Trauma management guidelines

Contents:

WMAS Clinical Guidelines

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	Specialist Paramedic - Urgent Care	**X**		

Introduction:

These guidelines aim to bring together a wide range of topics into a definitive document covering the management of the traumatically injured patient.

Intravenous access and fluids

1 Introduction

Venous access may be indicated for drug therapy or fluid resuscitation in the critically ill or injured patient.

Fluid resuscitation is not routine and should only follow specific indications.

2 Intravenous Access

A number of access routes are available; the one chosen will reflect both clinical need and the skills of the operator.

Venous or intra-osseous access should always be obtained in patients with an abnormal primary survey and/or GCS<15. Ideally this should be obtained before transportation, especially if going by air, but should not delay transfer to hospital for those deemed to be time critical.

Peripheral Venous Access.

Standard access for fluid resuscitation in adults is a 14G or 16G cannula in the forearm (or largest possible gauge for vein in child). The dorsum of the hand, antecubital fossa, and medial ankle (long saphenous) are good alternative sites.

Ideally two points of venous access in separate limbs should be obtained.

Where venous access is gained for IV drug therapy only (e.g. analgesia), a smaller gauge cannula may be considered.

Where possible:

- Choose an arm that is uninjured
- Choose an arm not associated with ipsilateral chest injuries
- Ensure a patent line above the diaphragm where pelvic or IVC disruption is suspected
- Think about accessibility during transport

Cannulae should be secured using the WMAS adhesive cannula dressing and labelled with the 'Ambulance' sticker contained in the dressing pack. Where this is not available cannulae should be securely taped in place.

Consider the use of a limb splint to minimise the risk of cannula dislodgment with movement (especially in children or agitated patients).

Multiple attempts at peripheral cannulation should be avoided and may prolong scene time. Following two failed attempts at venous access in the critically unwell patient an alternative means of gaining access (e.g. intraosseous) should be considered.

All trapped patients should have venous access prior to release.

Alternative Access Routes

Ext jugular (Doctors / Paramedics). The external jugular vein runs from the angle of the jaw to the midpoint of the clavicle. It can be a useful means of gaining venous access in medical patient in cardiac arrest. The application of cervical collar precludes its use.

Intraosseous access (Doctors / Paramedics). Is a useful route in children and can also be used in adults. It provides a rapid means of gaining circulatory access for the administration of resuscitation or anaesthetic drugs in an emergency. It is not the ideal method for rapid infusion of large volumes of fluid in adults.

Femoral Vein (Doctors). In extremis, a large-gauge cannula (e.g. 14G) may be inserted into the femoral vein. The femoral vein lies 1-2cm medial to the femoral artery (which in turn lies midway between the anterior superior iliac spine and the pubic symphysis). The presence of a femoral or pelvic fracture is not a contraindication to femoral venous access in an emergency. Note standard cannula length may be insufficient in bariatric patients.

3 Intravenous Fluids

The administration of intravenous fluids is not routine and should only follow specific indications (see below).

0.9% Saline is the intravenous fluid of choice for West Midlands Ambulance Service.

Where possible intravenous fluids should be administered warmed to body temperature. In the absence of a formal warming device, simple measures such as utilising body heat (bags held in inside jackets) to warm fluids may be used in cold conditions.

Specific caution should be employed when administering intravenous fluids to children and cardiac patients because of the risk of inadvertent fluid overload. Uncontrolled fluid administration may also be detrimental to the patient with suspected vascular injury or disease (e.g. Aortic Aneurysm).

In the multiply injured patient demonstrating shock, early control of external haemorrhage, splintage of long-bone and pelvic fractures, and the utilisation of minimal handling techniques during clothing removal and packaging must take priority. Every effort must be made to minimise blood loss, maximise clot formation and minimise clot disruption. A ventilatory cause for shock should be excluded early in all cases. Venous access is mandatory in this patient group and is likely to be technically easier the earlier it is performed. Fluid resuscitation however is not routine and should only follow specific indications.

Indications and end-points

Anaphylactic/Septic Shock

- Adult - Administer a 500-1000ml fluid bolus. Repeat if necessary
- Child - Administer a 20ml/kg fluid bolus. Repeat if necessary.

Cardiogenic Shock (e.g. right ventricular infarction)

- Adult - If indicated administer 250ml bolus cautiously.
- Child - If indicated administer 5ml/kg fluid bolus cautiously.

Head Injury

- Adult - Administer 250ml boluses to achieve a MAP > 80mmHg
- Child - Administer 5ml/kg boluses to achieve a MAP of:

Age	MAP (mmHg)
< 3months	40 – 60
3 months – 1 year	45 -75
1 – 5 years	50 - 90
6 – 11 years	60 - 90
12 – 14 years	65 - 95

Adult Blunt Trauma (without head injury)

- Administer 250ml fluid boluses to achieve either verbal contact or the presence of a radial pulse (SBP ~ 80-90mmHg)

Adult Penetrating Torso Trauma

- Administer 250ml fluid boluses to achieve either verbal contact or presence of a central pulse (SBP ~ 60-70mmHg).

Paediatric Trauma (Penetrating or Blunt)

- Child >1 yr - Administer 5ml/kg bolus to achieve either verbal contact or presence of a radial pulse
- Child <1 yr - Administer 5ml/kg bolus to presence of brachial pulse

Isolated Burns >25%TBSA

- Adults – Administer 1000ml fluid during transfer
- Child 5-11yrs – Administer 500ml fluid during transfer
- Child <5yrs – Administer 10ml/kg during transfer

Pregnant patients

- Hypotensive resuscitation should not be employed in pregnant women with trauma. Blood pressure should be normalised for age.

Prolonged Resuscitation

- All trauma patients should be resuscitated to a normal blood pressure after 60 minutes post-injury. Recent evidence suggests that continuing hypotensive resuscitation beyond the first hour post-injury worsens outcome.

