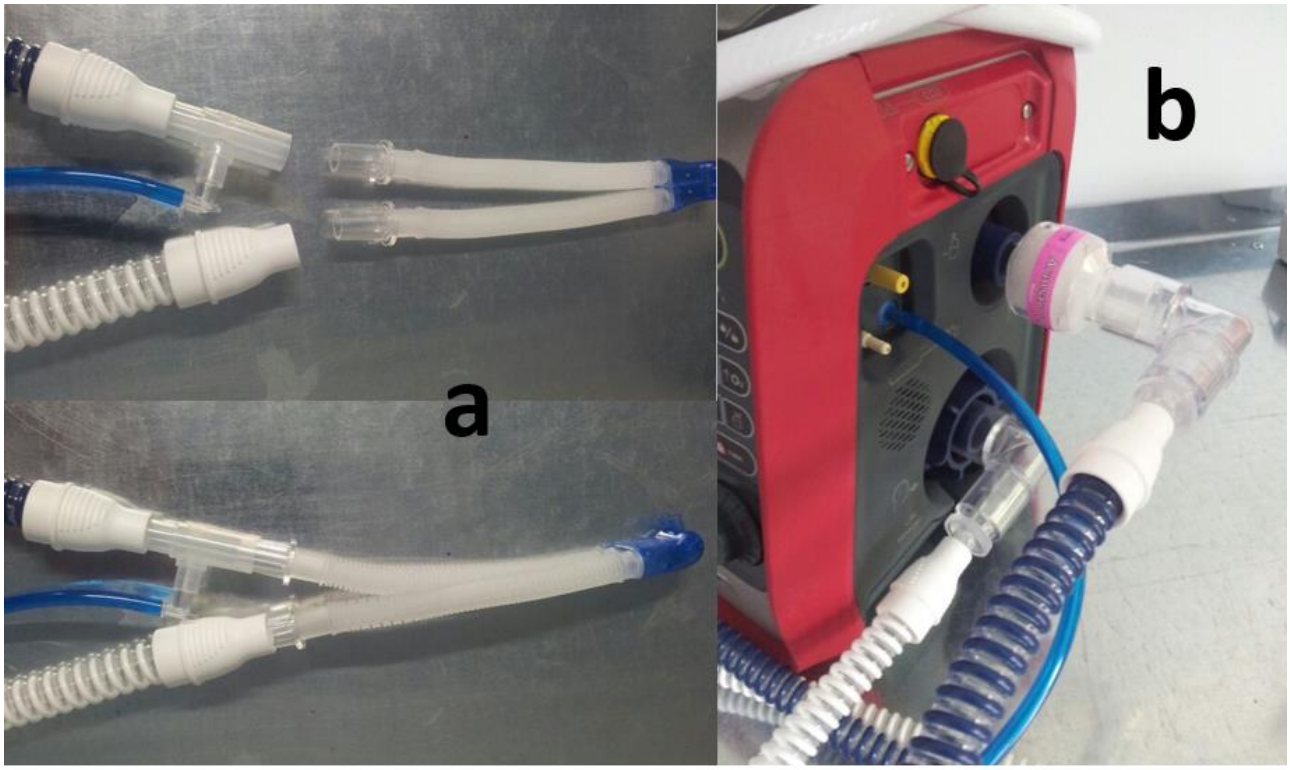
Avoid saturations of 100% in all babies if you can (as the pO_2 may then be very high, and this can be harmful, particularly in the preterm infant).

Do not worry if you need to use high concentrations of oxygen, or if saturations go higher than target for a short time.

Method:

1. Change to neonatal valve (see above).
2. Remove the flow sensor and short Y-connector from the ventilator tubing.
3. Attach the dual tubing to the trouser connector. Place the pressure sensor in the inspiratory limb (a)
4. Insert the pressure line into the blue housing. Ensure the inspiratory limb has a bacterial filter (b).

5. Set to n-CPAP mode.
6. Perform the checkout procedure. This is straightforward: follow the instruction on screen.
7. Set the FiO_2 to 50% (Once attached, titrate FiO_2 to achieve SpO_2 targets above).
8. Set the CPAP to 6cmH_2O.
9. Select size of hat and prongs using sizing guide (c).
10. Place hat on baby, covering the ears and nape of the neck. Tie the top of the bonnet closed with the attached ribbon.
11. Attach prongs to the trouser connector.
12. Once the machine is delivering gas, attach to baby (Figs d & e).
13. Carefully insert orogastric tube (see above).
14. Ensure the prongs fit snugly. Some babies lose CPAP pressure because the mouth is open. If closing the baby's mouth doesn't work you can try a pacifier, or a chin strap.
15. Reassess at 20 minutes clinically, and with heelprick/umbilical blood gas. Discuss with CHANTS re next steps.



Figs a&b: method of assembling tubing. Note that blue is inspiratory, and has a HME. Pressure line (also blue) inserted into inspiratory limb.

Fig c: Hat, trouser, and prongs, with sizing guide

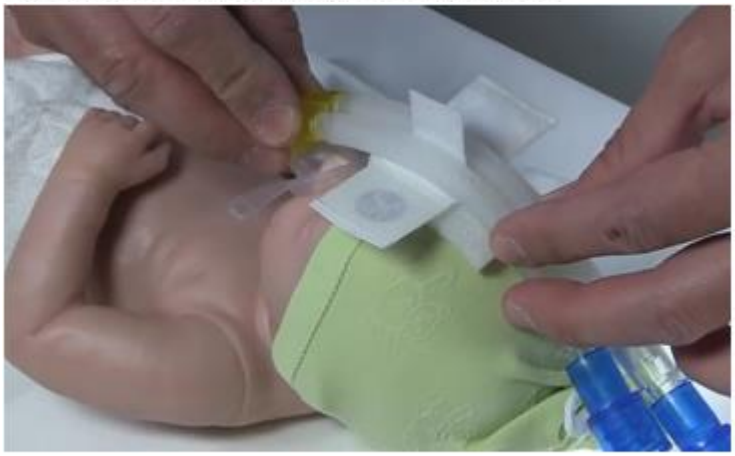


Fig d: Place one tube of the nCPAP generator on either side of the Velcro retainer

Fig e: Final position

Note

In babies with syndromes or facial deformities (e.g. Pierre Robin, Down's syndrome), there may be proximal airways obstruction making CPAP in effective. One option if nasal prong CPAP does not seem to be effective is to insert a longer nasopharyngeal 'prong'. This is a size 2.5/3 ET tube inserted through a nostril and cut to the level of just above the larynx. This will deal with the issue of airways obstruction due to the backwardly displaced tongue in a Pierre Robin syndrome or large tongue in Down's syndrome. In the context of EMRTS, these situations will be very rare.

2. Insertion of iGel

Background:

The iGel is an easily inserted supraglottic airway, which can facilitate airway management and the delivery of a high FiO_2. It can be used in babies down to 2kg, or 34 weeks' gestation. For all babies, the appropriate size is 1.

Indications

- Flat neonate requiring ventilatory support
- As a rescue technique in failed intubation.
- As an alternative to a Guedel airway.

Method

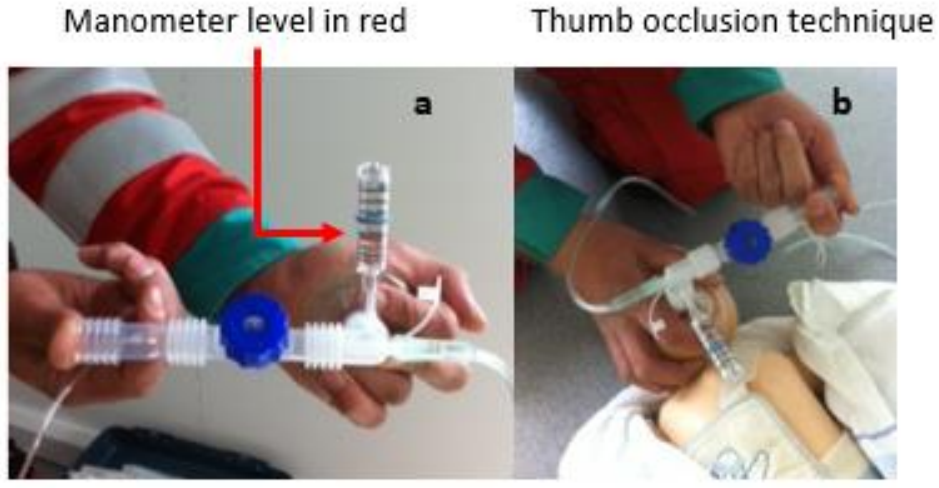
1. Lubricate device
2. Insert in the midline, gently, ensuring that you do not push the tongue back. It should pass easily backwards, until resistance is encountered.
3. Attach to breathing circuit and confirm the airway is patent using observations and CO_2 monitoring. If there is any doubt, take it out again.

3. Use of T-Piece

The EMRTS Mapleson C circuit doubles as a pressure-limiting device for neonatal ventilation.

Method:

1. Remove the inflation bag from the Mapleson C. Ensure the manometer is attached.
2. Set the gas flow at 10 LPM.
3. Occlude both ends of the circuit – the manomenter gauge will indicate the pressure you are generating.
4. Unscrew the blue valve until the desired pressure is reached (20cm H_20 reasonable).
5. Use thumb occlusion to inflate the baby's lungs with fresh gas flow.



4. Intraosseous access

Indication:
Venous access for any collapsed or unwell neonate.

Method: (acknowledgements to NWTS service literature)

1. Prepare set for connection. This should consist of: EZ-IO connector; triple octopus; 3-way tap (connect to one of the arms of the octopus); 5 ml syringe (connect to 3-way tap). Flush all ports clear of air. The 3-way tap will be for drug/fluid boluses. The remaining 2 octopus arms will be for glucose +/- morphine infusions.
2. Use the pink IO needle.
3. Identify landmark: flat anteromedial surface of tibia.
   To identify landmark, extend the leg. Insertion site is approximately 1 finger breadth below and 1 finger breadth medial to inferior border of patella (Fig 1).
4. Prepare the skin using 0.5% chlorhexidine.
5. Insert needle through skin until it reaches bone.
6. Squeeze trigger and apply steady pressure perpendicular to bone, but slightly away from epiphyseal plate.
7. There is a slight give as the marrow cavity is entered. Stop as soon as you feel the give - do not insert the needle to the hilt.
8. Remove the trocar and attempt to aspirate marrow – this sample can be used in our portable blood gas machine. Marrow cannot always be aspirated.
9. Flush the IO. It should flush easily, and there should be no swelling or leak. It should have a firm seating in the bone.
10. Secure using EZ-IO dressing (Fig 2). If the needle is not flush to the skin, pad it up with some gauze before putting the IO dressing on.
11. Attach pre-flushed connector (Fig 3 – three way tap and octopus not shown). The dead space of the EZ-IO connector is 1ml, and octopus 0.3ml, giving a combined dead space of 1.3ml (the dead space of the EZ-IO needle itself is 0.04ml, and of a 3-way tap is 0.1ml).