4 Vasopressors (advanced paramedics, nurses and doctors only)

There may frequently be times at which the mean arterial blood pressure is less than is required for adequate end-organ perfusion. This may be in part due to hypovolaemia, but may also be caused as a result of loss of vascular tone or cardiac output secondary to pharmaceutical interventions (e.g. sedation, anaesthesia).

Vasopressors in common use act through vasoconstriction (alpha), positive inotropic action (beta) or a combined effect.

Adrenaline and ephedrine exert similar effects and provide a mixed alpha and beta effect on the heart and the peripheral vascular system. Metaraminol is considered more of a pure alpha agonist, causing vasoconstriction alone.

Usage:

Ephedrine (30mg/ml, 1ml vial):

Draw into 9 ml of sodium chloride 0.9% or water for injection to 10ml (3mg/ml)
Label with appropriate salmon label
Administer through patent intravenous / intraosseous line and flush
Administer in 1 or 2 ml increments and titrate to blood pressure required.
Side effects: May cause transient tachycardia.
Cautions: Uncontrolled ischaemic heart disease.

Metaraminol (10mg/ml, 1ml vial):

Draw into 19ml of sodium chloride to 20ml (0.5mg/ml)
Label with appropriate salmon label
Administer through patent intravenous / intraosseous line and flush
Administer in 0.5 to 1ml increments and titrate to blood pressure required
Side effects: may cause transient bradycardia which may be profound.
Cautions: Uncontrolled hypertension.

5 Major Haemorrhage Pack (MHP) pre-alert

The concept of haemostatic resuscitation promotes early use of blood products in patients with major traumatic bleeding. There is evidence that this improves outcome in this patient group.

Where trauma patients demonstrate signs of haemodynamic compromise (i.e. SBP<90 mmHg failing to respond to fluid boluses with suspected or confirmed haemorrhage) the receiving Emergency Department should be informed of this during the pre-alert phone call and where appropriate a request made for a 'Code Red MHP activation' (Blood / FFP) to be available on arrival.

With blood available early, the decision to transfuse or not can be made by the receiving trauma team on arrival of the patient and haemostatic resuscitation commenced immediately where appropriate.

All patients with major haemorrhage suspected, be it traumatic or non-traumatic in origin, should be taken to one of the region's Major Trauma Centres, which have easy access to all the facilities required to deal with these types of patient.

Management of external haemorrhage:

1. Statement

A vast majority of external haemorrhages can be controlled within the remit of standard JRCALC guidelines through compression, elevation and splintage techniques.

In a significant minority of patients alternative methods will need to be implemented in order to control significant haemorrhage:

- The use of tourniquets
- The use of compressive bandages
- Haemostatic agents
- Hypotensive resuscitation

2. Introduction and Scope

All patients with external bleeding should have it controlled at the earliest opportunity. In a vast majority of these patients this can be achieved with:

- Elevation of the affected limb
- The application of compression dressings
- Splintage of open limb fractures

These techniques are considered basic medical care and are outlined within publications including JRCALC guidelines. They are not therefore covered in detail within this policy.

Advanced techniques may include:

- The use of tourniquets
- Haemostatic agents
- Hypotensive resuscitation

This section outlines the policy guidance for the control of external haemorrhage using these advanced techniques.

All patients should always be assessed and managed to the level of the health care providers' scope of practice, following current JRCALC, National Institute for Health & Clinical Excellence (NICE), Clinical Knowledge Summaries and other guidelines relevant to the patients' condition.

3 Clinical Guidance

Control of External Haemorrhage: Introduction

All patients with external bleeding should have it halted at the earliest opportunity. In a vast majority of these patients this can be achieved with:

- Elevation of the affected limb
- The application of direct pressure/compression dressings
- Splintage of open limb fractures

Advanced techniques include:

- The use of tourniquets
- Haemostatic agents
- Hypotensive resuscitation

It is generally considered good, modern practice to use the cABC approach in assessing poly/major trauma patients. This means that catastrophic haemorrhage will be controlled prior to assessing the airway and breathing. For an advanced pre-hospital team, control of catastrophic external haemorrhage and management of airway and breathing can often take place simultaneously.

A stepwise approach should be taken when attempting to halt an external haemorrhage:

Assessment of bleed
↓
Application of direct pressure (with elevation if possible)
↓
Splinting of limbs (if appropriate)
↓
Use of compressive bandages (if appropriate)
↓
Use of haemostatic agents (if appropriate)
↓
Use of tourniquets (if appropriate)
↓
Allowance and maintenance of hypotensive resuscitation

All external bleeds should be assessed, addressed and regularly reviewed. Interventions performed on scene or in transfer may cause additional external bleeding (administering ketamine, delivering fluids, moving the patient) which should be quickly identified and addressed.

Advanced control of external haemorrhage should only be performed by those assessed as competent to perform the procedure by West Midlands Ambulance Service.

4 Compressive Bandages

Indications and use:

Bleeding that originates from small to medium sized blood vessels may not be readily controlled with simple padding and bandages. In addition, the site of the bleeding may make simple dressings difficult to apply effectively (e.g. axilla, scalp). In these cases, the use of a compressive bandage should be considered.

Contraindications

None.

Application

Place absorbent pad on wound (or over haemostatic agent if used) and wrap the elastic bandage around the body part.

Insert the elastic bandage into pressure bar. Tighten elastic bandage and pull back over bar, forcing it down into pad. This applies direct pressure onto the wound.

Wrap the elastic bandage round and over the bar ensuring that all parts of the absorbent pad are covered. Secure closure end into elastic bandage.

Observe for signs of ‘strike-through’ (bleeding penetrating bandage). If this occurs, consider moving to use of haemostatic agents plus a fresh compressive bandage.

5 Haemostatic Agents

A wide range of haemostatic agents are available on the market. All have in common the ability to promote clotting by either absorbing water and haemoconcentrating clotting factors, or by causing cross links between clotting factors. They act independently of any coagulopathy and anticoagulant drugs and are not temperature dependent.

Indications and Use

Haemostatic gauze may be used for uncontrolled haemorrhage where standard methods are deemed inadequate. It may also be used in addition to CAT and is particularly useful in junctional haemorrhages.