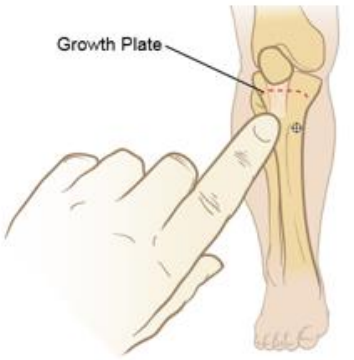


Fig 1: Proximal Tibial Landmark

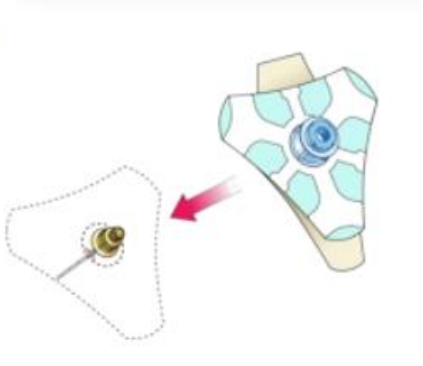


Fig 2: Apply Dressing

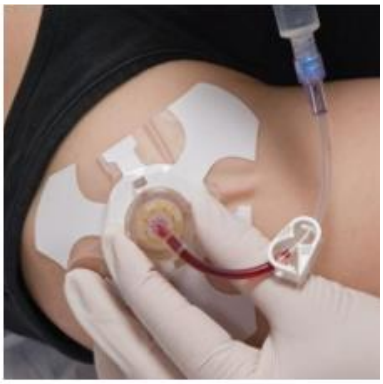


Fig 3: Attach Giving Set

Picture source: Vidacare Promotional Literature

5. Heel prick Blood Sampling

Indication: Assessment of acid/base status, CO_2 level and glucose level in any sick neonate.

Method:

1. Grasp ankle with index & middle finger of non-dominant hand, partly encircling the baby's heel with thumb.
2. Clean puncture site with water and gauze (not alcohol) and allow to dry.
3. Gently compress heel to place skin under tension.
4. Prick skin using lancet. Ensure that you are at the side of the heel, not the back.
5. Hold foot so that blood is allowed to hang, and gently compress to form droplet. Do not squeeze.
6. Hold capillary tube to droplet, in such a way that the blood flows **up** the capillary tube (to avoid air getting in). Releasing and reapplying gentle pressure will allow more blood to flow.
7. Apply pressure to site with gauze until bleeding has stopped.
8. Run sample through EPOC as per ESOP.

Interpretation:

Result will help guide need for respiratory support and for therapeutic hypothermia. If pH<7.25, then consider escalating level of respiratory support. If pH not improved significantly after 20 mins of CPAP, consider intubation (discuss with CHANTS consultant). If pH <7 or Base deficit >16 mmol/l, in baby >36 weeks gestation consider therapeutic hypothermia.

6. Use of Glucostop (dextrose gel)

Indication: hypoglycaemia

Dose: 0.5ml/kg

Method:

a. Squeeze the 40% dextrose into a gallipot, and draw up with a syringe.
b. Dry the baby's mouth with sterile gauze.
c. Massage the gel into the buccal mucosa
d. Feed the baby if possible.

7. Therapeutic hypothermia including temperature measurement

Introduction:

Whilst therapeutic hypothermia (TH) carries significant benefits, it also has risks. The priority for EMRTS is safe transfer of the baby. Thus, TH should only be instituted when cardiorespiratory stability has been achieved, and it should be abandoned if the baby becomes unstable. Particular care should be taken to avoid overcooling. However, since the NNT to prevent one adverse outcome is only 8, and since early TH is associated with the greatest benefit, TH is a technique that EMRTS should aim to offer in clear-cut cases. Always discuss with CHANTS consultant first.

Indications (modified from TOBY trial): >36 weeks gestation, plus any one of the following:

- Poor condition at birth and requiring resuscitation from birth to at least 10 minutes of age.
- Any blood gas (IO, heel prick or cord) with pH <7 in the first hour of life.
- Any blood gas (IO, heel prick or cord) with Base Deficit > 16 mmol/l in the first hour of life.

These criteria are sensitive but not particularly specific, and will include infants who are subsequently found to have a normal EEG. In these infants, cooling can be discontinued at the neonatal facility.

In addition, babies who have had seizures may benefit from cooling, but this should be determined after discussing with CHANTS (see Neonatal Emergencies SOP).

Method:

1. Ensure you have achieved cardiorespiratory stability (particularly oxygen saturation), as institution of hypothermia can destabilise the child.
2. Attach skin thermometer.
3. Allow the infant passively to a monitored temperature of 33-34 deg C by turning off the incubator heater.
4. Be careful not to overcool. If temp is falling too fast or too much, re-warm using incubator, hat, blanket, Ready Heat.
5. Start morphine infusion 5mcg/kg/hr: may need to be increased.
6. Start dextrose 10% infusion at 72ml/kg/day (3ml/kg/hr)

Complications: The default approach in the event of significant deterioration in the infant's condition should be to re-warm. Cooling can always be started again in the neonatal unit under more controlled conditions.

- Respiratory: Gas exchange may be impaired by cooling due to pulmonary hypertension.
- Cardiovascular: Heart rate drops by 14bpm per degree drop in temperature. However adequately cooled babies will have a heart rate of approx 90/min
- CNS: shivering/stress may interfere with cooling/neuroprotection. Give morphine as above.

Note: Cooled neonates can often be managed on CPAP – this is a discussion to have at the time with CHANTS consultant.

8. Insertion of an Orogastric Tube

Purpose: To empty the stomach of air and/or meconium, with the aim of improving ventilation and preventing meconium aspiration.

Indications:

- Following CPAP.
- Following Intubation.
- Significant meconium staining of liquor.
- Following Mask ventilation where stomach has been distended in order to deflate the stomach.

Method:

1. Use Size 8 for term, size 6 for preterm baby. You should not feel any resistance
2. Insert the tube to the appropriate depth (gauge this by measuring from lips to tragus, then from tragus to just past xiphisternum, using the tube itself).
3. Gently and slowly aspirate the tube using the purple 5ml syringe until the stomach is empty. If there is no aspirate at all, suspect malposition.
4. Fix the tube in position using white tape (see illustration)
5. If the baby is to have CPAP, leave the tube on free drainage. Otherwise, cap off.
6. Inform staff at destination that pH sampling has not been done.

9. Keeping baby warm (including Ready Heat)

Indication: all neonates who are not receiving therapeutic hypothermia. See figure.

- Dry and cover the baby. In premature babies, use neowrap.
- Place a hat on baby's head.
- Use incubator.
- Use ready heat blanket.

Attach the temperature probe to the skin and adjust the incubator to keep the temperature within target range of 36.5 to 37.5 degrees C. For a term baby try an initial incubator setting of 33 degrees and for a preterm baby an incubator temperature of 38 degrees C.

If a baby is already inadvertently cold (i.e below 35 degrees C) use Ready Heat Mattress.

Instructions for use of Ready Heat Mattress

1. Exposure to air (i.e. opening packet) will start the warming reaction. The blanket takes up to 20 mins to reach target temperature (38C), and remains warm for up to 8 hours.
2. Place under infant. **Do not place directly against skin**.
3. Package as per SOP (below).

10. Packaging

For information on using the BabyPod for packaging, see CSOP 047c.

EMRTS carries a dedicated neonatal incubator. This will be permanently attached to an aerolite stretcher, and brought on appropriate neonatal taskings.

Switch the incubator on as soon as you arrive, as it takes some time to warm up. Set it to 33 degrees for a term neonate, and 38 degrees for a preterm neonate.

Packaging System

EMRTS uses the EMBRACE packaging system with the incubator. This allows the neonate to be securely retained within the incubator, while still allowing access if needed. Before proceeding, confirm that baby is stable, that all infusions are connected and running, and that monitoring is functioning.

1. Ensure that the EMBRACE system is correctly attached to the base plate of the incubator.
2. To speed up the incubator warm up process, position an activated ready heat blanket into the incubator chamber.
3. Place ear muffs on baby (there are goggles in the photo as well, but these not used for transfer).
4. Place baby underneath the netting feet first (Fig 12.1A). Once this is done, disconnect SpO2, NIBP, ECG and temperature wires from the monitor (not the infant) and feed the wires out from the inferior side of the netting before reconnecting them. This is a fiddle, but is best done now.
5. Tighten the straps to a comfortable tension, and tie the inferior strap through the strap retainer on the lower flap (Fig 12.1B & C). Ensure that wires/tubing come out through the gap at the bottom right of the system. (Fig 12.1D)
6. Ensure you have access to the 3 way tap on the umbilical catheter. This may mean cutting a hole in the EMBRACE netting.
7. Transfer the whole package into the incubator, and place the ventilator, monitoring, and pumps in their nooks. This will need several pairs of hands, and a little thought.

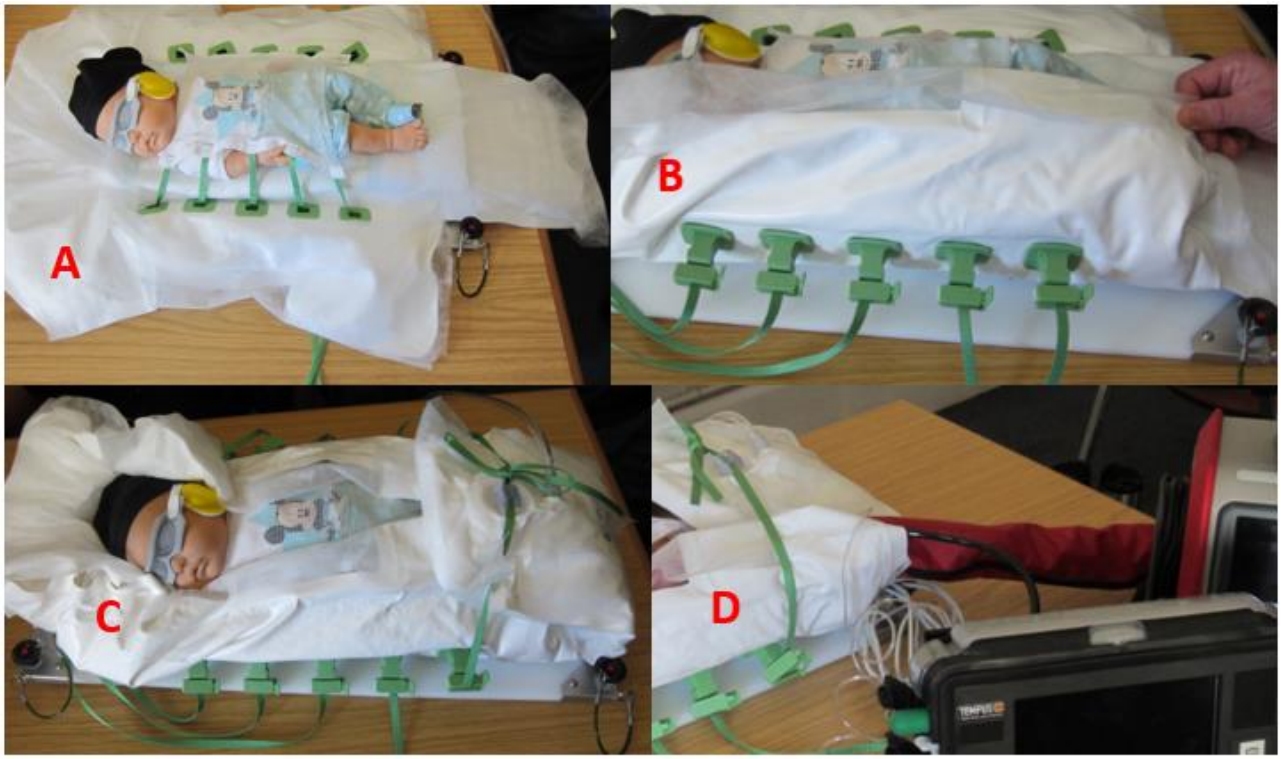


Fig 12.2 – EMBRACE Packaging system. **A**: baby placed underneath netting. **B**: detail of retaining straps. **C**: Baby secured in system. **D**: Detail of monitoring cables and ventilator tubing exiting the system caudally.

References and Further Reading

1. Royal College of Paediatrics and Child Health. Standards for children and young people in emergency settings. London; 2012 [accessed 26th Oct 2014]. Available from: http://www.ukpics.org.uk/documents/TRANSPORT/Intercollegiate%20Emegency%20Standards%202012%20FINAL%20WEB.pdf.

2. Paediatric Intensive Care Society. Standards for the Care of Critically Ill Children, 4th ed. London; 2010 [accessed 26th Oct 2014]. Available from: http://www.ukpics.org.uk/documents/PICS_standards.pdf.

3. Royal College of Anaesthetists. Guidelines for the provision of paediatric anaesthetic services. London; 2009 [accessed 26th Oct 2014]. Available from: http://www.rcoa.ac.uk/docs/GPAS-Paeds.pdf.

4. Vidacare Corporation. The Science and Fundamentals of Intraosseous Vascular Access. 2013 [accessed 26th Oct 2014] Available at: http://www.arrowezio.com/.

5. Hamilton Medical. Hamilton T1 brochure. 2014. [Accessed 26th Oct 2014]. Available at: http://www.hamilton-medical.com/products/hamilton-t1.html.

6. Cymru Inter-hospital Neonatal Transfer Service. Microsite. 2014 [accessed 26th Oct 2014]. Available at: https://www.wales.nhs.uk/sites3/home.cfm?orgid=942.

7. North West and North Wales Paediatric Transport Service. Clinical Guidelines. 2014 [accessed 26th Oct 2014]. Available at: http://www.nwts.nhs.uk/clinicalguidelines.

8. Great Ormond St Hospital for Children. Blood Sampling, Neonatal Capillary. London; 2014. [Accessed 26th Oct 2014]. Available at: *http://www.gosh.nhs.uk/health-professionals/clinical-guidelines/blood-sampling-neonatal-capillary*.

9. Advanced Resuscitation of the Newborn Infant. Resuscitation Council 2014.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Obstetric Emergencies

Reference Number	CSOP 049
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 47a, CSOP 048, CSOP 047b, CSOP -019, CSOP 050

Author(s)	Stuart Gill
Internal reviewer(s)	Jonathan Whelan, David Lockey
External reviewer(s)	
Sign off	COB

Introduction & Objectives

This service covers a large rural area containing isolated Midwifery Led Units (MLUs). Although high risk pregnancies should be triaged appropriately to consultant led secondary/tertiary care, the EMRTS may be called to assist rare unexpected complications. Midwifes clearly have vast experience of managing delivery and initial neonatal resuscitation. EMRTS clinicians are experts in critical care. The key to optimising outcome for unwell mothers and neonates is effective teamwork and joint decision making.

Equally this CSOP pertains to the management of obstetric emergencies that occur at home or in a birthing centre (i.e. in the pre-hospital environment).

This CSOP aims to cover the following key areas which the EMRTS will be involved with.

1. Transport of pregnant women.
2. Key anatomical and physiological differences in pregnancy.
3. Outline common obstetric emergencies and their management:
    Obstetric haemorrhage.
    Hypertensive disease of pregnancy/Pre-eclampsia.

Cardiac arrest in pregnancy.

The EMRTS does not undertake taskings to manage delivery related problems (e.g. pain relief, failure to progress) unless classified as time critical and life threatening to mother and fetus. The EMRTS will be contacted via the Air Support Desk (ASD) for both pre-hospital incidents and any involving calls from MLU's. The 'top cover' consultant will be involved in most taskings and will assist in decision making in equivocal cases.

Transport of Pregnant Women

A careful risk-benefit assessment needs to be made when deciding to transport the obstetric patient particularly by air. In the vast majority of cases this should be avoided.

Patients in advanced 1st stage (cervix 7-10cm) and 2nd stage (10cm) are NOT suitable for air transport. **Delivery on route will be extremely difficult to manage safely and will pose an unacceptable risk.**

Development of unanticipated complications pre-delivery **may** benefit from transfer to a secondary or tertiary centre. Decision to transport these patients needs to take the following into account;

- Degree of benefit - discussion with Obstetrician at the receiving unit
- Likelihood of delivery within 1.5 hours of ETA at receiving unit.
- Will depend on cervical dilatation and parity – take advice from midwife.
- Level of distress of patient and ability to co-operate with requirements for flight safety.
- Second opinion from 'top cover' consultant before proceeding.

Anticipated benefit to ante-partum patients would be for the following;

- Severe pre-eclampsia.
- Antepartum Haemorrhage (APH) early in labour.
- Fetal distress early in labour.
- Cord prolapsed.

Discuss with the pilot. If there is significant doubt as to flight safety – **go by road in an Emergency Ambulance**. Transfer in the EMRTS car would result in similar problems to transfer by air and should be avoided.

In all obstetric emergencies the pre-alert should consist of mobilising an obstetric surgeon and anaesthetist.

Physiological Changes

Airway

- Higher aspiration risk.
- Potentially more difficult laryngoscopy:
    - Oedema

- Engorged breast tissue
- Tilt applied

- The EMRTS carry a videolaryngoscope with an angulated "difficult" blade and stubby handle laryngoscopes as standard.

Breathing

- Reduced lung compliance (gravid uterus displaces diaphragm and flares ribs)
- Reduced Functional Residual Capacity (FRC)
- Increased oxygen consumption
- All the above result in less reserve and much more rapid desaturation.

Circulation

- IVC compression by uterus (from 20 weeks) – REMEMBER 15-30˚ left lateral tilt or manual displacement of uterus.

- More difficult assessment of degree of hypovolaemia – significant loss before manifest in clinical findings especially hypotension.

- Increased plasma volume (up to 50%) and lesser increased RBC mass (20-30%) – produces relative anaemia.

- Increased cardiac output (up to 40% by 2nd trimester).

- Hypercoagulable – always consider thrombo-embolic events.

Obstetric Haemorrhage

Significant work is ongoing in the field of obstetric haemorrhage in Wales as part of the Obs2 project.
A major finding of this is the benefit of early replacement of fibrinogen. As such, in the absence of near patient coagulation testing EMRTS practitioners should prioritise the use of fibrinogen concentrate in mothers requiring transfusion. Moreover the aim should be to give 4g, rather than 2g, and should be given from the outset.

Antepartum Haemorrhage (APH) – Two types:

Placenta Praevia

Low lying placenta can result in torrential bleeding if a patient is allowed to labour, PV examination may precipitate significant haemorrhage. For this reason **PV should not be performed on any patient presenting with bleeding at greater than 20 weeks gestation, if the placental site is unknown or is low lying.**

Adequate IV access and standard treatment of major haemorrhage should be instigated in the unstable patient. This includes placing the patient in left lateral tilt, administration of blood and blood products **prioritising fibrinogen concentrate** and Tranexamic Acid 1g. See CSOP 019. Urgent transfer to an obstetric unit is required. Permissive hypotension is not appropriate in APH other than in extremis due to compromise of placental flow.

Consider tocolysis (IV salbutamol 250 mcg slowly) to prevent deterioration during transfer to Obstetric Unit. Seek obstetric advice.

Abnormal placental presentation may also represent abnormal placental implantation (accrete/percreta) which poses significant risk of post-partum haemorrhage.

Abruption

May present as pain, hypovolaemic shock but more frequently fetal distress, with or without PV loss. The mainstay of treatment, other than standard resuscitation is transfer to an obstetric unit, preferably with SCBU facilities.

Post Partum Haemorrhage

Post-partum haemorrhage generally occurs as a result of one of 5 abnormalities;

- TONE - Failure of normal contraction of the uterus after stage 3 of labour leaving open vascular bed.
- TISSUE-Retained placenta, preventing normal uterine contraction.
- THROMBIN -Coagulopathy- either from prolonged ante-partum bleed or pre-eclampsia/HELLP syndrome.
- TRAUMA - Birth canal trauma – cervical, vaginal or perineal tear.
- PLUS - Abnormal placental implantation (percreta/accreta) resulting in open vascular bed after delivery (also results in reduced tone).

Care should focus on control of bleeding, holding measures and early delivery to definitive care – an obstetric surgeon.

- Standard ABCDE assessment. To include RSI if indicated BUT beware decompensation. Pay extra attention to risk of difficult airway, aspiration and desaturation.
- Left lateral tilt/uterine displacement.
- Adequate IV/IO access.
- Blood and blood product resuscitation to adequate perfusion – target radial pulse/cerebrating.
- Fibrinogen should be prioritized, at a full dose of 4g initially (see OBSCymru guideline in appendix).
- Give Tranexamic Acid 1g.
- Uterine massage to stimulate contraction.
- Pharmacological stimulation of contraction, escalated in order where adequate tone/control not achieved:
    - Oxytocin (Syntocinon) 5 units slow IV (over 1min) and repeat if required – **BEWARE** rapid bolus can precipitate significant hypotension.
    - Ergometrine 500mcg IM or SLOW IV – not where significant hypertensive disease. Be aware, highly emetogenic, warn mother of this.

- Examine vulva and perineum:
    Remove retained products if able – **gentle** traction on cord.
    Packing and pressure for obvious traumatic bleeding of birth canal. Consider off license use of CELOX gauze if not controlled with simple measures.
- Ensure massive haemorrhage protocol activated prior to arrival at the receiving unit.

Pre-eclampsia/Hypertension

Pre-eclampsia carries significant risk of morbidity and mortality, predominantly from intracranial haemorrhage or cardiovascular and pulmonary complications of fluid overload.

EMRTS involvement is only likely to be in patients presenting late with severe disease, only emergency management is considered in this CSOP.

Definitions

Gestational Hypertension

Blood pressure of > 140mmHg systolic or >90mmHg diastolic without significant proteinuria presenting after 20 weeks gestation

Mild:	DBP 90-99mmHg or SBP 140-149mmHg
Moderate:	DBP 100-109mmHg or SBP 150-159mmHg
Severe:	DBP >110mmHg or SBP >160mmHg

Pre-eclampsia

Hypertension with significant proteinuria.