Contraindications

Haemostatic gauze must not be applied over the eyes.

Delivery

Unwrap the gauze carefully. Cut or tear an appropriate sized strip of gauze and pack tightly into the wound. Further strips may be overlaid if the initial strip is not large enough.

Once the wound is completely packed, cover the wound with a compressive bandage (see section 4 above). Pressure is essential to the function of haemostatic gauze (failures are usually due to lack of applied pressure) and so use of haemostatic gauze mandates a compressive bandage whenever possible.

Haemostatic gauze must not be wrapped around a wound in the manner of a standard dressing and it must not be left uncovered.

Monitor the wound; apply fresh dressings on top of compressive bandage if required but DO NOT undress wound to observe bleeding.

On arrival at hospital, make very clear that there is haemostatic control in place, and wounds should not be inspected until definitive surgical control is available.

6 Tourniquets

Indications and Use:

Tourniquets should be applied to damaged limbs when other methods of halting bleeding have failed.

Contraindications

None.

Application

Tourniquets should be positioned as distally as possible on the injured limb (at least 5cm above the injury itself). The tourniquet must be tightened sufficiently to act as an arterial tourniquet - if only a venous tourniquet is achieved this will increase bleeding. Once the tourniquet is applied tighten it until you achieve the desired effect and document the time of application. Regularly review the tourniquet to ensure it is still achieving the desired effect – if necessary the tourniquet can be tightened, but should never be loosened or released. The tourniquet should be reviewed: every time the patient is moved, when delivering IV fluids and when giving sympathomimetics (e.g. ketamine).

If catastrophic bleeding continues, place a second tourniquet above the first and tighten to stop the bleeding.

NB a well applied tourniquet will be painful for the conscious patient, deliver IV analgesia if required.

On hand over to hospital ensure hospital staff are aware of the presence of the tourniquet and its purpose, as well as the time of application.

7 Hypotensive resuscitation

Definition

Permissive hypotension is the situation in which mean arterial blood pressure is allowed to remain below normal levels with the aim of maintaining vital organ perfusion without exacerbating haemorrhage. It is applied to trauma victims following the “first clot, best clot” paradigm. By delivering resuscitation fluids, (e.g. 0.9% Saline) clotting factors are diluted, the patient is cooled (further inhibiting clotting) and blood pressure may be raised (potentially disrupting the first clot).

Any external haemorrhage should be treated by direct compression as described above. Hypotensive resuscitation should be reserved for non-compressible haemorrhage such as in the chest, abdomen and pelvis (after binder has been applied).

Current guidelines recommend resuscitating to the presence of a radial pulse i.e. delivering aliquots of resuscitation fluid in 250ml boluses until a radial pulse is felt. The presence of a radial pulse approximates to a systolic BP of 80/90mmHg.

In a patient with penetrating chest injury the target is 60mmHg or the presence of a central pulse.

NB the presence of a systolic BP greater than 90mmHg does not require further action

NB the initiation of hypotensive resuscitation should make the patient time critical. Definitive treatment can only take place in hospital and may involve surgery or intervention radiology. A trauma alert should be put into the receiving hospital and consideration for requesting activation of the major haemorrhage protocol.

Indications for use

Adults with blunt or penetrating trauma **without** closed head injury.

Contraindications

Hypotensive resuscitation should not be attempted in patients with closed head injury or in the paediatric age group.

Delivery

Fluid should not be administered to trauma victims before haemorrhage control if a radial pulse can be felt.

In patients with major trauma early IV access should be obtained and maintained. Providing no contraindications are present the patient should be given 250ml boluses of (warmed) 0.9% Saline to maintain a radial pulse.

In the case of penetrating chest trauma the patient should be given 250ml boluses of (warmed) 0.9% Saline to maintain a central pulse.

8 Tranexamic Acid

Introduction

Uncontrolled Haemorrhage is a major cause of mortality in up to 50% of trauma patients who reach hospital. It is also an important contributor to multi-organ failure with its associated morbidity.

Activation of the coagulation pathway occurs in response to trauma. This response assists in maintenance of the integrity of the circulatory system following vascular injury.

Major trauma associated with haemorrhage results in an extreme challenge to this response. Anti fibrinolysis is recognised to be a normal part of this response but under conditions of major haemorrhage may result in pathological hyperfibrinolysis with subsequent clot breakdown.

Anti-fibrinolytic agents such as Tranexamic Acid have been shown to significantly reduce mortality in major trauma. The benefit of which appears to be greatest when administered as soon as possible from the time of injury.

Administration

Indication

Treatment of trauma associated with actual or suspected haemorrhage

Inclusion Criteria

Any patient who fulfils any of the following:

a. Significant haemorrhage
b. Systolic blood pressure less than 90mmHg (or age appropriate hypotension following trauma)
c. Heart rate more than 110 beats per minute (or age appropriate tachycardia following trauma)

d. Considered to be at high risk e.g.
    - Multiple rib fractures, Penetrating wounds, More than one proximal long bone fracture, Amputation, Use of haemostatic dressing

Exclusion Criteria

a. Greater than 3 hours from the time of injury
b. Isolated Head Injury
c. Known hypersensitivity to Tranexamic Acid
d. Patient refusal

Preparation and administration

Drug name, form & strength:	Tranexamic Acid 500mg in 5ml Injection
Legal Category:	POM
Dose (single loading dose):	Adult = 1g (10ml)
	Child = 15mg/kg (to maximum 1g)

Adult:

- Draw two Tranexamic Acid vials of 500mg/5ml into a 10ml syringe
- Do not dilute
- Before administration confirm drug, dose and product expiry date
- Administer bolus intravenous injection in 1ml aliquots over 10 minutes
- Flush with 0.9% saline

Child:

- Calculate correct dose of Tranexamic Acid to be administered
- Draw correct dose from Tranexamic Acid vials of 500mg/5ml into a 10ml syringe
- Dilute with 0.9% saline to total of 10ml
- Before administration confirm drug, dose and product expiry date
- Administer bolus intravenous injection in 1ml aliquots over 10 minutes
- Flush with 0.9% saline

Cautions

Do not add to injection containing penicillins or blood transfusion

Rapid administration may cause hypotension

Intravenous administration only

Frequency

Single loading dose

Side Effects

Nausea, vomiting and diarrhoea

Hypotension associated with rapid injection

Dizziness, Convulsions

Hypersensitivity including anaphylaxis

Packaging and spinal care

1. Introduction

The safe transfer of a patient from one location to another depends upon appropriate packaging and handling. The definition of 'safe' does not simply mean movement without physical injury. It includes the avoidance of pain and distress, the minimising of spinal movement, the preservation of coagulation products and reduction in bleeding, and the maintenance of core temperature.