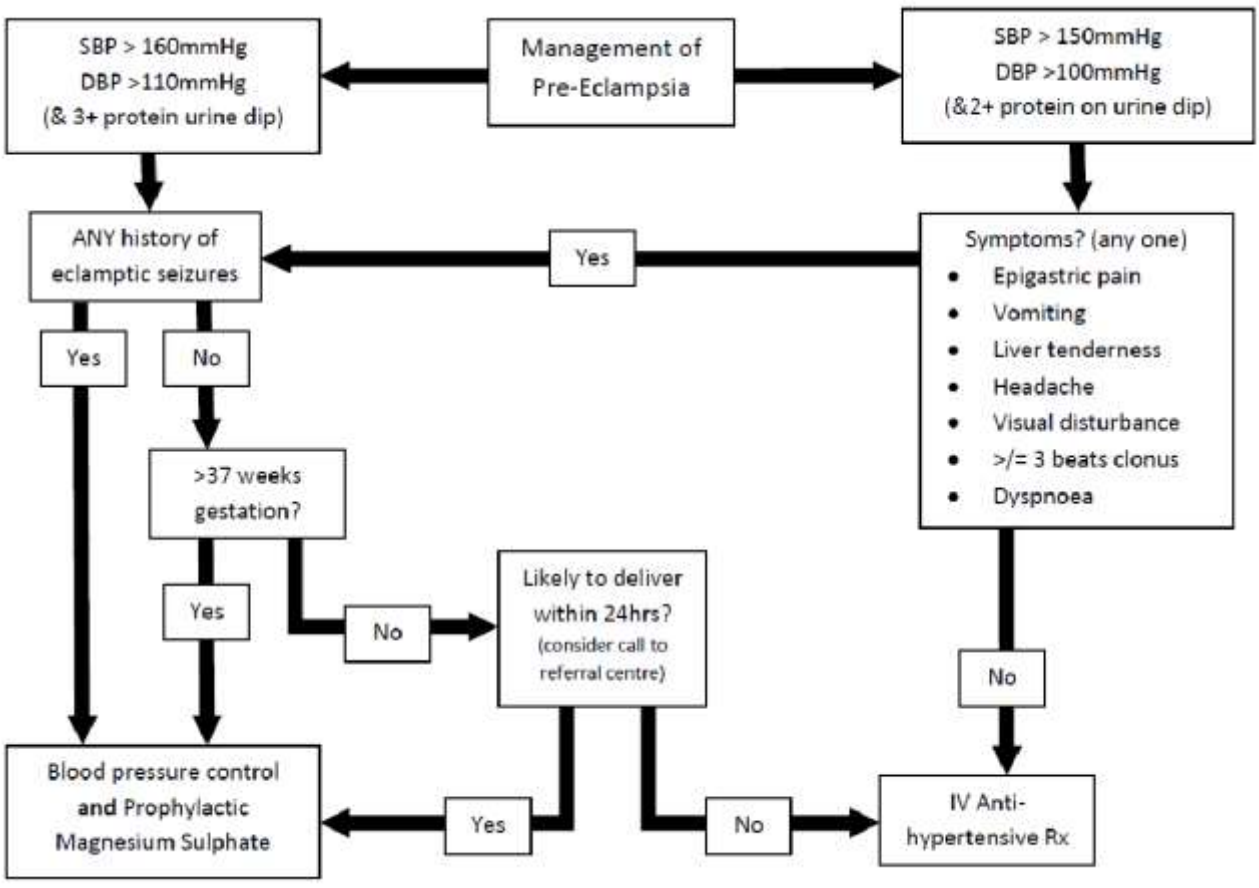
A patient unwell with hypertension should be assumed to have pre-eclampsia, final diagnosis requires in-hospital biochemical testing.

Severe pre-eclampsia presents with significant hypertension and one or more systemic symptoms;
- Neurological: headache, visual disturbance, agitation.
- GI: N&V, abdominal pain typically epigastric or right upper quadrant.
- Respiratory: dyspnoea, hypoxia, frank pulmonary oedema.
And/or
-Haematological or biochemical impairment

These symptoms **MUST** be taken seriously. These patients can deteriorate very rapidly developing eclamptic seizures and acute LVF.

NOTE may present POST partum (within 2weeks of delivery).

Management
- ABCDE assessment, oxygen, IV access, left lateral tilt.



- Great care over fluid management – limit to 80ml/h due to risk of pulmonary congestion.
- **URGENT** transfer to obstetric unit with critical care on site.
- Transfer by road if concern about seizures and unprotected airway.

IV Magnesium Sulphate:

SLOW 4g bolus (over 5mins):
8ml 50% MgSO4 diluted made up to 20ml with saline – beware of potential hypotension
(IF available treat recurring fits with a further 2g magnesium sulphate over 5mins – only possible if $MgSO_4$ from external agency)

Infusion not possible with current EMRTS carried stock, but for information – normally followed by infusion - 1g/hr
Dilute 20ml 50% MgSO4 with 30ml saline to make 50ml (200mg/ml). Run at 5ml/hr.

IV Anti-hypertensive's:

Target BP <150/100
Labetalol (5mg/ml) – give 20-40mg (4-8ml) increments at 10min intervals. 200mg in total.

Eclamptic seizure

- Any seizure in pregnant or recently delivered woman should be considered eclamptic until proven otherwise.
- Standard ABCDE, protect airway, oxygen.
- Magnesium Sulphate as above should be **first line** agent and treat high BP.
- If seizure does not terminate or low GCS treat as status - early RSI.
- Transfer as above to obstetric unit with critical care on site.

Cardiac Arrest in Pregnancy

The general principles of ALS stand with the following considerations;

- Manual displacement of the uterus (rather than tilt - better chest compressions if patient is kept supine)
- Place hands higher on sternum for compressions (uterus impedes movement)
- Greater emphasis on intubation
- Reversible causes – consider the following:

Toxins.

Pre-eclampsia – give magnesium (as outlined above).
Magnesium toxicity (when transferring pre-eclamptic patient) - give 10ml 10% Calcium Chloride.

Thromboembolic

Higher risk of VTE.
Amniotic fluid embolus possibility – little change in management.

Perimortem caesarean section as indicated - see CSOP 050.

Disposition of patient

The majority of patients should be managed in the nearest consultant lead obstetric units with critical care facilities. Contact should be made directly with the obstetric unit and patients transferred directly there rather than the ED.

North Wales

- Ysbyty Gwynedd, Bangor
- Ysbyty Glan Clwyd, Rhyl
- Ysbyty Maelor, Wrexham

Mid Wales (Powys)

- Princess Royal Hospital, Telford
- Hereford County Hospital

South Wales

- Glangwili, Carmarthen
- Singleton, Swansea
- Princess of Wales Bridgend
- Prince Charles Hospital Merthyr Tydfil
- Royal Gwent, Newport
- UHW Cardiff
- Neville Hall Hospital, Abergavenny *(Obstetric unit under review – service may move to Royal Gwent)*

Where significant neonatal complications are likely a unit with co-located NICU should be chosen. Ideally discuss with CHANTS on call (see CSOP 047a Neonatal Emergencies)

If major obstetric haemorrhage a unit with on site interventional radiology and vascular surgeon is ideal, but this should not lead to significant delay in transfer:

- UHW Cardiff (preferred as primary landing site)
- Bridgend
- Newport

Currently North Wales does not have 24 hour IR. Vascular services are shared on-call. If indicated and time allows check which hospital is “on” for vascular.

Summary

EMRTS will provide resuscitation and critical care support to isolated MLUs and complicated home deliveries only where initial measures instigated by midwifes/Emergency Services paramedics have been unsuccessful or it is clear from the outset that the patient requires urgent transfer to a consultant led unit.

No patients who are like to deliver within 1.5 hours of the anticipated arrival time at hospital should be transported by air.

References and Further Reading

1. Morris S, Stacey M. ABC of Resuscitation. Resuscitation in Pregnancy. *BMJ* 2003; 327: 1277-1279.
2. Greaves I, Porter K. Emergency Obstetrics and Gynaecology. In: Greaves & Porter. Oxford Handbook of Pre-Hospital Care Oxford: Oxford University Press 1997.
3. Tsuei BJ. Assessment of the pregnant trauma patient. *Injury* 2006; 37: 367-373.
4. Buckingham K, Fawdry A, Fothergill D. Management of vaginal bleeding presenting to the accident and emergency department. *Journal of Accident and Emergency Medicine* 1999; 16; 130-135.
5. Schmid BC, Rezniczek GA, Rolf N, Maul H. Postpartum hemorrhage: use of hemostatic combat gauze. *American Journal of Obstetrics & Gynaecology* 2012; e12-e13.
6. NICE 2010. Hypertension in pregnancy. The management of hypertensive disorders during pregnancy. NICE clinical guideline 107.
7. Engels PT, Caddy SC, Jiwa G, Matheson D. Cardiac arrest and perimortem caesarean delivery: case report and discussion. *Canadian Journal of Emergency Medicine* 2011; 13(6): 399-403.
8. Vanden Hoek TL, Morrison LJ, Shuster M *et al*. Part 12: cardiac arrest in special situations: 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation* 2010; 122: S829-861.
9. Whitten M. Postmortem and perimortem caesarean section: what are the indications? *Journal of the Royal Society of Medicine* 2000; 93: 6-9.
10. Brun PM, Chenaitia H, Dejesus I, Bessereau J, Bonello L, Pierre B. Ultrasound to perimortem caesarean delivery in prehospital settings. *Injury* 2013; 44: 151-152.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Maternal Cardiac Arrest and peri-mortem Caesarian Section

Reference Number	CSOP 050
Application	EMRTS Doctors & CCP's
Related SOPS	CSOP 051, CSOP 47a, CSOP 048, CSOP 047b

Author(s)	Jon Birks (ABM ULHB - Emrts Cymru)
Internal reviewer(s)	Tim Manfield
External reviewer(s)	
Sign off	COB

Introduction & Objectives

1. Highlight some background information relating to cardiac arrest in pregnancy and relevant physiological changes that occur during pregnancy.
2. Introduce algorithms for the management of both medical and traumatic maternal cardiac arrest
3. Method of procedure.

Background

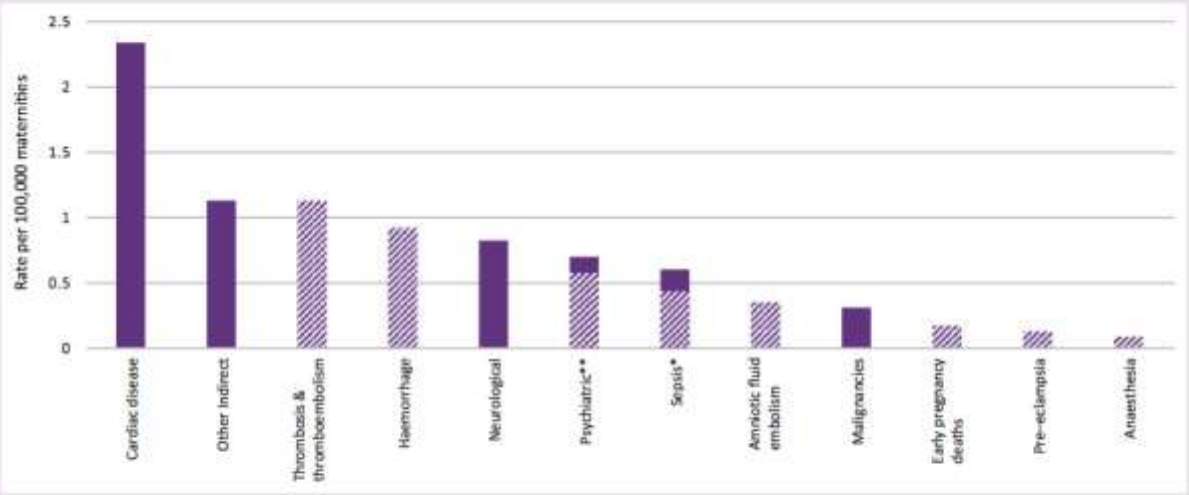
Cardiac arrest during pregnancy is rare; occurring in approximately 1:30,000 pregnancies The MBRRACE-UK report found In 2013-15 8.8 women per 100,000 died during pregnancy or up to six weeks after giving birth or the end of pregnancy. Two thirds of women who died had pre-existing physical or mental health problems.