2. Equipment available

Packaging starts at first patient contact, and comprises planning, preparation, execution and assessment of patient movement.

Extrication boards (formerly known as spinal boards)

- Use of a spinal / long board is no longer recommended for patient transport, and should be used as an extrication device only.
- Once extrication has occurred and the patient is in a suitable location, the board should be replaced as outlined below.

Orthopaedic scoop stretcher

- These stretchers are the preferred method for moving patients on and off the ambulance trolley, especially where spinal injuries are suspected.
- The stretcher should be placed using the minimum amount of turning to limit spinal movements.
- Patients should be fully strapped on before moving.

Vacuum Mattress

- The full body vacuum mattress is an option for transporting patients if available.
- It has good spinal protection properties, good thermal properties and can contain bodily fluids which has infection prevention benefits.
- It is reliant upon a vacuum pump, an intact membrane and a functioning valve, all of which should be checked prior to use as they are prone to puncture.

Pelvic Splint

- Various pelvic splints are available and their individual use depends upon training and availability.
- Regardless of brand, the purpose is to apply circumferential pressure to the pelvic ring to reduce any possible or actual pelvic fractures which may result in substantial internal haemorrhage.
- The pelvic splint should be applied to ANY trauma patient with a mechanism of injury that might result in pelvis fracture. Further guidance to the management of pelvic injuries can be found below

Thermal wrapping

- Heat loss is a substantial component of pre-hospital morbidity with effects on oxygen requirement, cardiac arrhythmias, conscious levels and coagulation.
- It is unlikely that active patient warming will be available, effective or appropriate due to the significant power demands and equipment this requires. Instead avoidance of heat loss should be aggressively pursued.
- A simple thermo-reflective wrap device deployed early can be a highly effective solution. Three devices are available:
    - Simple Mediwrap – this has little insulating property but is fluid absorbent. Use should be for normothermic patients in temperate conditions to maintain protection from wind and rain, and to absorb body fluids where required.
    - Blizzard EMS – a small packed insulating wrap that should be used for relatively normothermic patients in cool conditions – it is best applied between the patient and the scoop, and then wrapped around the patient.
    - Blizzard Heat-wrap – a larger sleeping bag style wrap for use in hypothermic patients, in extreme cold, for long distance transfer and following anaesthesia where thermoregulation is lost.

3. Primary packaging

Primary contact

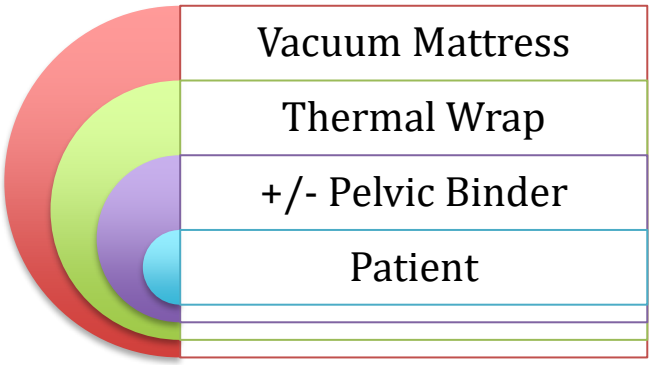
- This includes trauma and non-mobile medical patients that require transfer from scene.
- Patients are rarely found supine in a clear area, and will usually require some form of physical or mechanical extrication. Planning for extrication should start at first contact, and should be communicated to all team members.
- Use of a scoop stretcher should be employed wherever possible. Removal from a damaged car will still require an extrication board however.
- The patient should be fully assessed with respect to airway, breathing, circulation and disability. Clothing should be removed as appropriate.
- With no more than 15 degree rolling, the patient should be placed upon the scoop stretcher with a pelvic binder overlying the scoop where necessary. This can be done on any hard surface including an extrication board. It is difficult to perform this manoeuvre on a soft surface such as a bed.
- For very soft surfaces it may be necessary to roll the patient onto an extrication board prior to scoop.
- The use of an absorbent thermo reflective blanket is strongly advised.

4. Secondary transfer packaging

Preparation

- The patient should be fully assessed, and a thorough examination performed and documented.
- The patient should be placed onto a scoop stretcher as described above.
- The patient may then be transferred to a pre-prepared vacuum mattress. This comprises a flat full length vacuum mattress covered in a thermo-reflective wrap (e.g. Mediwrap, absorbent side uppermost), with a pelvic binder on top if required.
- The patient should be lowered onto the prepared mattress, the pelvic binder adjusted if needed, and the scoop removed. At this stage, cervical spinal immobilisation should be managed where necessary.
- If cervical spinal immobilisation is required, an appropriately sized and fitted collar should be applied if not already done, and standard blocks placed either side of the head.

- The pelvic binder can then be applied, followed by closure of the thermal wrap, followed by closure of the vacuum mattress around the patient before vacuum is applied.
- Where head blocks are present, these should be wrapped within the vacuum mattress to secure them in place. Ideally tape should not be used as this can damage the vacuum membrane on removal.
- The scoop should then be relocated under the vacuum mattress to allow ease of carrying.
- Care should be taken to ensure visual and physical access to all relevant infusion sites. Lines should travel directly from the site to an anchor point. This may be a clip or similar attached to a fixed point. Tape should not be applied to the vacuum mattress.
- Once packaged, a full reassessment of the patient should occur including monitoring, vital signs, ventilation, cardiovascular stability and infusion sites.



5. Paediatrics

- Children should have the same standards of packaging applied – immobilisation, heat loss avoidance and safety are of no less importance.
- Vacuum mattresses are excellent means of transferring children and should be used wherever possible.
- Consider a smaller vacuum device for small children – a large leg splint may be appropriate up to 4-5 years of age.
- Scoops may not be effective or appropriate in young children, and consideration of direct rolling onto a thermal wrap/mattress should be made.

Spinal care

Following on from the Faculty of pre-hospital care consensus statement on spinal immobilization in 2013, the following principles should be considered;

- The evidence base supporting current 'gold standard immobilisation' remains equivocal; it may even worsen outcome
- In hospital practice should inform, but may not determine, pre-hospital practice; the different patient groups have different priorities
- Spinal care for a potential spinal injury should not exacerbate known and potential injuries, or patient comorbidities
- The process of spinal care should not unnecessarily impede or delay definitive treatment
- The nature of pre-hospital spinal care should take into consideration the likelihood of the patient having sustained a spinal injury. Individual, patient level decisions, should be made balancing the benefits and harms associated with spinal care for that specific patient.
- The concept of triple immobilization should no longer be accepted as best practice
- Pre-hospital spinal care should follow the principles of self-support, self-extrication, movement mitigation and careful handling, with transport in a position of comfort.
- Resuscitate the cord – minimize secondary injury from hypoxia and hypovolaemia where appropriate
- Patient stratification;
    - Group 1: Compliant, no neurology
        - The cervical spine can be 'cleared' according to established practice if appropriate.
        - Patients should be given the option to self-extricate under supervision.
        - Patients who are transported to definitive care should be transported in a position of comfort.

- Group 2: Compliant, altered neurology
  - Self-extricate or extricate in position of comfort.
  - Transport to definitive care in in position of comfort
- Group 3: Non-compliant
  - Imposing immobilisation is likely to be resisted, and as such futile, with increased risk of harmful effects
  - Minimise time to definitive care
  - Transport in position of comfort as able
- Group 4: Unconscious
  - Group likely to have highest incidence of spinal injury; but likely to have the highest
  - incidence of other time critical injuries
  - Aim to rapidly extricate
  - During extrication optimum care for these patients is MILS
  - If resources/access are limited a cervical collar may be of use to aid stabilising the head during extrication (this would normally then be removed for transport once in neutral position for transport)
  - Aim to transport to definitive care in supported neutral position

Pelvic injury and splintage

1. Introduction

Early suspicion, identification and management of a pelvic fracture in the pre-hospital environment are essential to reduce blood loss and the risk of hypovolaemic shock. Pelvic fractures are a hallmark of significant injury and are frequently associated with major intra-abdominal and vascular injuries.

Early external pelvic splintage, whilst clotting factors are still functional, will reduce bleeding by apposition of the fracture site and reducing movement of the bone ends which could disrupt established clot. Consider the use of tranexamic acid in addition to a pelvic splint.

2. Pre-hospital assessment

Consider mechanism of injury:

- RTC, particularly front seat occupants in head on collisions and patients sitting on side of impact with intrusion
- Pedestrians
- Motorcyclists
- Fall from height
- Crush injury
- Simple falls in the elderly

Look for signs of shock, and the presence of pain in the pelvic area including the lower back, groin and hips.

Additional indicators of pelvic injury include:

- Obvious deformity
- Bruising and swelling over the bony prominences, pubis, perineum and scrotum
- Leg length discrepancy or rotational deformity of a lower limb (without fracture in that extremity)
- Wounds over the pelvis or bleeding from the patient's rectum, vagina or urethra if detected indicate an open pelvic fracture.

THE PELVIS SHOULD NOT BE 'SPRUNG' TO TEST FOR TENDERNESS OR INSTABILITY. This risks disturbing clot and has also been shown to be unreliable in detecting pelvic injuries.

If trapped within a vehicle whilst suspicion exists of pelvic injury (side impact, mid shaft femoral fracture), the patient should wherever possible be extricated rearwards onto an extrication board following roof removal. Rotating the patient or rolling the patient

sideways should NOT be attempted unless there is an immediate threat to life as this may convert a simple fracture into a major vascular injury.

3. Pre-hospital management

Indications for splintage

- *Alert and Orientated Patients Without Distracting Injury*:
  - Pelvic Splintage should be applied to all patients who have had a mechanism of injury likely to result in pelvic fracture AND who have signs consistent with pelvic fracture on inspection, or have pain in the pelvic area.

- *Trauma Patients with Reduced Conscious Level and/or Distracting Injury*:
  - Pelvic Splintage should be applied to all patients who have had a mechanism of injury likely to result in pelvic fracture

Exceptions:

- It may not be practicable to apply a pelvic sling due to the patient's body habitus or injuries e.g. impalement.
- The pelvic sling is not designed for use on children.

Minimise movement of the patient and avoid log rolling as this is likely to precipitate further bleeding.

Apply a pelvic splint; designed to apply the optimum amount of pressure to close the pelvic ring without overtightening.

The splint can be applied on top of clothes. However, consider removing clothing prior to application to reduce the need for further rolling once in hospital. Obvious wounds in relation to the pelvis should be dressed.

Application

- The pelvic binder should be applied according to the manufacturer's instructions
- Once the splint has been applied, use a scoop stretcher (with maximal tilt of 15^{o}) to lift the patient directly onto stretcher or vacuum mattress for transportation. Consider transporting on scoop.

Resuscitation: Insert 2 IV access, and follow IV fluid resuscitation principles as described elsewhere in this guideline. If there is suspicion of a pelvic injury that warrants application of a pelvic sling, also consideration should be given to the use of tranexamic acid.

Additional information

Hospital teams should be encouraged to leave the pelvic splint in situ until definitive care can be initiated.

The splint should only be removed after a full radiological study excludes instability (images should be performed through the splint or when other means of stabilisation have been initiated). Hospital personnel should be advised that reduction of a pelvic fracture with a splint can make it difficult to see the fracture on xray and if the index of suspicion is high, consideration should be given to relaxing tension on the splint and repeat xray.