Only 1% of females of childbearing age included in the UK trauma registries are pregnant at the time of their injuries, however they do have a higher mortality rate.

Causes of maternal death are different to those in the non-pregnant population, and include (in decreasing order of frequency):

Pregnancy related causes (direct)	Non-pregnancy related causes (indirect)
Sepsis	Cardiac disease
Pre-eclampsia/eclampsia	Neurological conditions
Thrombotic	Psychiatric
Amniotic fluid embolism	Malignancy
Haemorrhage	

Figure 2.3: Maternal mortality by cause 2013–15



Hatched bars show direct causes of death, solid bars indicate indirect causes of death;
*Rate for direct sepsis (genital tract sepsis and other pregnancy related infections) is shown in hatched and rate for indirect sepsis (influenza, pneumonia, others) in solid bar
**Rate for suicides (direct) is shown in hatched and rate for indirect psychiatric causes (drugs/alcohol) in solid bar
Source: MBRRACE-UK

Maternal physiology

Management of an arrested pregnant patient may be more challenging due to a number of physiological changes which occur during pregnancy.

Airway

Laryngoscopy can be impaired by the enlarged breast tissue and oedema of the laryngeal structures.

The gravid uterus compresses the diaphragm reducing functional residual capacity and oxygen consumption is higher causing rapid desaturation.

Reflux and delayed gastric emptying are common and therefore increase risk of aspiration.

Circulation

By term, there is a 30% increase in circulating blood volume, with a relative (dilutional) anaemia and a 40% increase in cardiac output.

In the supine position, the uterus compresses the IVC, impairing venous return to the heart by up to 30%.

Initial management of arrest

Full ALS algorithms should be implemented as for any patient.

Key additions in the pregnant patient:

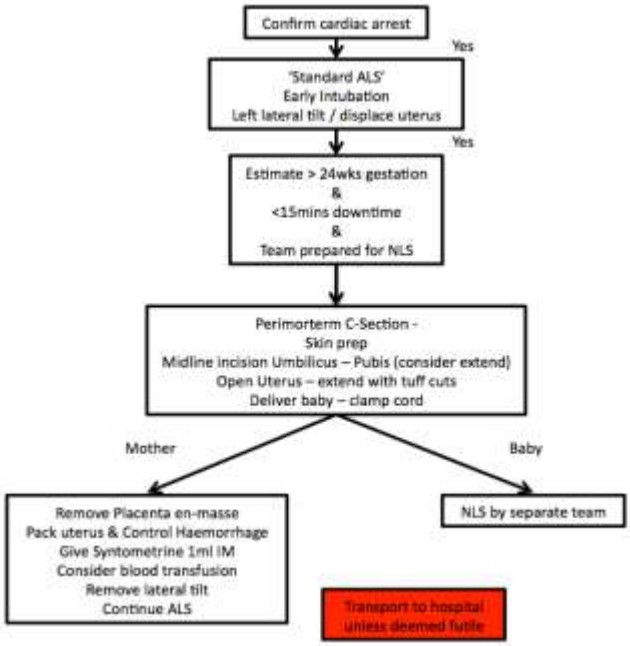
Early intubation/airway protection.

Lateral displacement of uterus to improve venous return (either by tilting the patient or by manually displacing the uterus to the left).

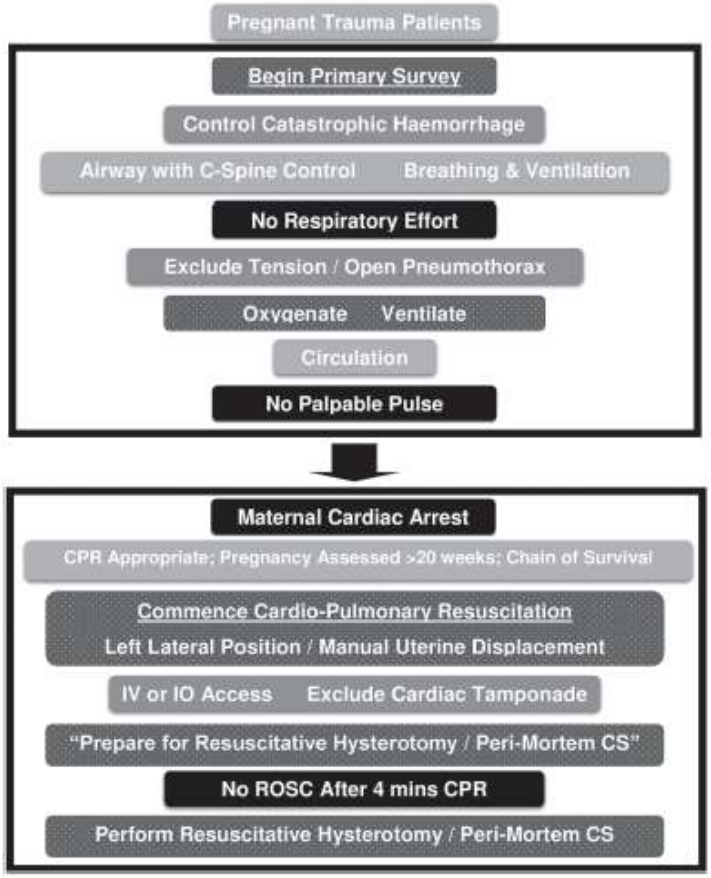
Consideration of peri-mortem caesarean delivery of fetus.

Please refer to the algorithms below for 'medical' and 'traumatic' cardiac arrest in pregnancy.

Algorithm – Medical



Algorithm - Trauma



Peri-mortem caesarean delivery

Delivering the fetus and placenta during maternal resuscitation can improve venous return to the maternal circulation. Evidence from case reports indicates improved maternal condition and increased

rate of ROSC in mothers whom have undergone peri-mortem caesarean section. Between 2000-2007, 52 peri-mortem Caesarian Sections were reported.

There is also evidence for neonatal survival following peri-mortem caesarean delivery – this is particularly true if the procedure is carried out within 15 minutes of arrest (neonatal outcomes improved by advancing gestational age and shorter time between collapse and delivery).

Guidance suggests that peri-mortem caesarean delivery should be initiated within 4 minutes of arrest, although there are case reports with good outcomes up to 15 minutes post arrest.

Indication for peri-mortem caesarean delivery

1. The primary indication for peri-mortem caesarean delivery is maternal resuscitation. Until point of delivery, the fetus has no legal standing. Duty of care is to the mother.
2. Gestation known or estimated to be over 24 weeks (uterus at or above umbilicus).
3. A suitable team is present to perform peri-mortem caesarean delivery, and continue both maternal and neonatal resuscitation.

Preparation

Brief all team members on the plan - this will be the first time they have seen this, it will be distressing for all concerned. If possible delegate a team member to support any other family present.

Ensure full ALS is ongoing including intubation.

Equipment required:

Maternity pack (for cord clamp, gauze packs etc).

Skin decontamination (Chlorprep).

Large scalpel (22 blade).

Scissors/Tuff cuts.

Gauze packs.

Syntometrine 1ml.

Procedure

Rapidly prep skin and cut a long vertical skin incision from umbilicus to pubis, extending to epigastrium if necessary. Where possible avoid injury to bladder and bowel, which will be in close proximity.

Make a cautious vertical incision into the uterus, taking care not to injure the fetus. Extend this incision using scissors/tuff-cuts so as to avoid blade injury to fetus.

Deliver the fetus (made easier by the identification of head/bottom/legs to pull. Clamp and cut the cord. Deliver infant to provider capable of NLS (possibly CCP) which should be commenced immediately.

Remove the placenta en-masse and pack uterine cavity with gauze packs. Control any major bleeding where possible with pressure/large sutures.

Administer Syntometrine IM 1 ml.

ALS should continue and the lateral tilt can be removed to facilitate effective chest compressions.

Post delivery care

In most cases, both mother and infant should be transported to hospital with resuscitation ongoing unless confident that there is no chance of survival.

Summary

1. Peri-mortem caesarean delivery is part of maternal resuscitation.
2. Ensure effective and ongoing ALS at all times.
3. Decision to deliver should be made within 4 minutes of arrest.
4. Continue both neonatal and maternal resuscitation post delivery.

References and Further Reading

Truhlář A, Deakin CD, Soar J, Khalifa GE, Alfonzo A, Bierens JJ, Brattebø G, Brugger H, Dunning J, Hunyadi-Antičević S, Koster RW, Lockey DJ, Lott C, Paal P, Perkins GD, Sandroni C, Thies KC, Zideman DA, Nolan JP; Cardiac arrest in specialcircumstances section Collaborators. European Resuscitation Council Guidelines for Resuscitation 2015: Section 4. Cardiac arrest in special circumstances. Resuscitation. 2015 Oct;95:148-201

Katz VL, Dotters DJ, Droegemueller W. Perimortem cesarean delivery. *Obstetrics & Gynecology* 1986; 68(4): 571-576.

Katz V, Balderston K, DeFreest M. Perimortem cesarean delivery: were our assumptions correct? *Am J Obstet Gynecol* 2005; 192(6): 1916-1920.

Morris S, Stacey M. Resuscitation in pregnancy. *BMJ* 2003; 327: 1277-9.

Managing Obstetric Emergencies and Trauma - The MOET Course Manual (2nd Ed) Charles Cox, Kate Grady and Charlotte Howell.

Kaye, R. *et al.* (no date) 'The obstetric caseload of a physician-based helicopter emergency medical service: case review and recommendations for retrieval physician training'.

Battaloglu, E. and Porter, K. (2017) 'Management of pregnancy and obstetric complications in prehospital trauma care: prehospital resuscitative hysterotomy/perimortem caesarean section', *Emerg Med J*, 0(10), pp. 1–5.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Mental Capacity and Deprivation of Liberty

Reference Number	CSOP 051a
Application	EMRTS Doctors and CCP's
Related SOPS	Multiple

Author(s)	Tim Mansfield
Internal reviewer(s)	
External reviewer(s)	
Sign off	COB

Introduction & Objectives

Deprivation of Liberty describes the situation where physical, mechanical or pharmacological restraints are used in order to facilitate medical care. This forms part of the Mental Capacity Act (MCA). EMRTS staff have a formal duty of regard to the Act and the Code of Practice and will need to take active responsibility for equipping themselves to practice within the law. Staff should be able to explain how they have regard to the MCA and the Code of Practice when acting or making decisions on behalf of people who lack capacity to make decisions for themselves.

Mental Capacity Act

In every situation, staff must assume that a person can make their own decisions unless or until such time that it is proved that they are unable to do so. There will always be a presumption of capacity.

Staff must always act in the best interests of any person who lacks capacity and follow the relevant organisational policy or procedure.