Head injury management

1. Introduction

Traumatic brain injury is a common problem in the pre hospital environment. Early appropriate intervention can have a significant impact on long term outcome by adjusting the factors which cause secondary brain injury. Specialist services such as MERIT has the additional opportunity to optimise ongoing care by transferring patients to a hospital which has full facilities for the assessment and management of head injuries.

The management principles in this guideline augment the guidance from JRCALC and should be read in conjunction with this guidance.

2. Pre-hospital assessment

Mechanism of injury

How the injury has been sustained and the amount of energy transfer there has been enables the practitioner to establish likely injury pattern and severity of injury. The pre-hospital provider should consider details such as height of fall, weapon used or vehicular damage, for example bulls-eye to windscreen, in a road traffic accident.

A high energy ‘dangerous’ mechanism of injury includes:

- Pedestrian struck by a motor vehicle
- Occupant ejected from a motor vehicle
- High speed collision
- Rollover motor vehicle accident
- Motorised recreational vehicle accident i.e. quad bike
- Bicycle collision
- Fall from height > 1m or 5 steps
- Diving accident

Any period of loss of consciousness is indicative of a significant brain injury. A clear history of LOC or not should be established.

Patients may present with an isolated head injury or the head injury may be part of multiple trauma. Associated injuries should be searched for and appropriately managed, particularly cervical spine injury. If the patient is unconscious or unreliable from his injury or an intoxicating substance presume a cervical spine injury is present and treat this accordingly.

3. Pre-hospital management

The basic principles behind pre hospital management of head injury follow the cABCDE doctrine.

- Arrest catastrophic haemorrhage
- Ensure a patent airway, with cervical spine protection
- Ensure adequate oxygenation and ventilation
- Ensure optimal blood pressure to provide good cerebral perfusion pressure
- Assess GCS, pupils and capillary blood glucose
- Reduce exposure
- Reassess

Following an cABCDE approach will reduce the impact of secondary brain injury from hypoxia, hypo/hypercarbia, hypovolamia, hypo/hyperglycaemia, which all impact on intracranial pressure.

Rapid sequence induction

Rapid sequence induction and intubation may optimise management of airway and ventilation, and should be considered if an appropriately skilled practitioner is present. Specific indications for RSI in head injured patients are:

- Airway obstruction (actual or impending)
- Anticipated airway problem during transport
- Risk of aspiration
- Oxygenation +/- ventilatory failure
- Unconsciousness
- Anticipated clinical course
- Agitated/combative patient (GCS < 15)

RSI in head injured patients should minimise ICP rises by:

- Using the maximum induction agent that the patient's cardiovascular status allows
- Using appropriate dose of neuromuscular blocking drug to ensure adequate paralysis
- Gentle and minimal laryngoscopy, avoiding stimulation of the posterior pharyngeal wall

- Minimal tube movement e.g. holding the tube when the patient is moved

If RSI is indicated but not possible due to patient, logistical or crew factors, airway and ventilation should be optimised by basic manoeuvres and the patient transferred to the most appropriate ED (Major Trauma Centre wherever possible) where skilled anaesthetic assistance is available. A combative patient should normally be transferred by road in these circumstances. If the decision is made to use sedation in a head injured patient:

- the practitioner must be able to demonstrate appropriate training and experience
- verbal contact should be maintained with the patient
- full monitoring, as for RSI, must be in place and
- rescue airway techniques, such as LMA and surgical airway, must be immediately available.

Aims of treatment

Normalise oxygenation, carbon dioxide, blood pressure, temperature and BM. Aim for:

- SpO_2 > 94%
- $ETCO_2$ 4-4.5 (equates to $PaCO_2$ 4.5-5)
- Mean Arterial Pressure: the targets recommended by the AAGBI and the NHS Children's Transport Service are:

Age	MAP (mmHg)
< 3months	40 - 60
3 months – 1 year	45 -75
1 – 5 years	50 - 90
6 – 11 years	60 - 90
12 – 14 years	65 - 95
Adult	>80

- In a patient with polytrauma and non-compressible bleeding, and a head injury, give fluid boluses to maintain a radial pulse
- Normoglycaemia, treat hypoglycaemia aggressively

- Temp 35-37^{o}
- Adequate analgesia, as pain can also result in raised ICP

Impending herniation

In a head injured patient with evidence of raised ICP: hypertensive +/- bradycardia +/- dilated unreactive pupil consider the following temporising measures to prevent coning.

- Hyperventilate in 100% oxygen (to $ETCO_2$ 3.5-4)
- Ensure MAP > 80

Seizures

Fits are common post head injury and impact on secondary brain injury by compromising the airway, impairing ventilation and increasing the brain's metabolic demands. Seizures should be controlled with iv midazolam or diazemuls. Consider RSI in fitting head injured patients, thiopentone would be the induction agent of choice in a haemodynamically stable patient.

4. Transfer

Once the patient has been immobilised consider loosening the c-spine collar to ensure no obstruction to venous return from the head. Certainly, do not apply the collar too tightly.

Consider transporting the patient with a head up tilt of 30^{o} if practicable.

Transfer to a major trauma centre capable of immediate (<1 hour) CT scanning if:

- GCS < 13 on initial assessment
- GCS < 15, two hours post injury
- Suspected open or depressed skull fracture
- Any sign of base of skull fracture (haemotypanum, 'panda' eyes, cerebrospinal fluid leak from ear or nose, Battle's sign)
- Post traumatic seizure
- Focal neurological deficit
- More than one episode of vomiting
- Amnesia for events more than 30 minutes before the impact

Or any LOC/amnesia with the following:

- Age > 65 years
- Coagulopathy (history of bleeding, clotting disorder, current treatment with warfarin)
- Dangerous mechanism

Traumatic cardiac arrest

1. Introduction and scope

This guideline is intended for all clinical personnel involved in the provision of prehospital traumatic cardiac arrest (TCA) care. Not all of these personnel will have the competencies or authority from their governing organisations to perform all of the skills described within this document; the complete guideline is intended as information to allow a complete team approach. Readers should be guided by their appropriate professional organisations and should only work within their own documented competencies.