The MCA has five key principles which emphasise the fundamental concepts and core values of the MCA. These must be considered and applied when you are working with, or providing care or treatment for people who lack capacity.

The five key principles are:

1. Every adult has the right to make decisions and must be assumed to have capacity to do so unless it is proved otherwise. This means that you cannot assume that someone cannot make a decision for themselves just because they have a particular medical condition or disability.
2. People must be supported as much as possible to make a decision before anyone concludes that they cannot make their own decision. This means that you should make every effort to encourage and support the person to make the decision for themselves. If a lack of capacity is established, it is still important that you involve the person as far as possible in making decisions.
3. People have the right to make what others might regard unwise or eccentric decisions. Everyone has their own core values, beliefs and preferences which may not be the same as those of other people. You cannot treat them as lacking capacity for that reason.
4. Anything done for or on behalf of a person who lacks mental capacity must be done in their best interests to protect them from harm.
5. Anything done for, or on behalf of, people without capacity should be the least restrictive of their basic rights and freedoms. This means that when you do anything to or for a person who lacks capacity you must choose the option that is in their best interests and you must consider whether you could do this in a way that interferes less with their rights and freedom of action.

The Act only applies to people over 16 years of age, who lack mental capacity or who are reasonably believed to lack mental capacity. It applies to public and private locations.

Assessing Capacity

You should always start from the assumption that the person has the capacity to make the decision in question. There are two questions to consider if you are assessing a persons capacity:

1. Is there an impairment of, or disturbance in, the functioning of the person's mind or brain?
2. Is the impairment or disturbance sufficient to cause the person to be unable to make that particular decision at the relevant time?

This two stage test must be used and you must be able to show it has been used. Remember that an unwise decision made by a person does not in itself indicate a lack of capacity. Most people will be able to make most decisions, even when they have a label or diagnosis that may seem to imply that they cannot. This is a general principle that cannot be over-emphasised.

When determining if there is an impairment of mind or brain, the consumption of alcohol is often a complicating factor as per CSOP 052.

Psychiatric Illness

Psychiatric illness may produce a situation where the patient retains capacity but makes irrational decisions due to the nature of the illness. These patients cannot be forced to undergo treatment under the Mental

Capacity Act. Instead they must be formally assessed by an appropriate mental health professional using the Mental Health Act. The police also have powers under the mental health act (see CSOP 051b)

Best Interests

If a person has been assessed as lacking capacity then any action taken, or any decision made for or on behalf of that person, must be made in their best interests. The person who has made the decision is known as the 'decision maker'. This may be a doctor, ambulance clinician, police officer, the carer responsible for the day to day care, or social worker. In emergencies where there is limited or no information available, it will often be in a patient's best interests for urgent treatment to be provided without responsive delay.

Use of Restraint by EMRTS

EMRTS staff are legally authorised and obliged under the MCA to act in the best interests of (and provide treatment for) patients who are lacking capacity, even where the patient refuses treatment or are abusive, threatening or violent.

The MCA supports the use of reasonable force to ensure that patients lacking capacity receive care that is in their best interests or are protected from further harm. Section 6 of the Act defines restraint as the use or threat of force where an incapacitated person resists, and any restriction of liberty or movement whether or not the person resists. Any actual or threatened force considered must be deemed a proportional response when compared to the potential harm faced by not acting. However, EMRTS staff are neither trained nor expected to restrain patients who are acting in a threatening or violent manner. Assistance must be sought from the Police.

EMRTS staff should complete a Dynamic Risk Assessment in all cases prior to the use of any form of minimal restrain, recording decisions and actions on the Patient Clinical Record.

EMRTS staff will be protected from liability when they use minimal restraint if they observe the following two conditions:

1. You must reasonably believe that restraint is necessary to prevent harm to the person who lacks capacity; and
2. The amount and type of restraint used and the amount of time it lasts must be a proportionate response to the likelihood and seriousness of harm to the patient.

Transfer and Continuing Care

The decision making with regards to transfer will depend on the clinical circumstances, the nature of the patient and the nature of the restraint used. If the police are involved in the restraint of the patient then they must accompany the patient on transfer. The patient should be transferred by road in an ambulance.

Sedation should only be used after a full risk assessment. If used it must be done with full monitoring.

A patient who is a clear risk should not be transferred by air unless intubated and ventilated. The situation may dictate intubation and ventilation for flight safety reasons in order to facilitate time critical

intervention at a unit that is distant. There must be clear benefit to transfer to the specified unit by air and a clear risk of going by road.

Deprivation of Liberty Safeguarding (DoLS)

Deprivation of Liberty Safeguarding is an administrative system that allows a care home or hospital to refer a case of suspected deprivation of liberty to a supervisory authority to carry out an independent assessment, which may lead to the granting of a DoLS authorisation.

The system is impractical to use in the pre-hospital environment due to the need for immediate intervention. However the principles of safeguarding are the same and each case should be reviewed by an independent body.

Deprivation of liberty can occur in order to initiate life sustaining treatment or to do a vital act. If deprivation of liberty is carried out teams must retrospectively fill out the DoLS form for review. This is vital in order to protect the medical staff legally as well as to ensure the appropriate safeguards are in place.

Summary

The law provides a checklist of key factors which you must consider when working out what is in the best interests of a patient who lacks capacity (The MCA Code of Practice). It is important not to make assumptions about someone's best interests merely on the basis of the patient's age or appearance, condition or any aspect of their behaviour.

Audit Criteria

The DoLS form must be retrospectively filled in and reviewed for all cases where deprivation of liberty has occurred. (100%)

References and Further Reading

Great Britain. Department for Constitutional Affairs. (2007). *Mental Capacity Act 2005: Code of Practice.* London: TSO.

Mental Capacity Act 2005: Deprivation of liberty safeguards – Code of Practice to supplement the main Mental Capacity Act 2005 Code of Practice.

Deprivation of liberty in Intensive Care. Journal of the Intensive Care Society. Volume 15 Number 4 October 2014.

NICE 2011. *http://www.nice.org.uk/guidance/cg123* (Accessed 10 November 2014).

Joint Royal Colleges Ambulance Liaison Committee, (JRCALC). (2013). *UK ambulance service clinical practice guidelines 2013.* Bridgewater: Class.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Care of Psychiatric Patient

Reference Number	CSOP 051b
Application	EMRTS Doctors and CCP's
Related SOPS	CSOP 052a

Author(s)	Graham Mayers
Internal reviewer(s)	David Lockey
External reviewer(s)	
Sign off	COB

Introduction & Objectives

The provision of care to those suffering from a mental health crisis is as important as the provision of care to those suffering a physical crisis. A multi disciplinary approach to the management of these patients is generally required.

This Guideline aims to provide EMRTS staff involved in the delivery of care to mental health patients with the necessary information to ensure that the care of patients subject to conveyance is delivered in line with current legislation. Mental disorder is defined for the purposes of the Mental Health Act 1983 (2007 amendment) as "any disorder or disability of the mind."

This CSOP is to support staff in understanding the application of the Mental Health Act and wherever possible ensure that the patient's rights to be treated according to the legislation are maintained. Patients who have a "mental disorder" can be admitted to hospital against their wishes provided the rules of the Act are followed.

Mental Capacity and Psychiatric Illness

A mental capacity assessment must be carried out on all patients. If the patient is deemed not to have capacity and treatment is thought to be in their best interests, they can be cared for under the mental capacity act (see CSOP 052a).

However it is important to understand that psychiatric patient undergoing an acute psychiatric illness episode may have full capacity. They often can retain information, use that information appropriately and refuse treatment. As such will pass a capacity assessment. These patients cannot have their liberties deprived under the Mental Capacity Act in order to initiate treatment.

Refusal of treatment is often a product of the acute psychiatric event and may require urgent or immediate expert care. In these situations a patient may have liberties deprived, be transferred to an appropriate site and treatment initiated for their psychiatric illness under the Mental Health Act 2007.

EMRTS teams are not trained in the diagnosis of psychiatric illness. As such early involvement of an approved mental health professional (AMHP) is vital. However teams must act if the safety of the patient or the general public is immediately threatened. Early police involvement may be required.

Mental Health Act

The Mental Health Act gives an AMHP the power to make an application to admit patients to hospital under a section of the Act if they consider it necessary and the best way of ensuring the patient receives the right care and treatment.

Before doing this, the AMHP must interview the patient and be satisfied that detention in hospital is, given all the circumstances, the most appropriate way of providing the care that is required. The patients nearest relative, also has the right to apply for the patient to be detained under the Act. However, for practical reasons the AMHP usually makes the application, which is advised by the Mental Health Act Code of Practice.

A Police Officer may use powers of entry under section 135(1) of the Act when it is necessary to gain access to premises and remove a person to a place of safety who is believed to have a mental disorder and is not receiving appropriate care. This requires a magistrate's warrant. A magistrate may issue a warrant under section 135(1) in response to an application from an AMHP. A Police Officer may also use powers of entry under section 135(2) of the Act when it is necessary to gain access to premises to retake a person into custody who is already liable to detention or recall under the Act.

A Police Officer or anyone authorised under the Mental Health Act may apply for the warrant if evidence exists to show that access to the premises has already been attempted and denied or if it is apprehended that access would be denied. Whilst it is recommended good practice for the Police Officer to be accompanied by a mental health practitioner it is not always required.

There are occasions when the Police may act if they believe that someone is suffering from a mental illness and is in need of immediate treatment or care. Section 136 of the Mental Health Act provides Police Officers with the authority to take a person from a public place to a 'Place of Safety', either for their own protection or for the protection of others, so that their immediate needs can be properly assessed.

The Police and Criminal Evidence Act 1984, Section 17 allows a police officer to enter and search any premises for the purpose of saving life or limb or preventing serious damage to property.

A Place of Safety could be a hospital, police station or some other designated place. For EMRTS patients a hospital must be the chosen place of safety unless another site is designated by the AMHP.

In order to support decision making in relating to the conveyance of patients with Mental Health concerns, the following questions should be considered before conveying a patient:

1. Is the patient to be transferred an informal patient or are they detained under the Act?
2. What transportation method is appropriate?
3. What are the wishes and views of the patient, including those made in any advance statement or Advance Decision made by the patient?
4. What is the patient's age?
5. Does the patient have any physical disability?
6. Is there a need for clinical care?
7. Will the patient be sedated for the journey?
8. What is the nature of their mental disorder?
9. What is there current state of mind?
10. What is the likelihood of the patient behaving in a violent or aggressive manner?
11. Is there a risk to the individuals involved in conveying the patient?
12. Is the patient likely to abscond?
13. Is the AMHP making the decision to detain, accompanying the patient and have they confirmed they have made sufficient plans for how they are going to return to their required destination?

A person being conveyed to any place authorised by the Mental Health Act is deemed to be in legal custody (Section 137(1)). An application for admission provides the applicant (AMHP or nearest relative) or any person authorised by the AMHP or nearest relative to take the patient and convey to hospital within specific time limits (14 days or 24 hours in the case of an emergency).

Any person authorised to detain or convey a patient under the Mental Health Act has the powers of a Police officer taking someone into custody, whilst detaining or conveying that person (Section 137(2)).

In accordance with the Mental Health Act Codes of Practice, a patient should normally not be conveyed by car. In the exceptional circumstance where an ambulance is not used, the reasons should be clearly recorded along with details of an appropriate risk assessment.

It will generally be thought undesirable and unnecessary to have a person sedated prior to conveyance to hospital, although there may be occasions where this is deemed necessary.

Suicide and Self Harm

Self-harm is defined as an act with a non-fatal outcome in which an individual intentionally carried out one or more of the following:

1. A behaviour (e.g. self cutting) intended to cause self-harm.
2. Ingesting a substance in excess of the prescribed or generally recognised therapeutic dose.
3. Ingesting a recreational or illicit drug that was an act that the person regarded as self-harm.
4. Ingesting a non-ingestible substance or object.

Self-harm is not an attempt at suicide in the vast majority of cases. It is usually an attempt to maintain control in very stressful situations or emotional pressures (e.g. bullying, abuse, academic or work pressure). Self- harm is usually done in private and hidden from anyone else. In order to support clinicians in determining the risk of suicide or self harm the JRCALC risk assessment tool can be used.

Transfer and Continuing Care

It is always preferable to transport the patient by ambulance. However, when there are identified risks, then measures may need to be taken to ensure the safety of the patient, staff and police officers.

The other options to be considered are:

1. Police officer to travel in the ambulance with patient and staff.
2. Police vehicle to follow the ambulance and in a position to assist if necessary.
3. Patient to be transported in a police vehicle only in exceptional circumstances with staff observing in a safe position within the police vehicle or an ambulance travelling behind the police vehicle and in a position to assist if necessary.

After full risk assessment and physician involvement consider sedation of the patient with a benzodiazepine. Full sedation care including monitoring must be initiated. The patient cannot be handed onto a standard land crew if sedated.

Time Critical Illness and Flight Safety

Occasionally psychiatric illness and time critical injury or illness occur concurrently prompting immediate transfer to hospital in order to save life. This is common in patients who have attempted suicide. An un-intubated patient cannot be transferred by air due to the risks to themselves and the aircraft. Patients can be intubated purely for flight safety if there is clear benefit to transfer by air and a significant risk to transfer by road (e.g. large transfer distance to an MTC for time critical interventions).

Documentation and Clinical Support

EMRTS staff must complete documentation with the normal clinical information including, full details of the psychiatric assessment, risk factors, actions agreed with police, police collar details, transport method and a description of any restraint applied by either staff or police officers.

EMRTS staff should seek advice from the on call psychiatric services at the destination hospital (unless already involved). Advice and discussion with the EMRTS top cover consultant should also be undertaken.

References and Further Reading

Department of Health (2008). Mental Health Act 2007. London. The Mental Health Act

Welsh Assembly Government. (2008). Mental Health Act 1983: Code of practice for Wales. Cardiff: Welsh Assembly Government.

Police and Criminal Evidence Act 1984 Section 17(1).
http://www.legislation.gov.uk/ukpga/1984/60/section/17 (Accessed 12 November 2014).

Police and Criminal Evidence Act 1984 Section 135 (1)/(2).
http://www.legislation.gov.uk/ukpga/1983/20/section/135 (Accessed 12 November 2014).

NICE 2011. http://www.nice.org.uk/guidance/cg123 (Accessed 10 November 2014).

Joint Royal Colleges Ambulance Liaison Committee, (JRCALC). (2013). UK ambulance service clinical practice guidelines 2013. Bridgewater: Class.

British Medical Association (2009) Healthcare of Detainees in Police Stations. Third Edition. London: BMA.

Doy R, Burroughs D, Scott J. The ABC of community emergency care: Mental health – Consent, the law and depression - management in community emergency settings. EMJ 2005; 22: 279–285.

Shaban R. Mental health and mental illness in paramedic practice: A warrant for research and inquiry into accounts of paramedic clinical judgment and decision-making. *Journal of Emergency Primary Health Care,* 2004.

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

Alleged sexual assault, domestic violence and vulnerable adults

Reference Number	CSOP 054
Application	EMRTS doctors and CCP's
Related SOPS	NA

Author(s)	Scott Farmery
Internal reviewer(s)	Dindi Gill
External reviewer(s)	Phillip Cowburn
Sign off	COB

Introduction & Objectives

To highlight the practical, forensic and procedural aspects of dealing with assaults in these key groups. There are the main considerations are; scene safety, forensic evidence and patient disposition.

Scene safety

1. The assailant(s) may still be in the vicinity. For serious assaults, especially those involving weapons, arranging a RVP with a Tactical Firearms Unit is essential. In other cases ensure that Police are on-scene and the assailant has left or ideally is in suitable restraint. Additional PPE will not be required by the EMRTS as the team will not proceed without prior indication that the area has been declared safe. Where the patient has been accessed with the assailant still at large the casualty should be moved as soon as practically possible to a place of safety and non-essential examination deferred until this has been achieved.

2. The victim may request or be offered the presence of a personal companion. This should be accommodated where possible.

3. The victim may be intoxicated, agitated or confused and also pose a risk to health. In sexual assault, occasional cases of spurious claims arise or routine medical activity (e.g. removal of clothing) could be mis-construed as inappropriate. To prevent claims of inappropriate behaviour by EMRTS the

presence of at least one other allied professional should be ensured and documentation should be comprehensive in all cases.

4. Note it is rare for individuals to be concerned about the specific gender of medical staff looking after them. Exceptions can occur in cases of chronic abuse by a single gender in vulnerable adults due to the limited exposure they have to people other than their carers. In these cases, one particular gender can become associated with assaults. Where feasible utilise the appropriate gender of hands-on EMRTS staff in these circumstances.

5. Stab victims are not necessarily aware of all wounds. A quick survey to assess all areas of torso and proximal limbs is essential including easily missed areas - perineum, natal cleft and axillae.

Forensic Factors:

1. The medical care of the patient is always the primary concern and police enthusiasm for gathering or preservation of evidence should not compromise good patient care. However good evidence will potentially allow clearer understanding of the nature and extent of the alleged assault while loss of key evidence may result in failure to identify/convict an assailant and expose the victim to further assaults in future. Where possible, EMRTS should permit or assist with evidence gathering and preservation.

2. Police Involvement - in cases of assault serious enough to warrant EMRTS activation it is likely that the police will already be involved. Serious assaults should generate a senior presence, which will be able to guide medics and junior police officers as to best practice. If no senior officer is involved the on-scene police should be advised that wounds are "life-altering" of "life-threatening" if appropriate as these are recognised terms that will generate a high level response.

3. Forensic evidence - in essence, where there is a contact, there is a trace. Clothing worn during or after the assault should be preserved for analysis. If the patient is cleaned with wipes or any other material (including internal swabs etc) these should also be preserved separately rather than disposed. Victims should be advised not to wash, eat, gargle or change clothing as this may remove key evidence. Where feasible a change of clothing should be brought with the patient as their current clothing is highly likely to be retained by police.

4. Typical investigative samples include blood, skin, mouth and vaginal/cervical/anal swabs but these can be done later and need to be taken by an appropriately trained individual. This is not the responsibility of the EMRTS. In the case of sexual assault there are SARC (Sexual Assault and Rape Centre) facilities in all regions. In suitably well and mobile victims the examination and samples will be

taken here but if the victim remains as an in-patient then a police surgeon is likely to be mobilised to the hospital.

5. It is not the EMRTS' role to take a history of the assault however if information is volunteered it should be documented in the patient's own words as far as possible. Any alleged history should be flagged up to the treating ED.

Disposition of patient

Most patients can be managed at their local acute hospital with an ED. However some patients will need to be managed in specialist centres (e.g. a trauma centre) depending upon their injuries.

SARC UNITS - the police will arrange transfer to a SARC unit if the patient can safely discharged.

References and Further Reading

www.dashriskchecklist.co.uk

The Domestic Assault, Stalking and Honour-Based Violence (DASH) Questionnaire.

The DASH Questionnaire is an evidence-based series of questions used to identify individuals at increased risk of further assault or even murder. The formal document requires 27 questions to be answered with 14 or more positive responses indicating increased risk. Samples of the questions are copied below.

Has your partner tried to keep you from seeing your friends or family?

Has your partner ever struck you with an object (e.g. belt/stick) or threatened you with a weapon?

Does your partner constantly belittle or humiliate you, or regularly criticise or insult you in front of other people?

Are you ever scared of your partner?

Have you ever changed your behaviour because you're afraid of what your partner might do or say to you?

Has your partner ever deliberately destroyed any of your possessions?

Has your partner ever hurt or threatened you or your children?

Has your partner ever kept you short of money so you're unable to buy food and other necessary items for yourself and your children?

Emergency Medical Retrieval and Transfer Service (EMRTS) Cymru

CLINICAL STANDARD OPERATING PROCEDURE (CSOP)

CSOP 055 - Regional Anaesthesia

Reference Number	CSOP 055
Author(s)	Stephan Clements, Kate Owen
Version	3.0
Review Due	24/12/2023

Introduction and Scope of Practice

Regional anaesthesia techniques are common practice in hospital and can be used in the pre-hospital environment (Owen, 2017). EMRTS consultants have varying experience in regional anaesthetic techniques, and with this in mind there is scope for both EMRTS consultants and CCPs to develop a skill set to provide regional anaesthesia to certain patient groups.

Regional anaesthesia has the advantage of providing analgesia without the physiological and psychological side effects of delivering systemic analgesic or hypnotic agents.

The EMRTS Cymru carry the Sonosite iViz ultrasound device, which has a linear high-frequency probe, commonly used for vascular sonography. This device also has the 'Nerve' preset settings installed. This device is suitable for regional anaesthesia, and its image capture will provide robust governance post-procedure.

EMRTS consultants should be proficient and well-practiced at their chosen technique of regional anaesthetic. They must regularly perform these procedures within their own working environment. The type of nerve or plexus block and its technique will remain the choice of individual consultants.

At this time, CCPs will not be providing regional anaesthesia.

Indications

- Multimodal analgesia, reducing unwanted effects of systemic analgesia or hypnotic agents
- To facilitate extrication
- To facilitate packaging for transfer

Contra-indications to regional anaesthesia

Absolute:

- Patient refusal

- Infection at the site of injection
- Prosthetic material (e.g. previous femoral bypass surgery) at the site of injection
- Allergy to local anaesthetics

Relative:

- Coagulopathy (anticoagulants, genetic i.e. haemophilia, acquired i.e. hepatic failure). An individualised risk-benefit assessment should be performed. For blocks such as Fascia Iliaca, Serratus Anterior & Erector Spinae Plane, the risk of clinically significant haemorrhage or haematoma is very low. For patients on Warfarin, obtain an INR. (An INR of less <1.5 can be considered normal risk, A higher INR does not necessarily preclude RA, if there is a clear benefit.)
- Pre-existing neurological deficit in the affected limb (must be fully assessed and documented before proceeding with RA)

Patient preparation

- The neurovascular status of the limb should be accurately assessed & documented, unless the limb is trapped. Full assessment may not be possible until analgesia is commenced.
- Early short-acing opioid analgesia must be considered whilst the limb is prepared for regional anaesthesia.
- Capacity and consent to regional anaesthesia must be assessed *(see CSOP 051a)* and this must be documented on the Patient Care Record (PCR).
- The patient must have full monitoring instituted including ECG, NIBP, SpO_2 and HR as a minimum.
- IV/IO access must be gained prior to the procedure.
- The skin should be cleaned with Chloraprep solution and allowed to dry fully.