TCA is associated with a high mortality rate. In most cases, catastrophic injuries result in early loss of cardiac output and irreversible arrest. Those patients with devastating injuries such as massive cranial destruction, incineration with near 100% burns, hemi-corporectomy, massive truncal injury or decapitation will not survive. Resuscitation should not be started in these patients and “recognition of life extinct” (ROLE) procedures should be followed.

In some patients, if reversible causes are identified early and addressed adequately, return of spontaneous circulation (ROSC) may be possible and allow transfer of the patient to definitive care. By focusing resuscitation efforts on the reversible pathologies (as described below), ROSC and survival are more likely. There are reports of survivors with good neurological outcome.

A medical cause of cardiac arrest must be considered, particularly in the older patient. Did a medical event lead to the trauma? If the apparent injuries are not in keeping with causing a traumatic arrest (e.g. minimal damage to vehicle in RTC with driver in cardiac arrest or collapse witnessed prior to impact), standard ALS protocols should be followed considering the 4 H’s and 4 T’s during resuscitation. Good quality chest compressions with early defibrillation are vital.

In contrast, in TCA there are 4 main pathologies to focus on simultaneously, using the acronym HOT

- Hypovolaemia
- Oxygenation
- Tension pneumothorax / cardiac tamponade

- Hypovolaemia should be addressed by:
  a. Minimising ongoing external bleeding e.g. arterial tourniquet
  b. Minimising internal bleeding e.g. pelvic splint, traction splints
  c. Rapid large bore IV/IO access
  d. Replacement of lost volume with IV fluids, typically 2000 ml fluid challenge

- Oxygenation should be addressed by:
    a. Achieving definitive airway with intubation
    b. Delivering 100% oxygen
    c. Ventilating with $ETCO_2$ monitoring

- Tension pneumothorax should be addressed by:
    a. Immediate bilateral needle decompression (if there is any delay to open thoracostomies)
    b. Preferably bilateral thoracostomies (if trained to do so)

- Tamponade is likely to be in the context of penetrating chest injury
    a. Consideration for clamshell thoracotomy if appropriate: see SOP

Chest compressions in the context of TCA are not the priority as compressing an empty heart prior to volume loading will be futile. They should be undertaken only if there are sufficient personnel to do so and where it does not delay treating the HOT causes/or following their application; or where:

- a medical cause of arrest is suspected **or**;
- Impact Brain Apnoea is suspected, not in the setting of major haemorrhage elsewhere **or**;
- A hypoxic mechanism rather than hypovolaemic mechanism is most likely

Do not rely on signs such as pupillary size or reactivity to determine prognosis.

Ultrasound has a very limited role in TCA as the HOT principles should be addressed immediately (ultrasound unlikely to give a timely and assured 'rule-out'). Its use may be considered once the HOT causes have been addressed. It should not delay thoracotomy where this procedure is indicated, for similar reasons.

Resuscitation should be continued until all reversible causes have been addressed. Prolonged or ongoing resuscitation should be considered in the following situations:

- Where the patient is a child
- Where the patient has drowned and is hypothermic
- Where it is not safe to stop (threatening relatives etc)
- Where the patient loses signs of life en route to hospital before interventions have been undertaken (though HOT interventions can usually be performed in transit, stopping the vehicle if necessary to do so)

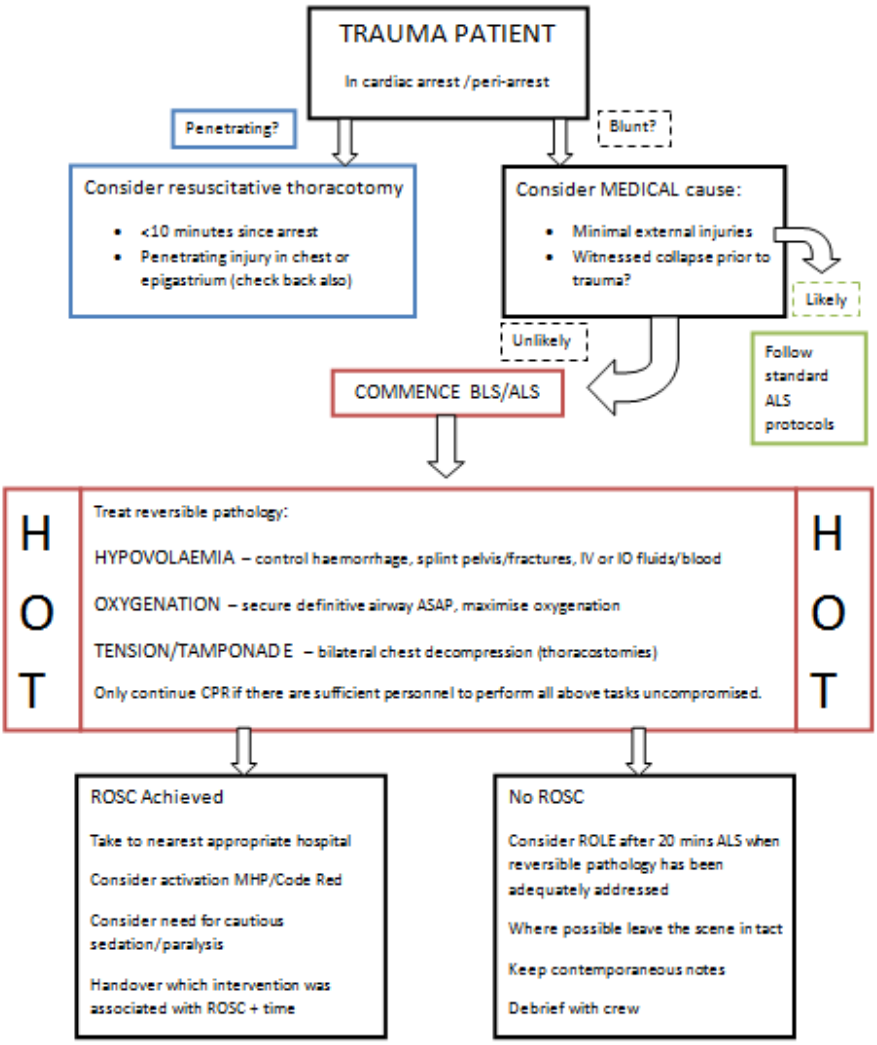
Resuscitative Hysterotomy is not included within the scope of this guideline but is a consideration post-20 weeks of gestation (for the mother's resuscitation).

Where ROSC is achieved and the patient is transported to hospital, consider the following:

- Activating Major Haemorrhage Protocol/ "Code Red" at receiving unit.
- Documenting/handing over which intervention resulted in clinical improvement as recurrent deterioration is likely.

Where ROSC is not achieved and ROLE is performed, consider Immediate incident debrief with those involved (sometimes needed to explain the 'aggressive' approach to the management of HOT causes)

Algorithm for TCA (adapted from Lockey et al, 2013)



Appendix 1

Amputation

Authorised staff for this section:

Advanced paramedic	**X (assistance only)**
Nurse	**X**
Doctor	**X**

1. Introduction

Amputation of a limb at the scene of an incident is a true emergency procedure, where it means 'Now' or 'Never'. It is a technique that is used rarely, and should be reserved for when there is no other mechanism possible for the salvage of life other than to remove an entrapped limb to free a patient.

2. Scope

This guideline is designed to outline the basic indications, technique and management of amputation.

It is beyond the scope of this document to outline every situation where amputation may be necessary, but it is intended to be used when all other techniques to free a patient in a timescale appropriate for the clinical condition have failed, and life in in immediate danger.

The procedure itself should only be performed by a WMAS approved doctor. At the first point that amputation is considered, an immediate request for further support should be relayed via the Regional Trauma Desk.

3. Definitions

Amputations can be complete or partial.

- Complete: a complete amputation is one in which there are no tissues, ligaments, muscles or other anatomical structures connecting the amputated part to the body.
- Partial: a partial amputation is one in which there is still an anatomical structure including skin, muscle bone, ligament, tendon or vessels connecting the body with the distal part.

5. Indications

Entrapped extremity

- There may be situations in which the patient is trapped by a limb and there is no reasonable chance of release or in-situ resuscitation before death. This may be due to the unavailability of lifting / cutting equipment, developing risk of fire / structure collapse, or in extremis (non-responder to fluid).
- There are no other indications covered within this guideline, although it is recognised that extreme situations may arise which can not be predicted that may warrant amputation.

6. Equipment

- Tourniquets x2
- IV / IO access
- Intravenous fluids and giving sets
- Analgesia and sedation
- Monitoring including ECG, SpO2, NIBP and ETCO2 as a minimum set
- Scalpel (large blade)
- Tuff-cut scissors
- Gigli Saw
- Artery forceps
- Sterile gloves
- Haemostatic Dressing
- Elasticated absorbent bandages (Israeli)
- Plastic bag for body part

7. Technique

Preparation

- Inform Trauma Desk of plan to record contemporaneous decision making in log and to request immediate response from any available BASICS responder.
- Secure safe environment and have this assessed constantly by attending fire officers.
- In the case of a confined space, plan your escape route out if necessary.
- If area is unsafe, do not commit to a surgical procedure.
- Full PPE including clinical gloves and glasses is mandatory.
- All team members must be committed to the procedure and agree the indications.

Pre-Procedure

- Ensure that at least 2 IO/IV access points are achieved and secured
- Prepare the receiving ambulance trolley stretcher in the manner of a resuscitaion area including all equipment required for RSI and catastrophic haemorrhage control. Ensure route to ambulance/helicopter is clear.
- Begin fluid infusion including tranexamic acid as per haemorrhage control guidelines
- Provide analgesia and sedation the patient. Ketamine is the drug of choice at 0.5 to

1 mg/kg

- Allocate a competent practitioner to the airway.
- Access the limb
  - Remove clothing around the limb if not already done
- Apply two tourniquets – one as near to amputation point as possible and not over a joint, and one 6 above the first.
  - Tighten the distal tourniquet
- Apply skin preparation wherever possible

Procedure

- Incise skin to muscle in a circumferential manner.
- Incise muscle perpendicular down to bone
  - Tuff cut scissors can be used to cut tissue if required
- If possible, apply large gauze swab to proximal muscle bulk and instruct an assistant to retract to allow clear view of tissues being cut / incised.
- Use Gigli saw to saw through bone as distal as possible and as perpendicular to the bone axis as possible.
  - The Gigli saw should be applied under the bone and upward pressure directed whilst long sweeping sawing action is carried out.
  - Do not saw too quickly as heat is generated which may snap the saw
  - Saline can be irrigated over the cutting area during the use of the Gigli saw.
- Any large vessels visible should be secured with artery forceps.
- Dress the stump with an elasticated absorbent (Israeli) dressing, and consider haemostatic dressing if bleeding continues.
- If bleeding is considerable, DO NOT remove the lower tourniquet, but slowly increase pressure of the top tourniquet until control is achieved.

Post procedure

- Once amputation has been achieved swiftly move the patient to the trolley ensuring tourniquets remain in place and working.
- Re-evaluate the patient now that 360 degree access has been achieved.
- Extend analgesia/sedation as required.
- Manage fluid infusion if blood pressure stable as per fluid clinical guideline.
- Resuscitate as normal
- If possible, take limb to hospital for skin/nerve salvage

Special considerations

- Best practice is dual doctor procedure – consider BASICS / MIO support early, but do not delay procedure to wait

- Members of ambulance, police and fire services witnessing this procedure may require feedback and appropriate follow-up.
- Antibiotics are not indicated in the pre-hospital environment as unless administered several minutes before application of tourniquet, tissue penetration at the operative site will be low.
- If performed, this procedure must be notified to the Clinical Lead at the earliest opportunity, and a full longitudinal case review must be carried out.

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