Equipment preparation

- Prepare the local anaesthetic solution. Considerations:
    - The EMRTS Cymru carry levobupivacaine 0.5% (maximum dose 2mg/kg) and lidocaine 1% (maximum dose 3mg/kg)
    - Consideration should be made to the duration of action, and the need for repeated neurological assessment in hospital vs the duration of analgesia
    - If larger volumes are required (e.g. FICB is a 'volume' block, ideally requiring up to 40ml), then dilute with 0.9% sodium chloride
- Ensure intra-lipid solution is available should toxicity occur (see below).
- Turn on the ultrasound device and ensure the linear probe is attached. Ensure the device is in the correct mode 'Nerve'.
- Sterile ultrasound gel sachet should be used with the sterile ultrasound probe cover.

Procedure

The choice of block (location, approach, technique) is at the discretion of the Consultant and is determined by their competency, the patient's anatomy and location of injury.

It should be performed using Aseptic Non-Touch Technique (ANTT) with sterile gloves.

Prior to performing the block, the Regional Anaesthesia checklist should be used.

Post-Block Care

Monitor for signs of local anaesthetic (LA) toxicity asking the patient to disclose if they experience any perioral tingling, auditory/visual disturbance or dizziness (Refer to AAGBI guidelines below). EMRTS clinicians must remain with the patient for a minimum of 20 minutes. Vital signs should be monitored for 45 minutes post procedure.

Package the limb appropriately. This may include using a Kendrick Traction Device (KTD) or similar splinting.

Local Anaesthetic toxicity

LA toxicity may manifest in different ways and can be difficult to recognise. It generally presents as neurological symptoms and then cardiovascular symptoms both worsening as serum concentrations of LA rise.

Neurological symptoms: initially altered taste, tingling and/or paraesthesia in the non-blocked limbs and auditory/visual disturbance. This then leads to alteration in mental status, severe agitation or loss of consciousness with or without seizures.

Cardiovascular symptoms: initially chest pain and palpitations followed by sinus bradycardia, conduction blocks, asystole and/or VT.

These symptoms are progressive so early recognition is essential to prevent further collapse. The AAGBI safety guideline (Appendix 1) shows recognition, immediate management, treatment and follow-up.

Documentation

The following should be documented on the PCR:

- Consent obtained
- Neurovascular assessment of affected limb
- Pre and post procedure pain scores
- ANTT
- Ultrasound guided or Landmark technique
- Block needle used
- Regular aspiration during injection
- Drug concentration and volume.
- Any immediate complications including ‘nil’

When using ultrasonography for regional anaesthesia, it is recommended that images are captured and uploaded to the database for clinical governance purposes.

References and Further Reading

- Owen, K. (2017). Regional Anaesthesia in the Pre-hospital Setting. Found in Education Section on SharePoint – EMRTS Cymru
- AABGI (2010) *Safety guideline: Management of severe local anaesthetic toxicity.* [online]. Available from: https://www.aagbi.org/sites/default/files/la_toxicity_2010_0.pdf [Accessed 4 September 2017].
- NYSORA: http://www.nysora.com
- Sites, B., Chan, V., Neal, J., Weller, R., Grau, T., Koscielniak-Nielsen, Z. & Ivani, G. (2010) The American Society of Regional Anesthesia and Pain Medicine and the European Society of Regional Anaesthesia and Pain Therapy Joint Committee Recommendations for Education and Training in Ultrasound-Guided Regional Anesthesia. *Regional Anesthesia and Pain Medicine*. 35 (Suppl 1), pp. S74-S80.

Appendix 1

AAGBI Safety Guideline

Management of Severe Local Anaesthetic Toxicity

1 Recognition

Signs of severe toxicity:

- Sudden alteration in mental status, severe agitation or loss of consciousness, with or without tonic-clonic convulsions
- Cardiovascular collapse: sinus bradycardia, conduction blocks, asystole and ventricular tachyarrhythmias may all occur
- Local anaesthetic (LA) toxicity may occur some time after an initial injection

2 Immediate management

- Stop injecting the LA
- Call for help
- Maintain the airway and, if necessary, secure it with a tracheal tube
- Give 100% oxygen and ensure adequate lung ventilation (hyperventilation may help by increasing plasma pH in the presence of metabolic acidosis)
- Confirm or establish intravenous access
- Control seizures: give a benzodiazepine, thiopental or propofol in small incremental doses
- Assess cardiovascular status throughout
- Consider drawing blood for analysis, but do not delay definitive treatment to do this

3 Treatment

IN CIRCULATORY ARREST

- Start cardiopulmonary resuscitation (CPR) using standard protocols
- Manage arrhythmias using the same protocols, recognising that arrhythmias may be very refractory to treatment
- Consider the use of cardiopulmonary bypass if available

GIVE INTRAVENOUS LIPID EMULSION
(following the regimen overleaf)

- Continue CPR throughout treatment with lipid emulsion
- Recovery from LA-induced cardiac arrest may take >1 h
- Propofol is not a suitable substitute for lipid emulsion
- Lidocaine should not be used as an anti-arrhythmic therapy

WITHOUT CIRCULATORY ARREST
Use conventional therapies to treat:

- hypotension,
- bradycardia,
- tachyarrhythmia

CONSIDER INTRAVENOUS LIPID EMULSION
(following the regimen overleaf)

- Propofol is not a suitable substitute for lipid emulsion
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4 Follow-up

- Arrange safe transfer to a clinical area with appropriate equipment and suitable staff until sustained recovery is achieved
- Exclude pancreatitis by regular clinical review, including daily amylase or lipase assays for two days
- Report cases as follows:
  in the United Kingdom to the National Patient Safety Agency (via **www.npsa.nhs.uk**)
  in the Republic of Ireland to the Irish Medicines Board (via **www.imb.ie**)

If Lipid has been given, please also report its use to the international registry at **www.lipidregistry.org**. Details may also be posted at **www.lipidrescue.org**

Your nearest bag of Lipid Emulsion is kept .....

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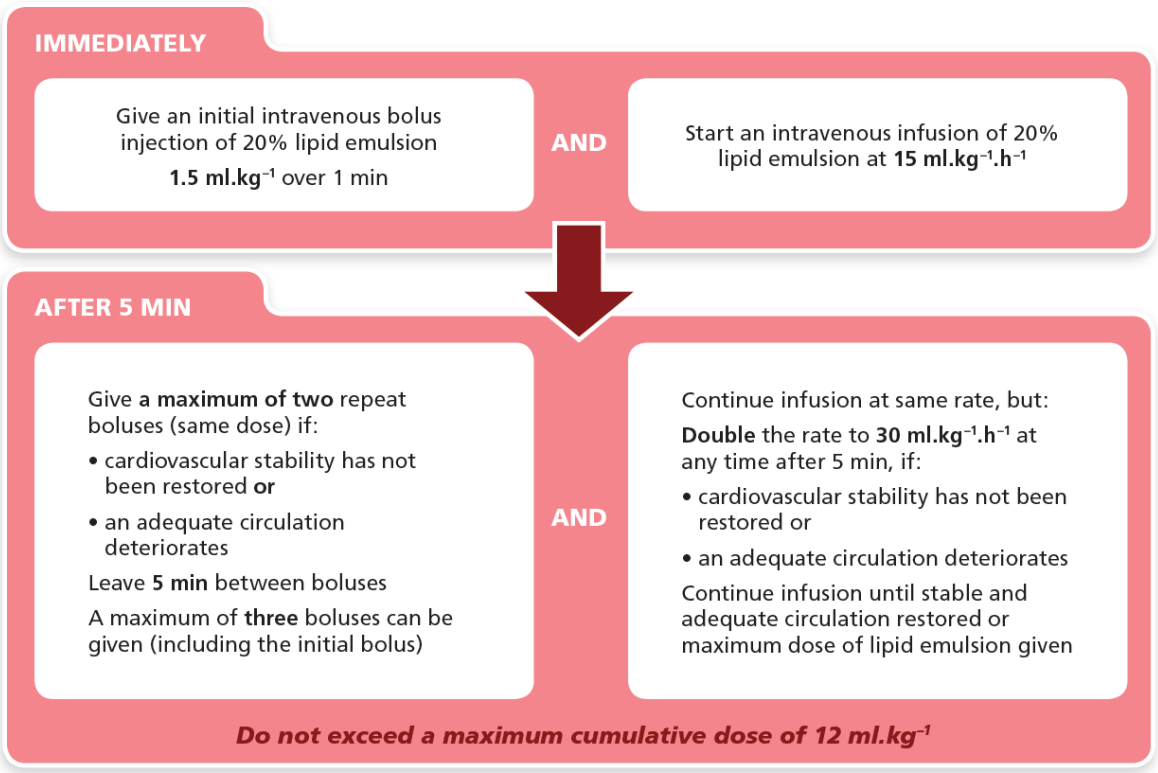
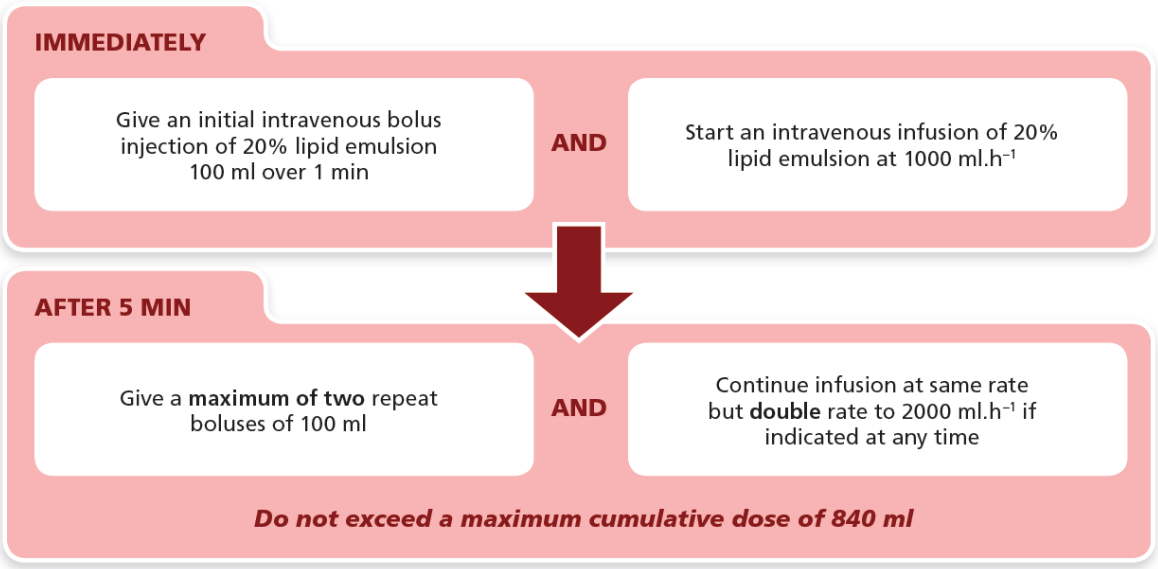


An approximate dose regimen for a 70-kg patient would be as follows:



This AAGBI Safety Guideline was produced by a Working Party that comprised:
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This Safety Guideline is endorsed by the Australian and New Zealand College of Anaesthetists (ANZCA).