Severn Trauma Adult Guideline Manual

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Project Lead & Lead Editor: Jim Blackburn
Editors: Rowena Johnson, Richard Turck
Guideline Formatting & Document Production: Rowena Johnson

Approved By: Severn Major Trauma Network Clinical Lead
Distribution: Severn Major Trauma Network, Trauma Team Leaders, Trauma Team
STAG Project Leads

Dr Benjamin Walton - Southmead Major Trauma Centre Clinical Lead  
Ms Sarah Lapham - Major Trauma Centre Administrator  
Dr James Blackburn - Project Lead for STAG, Lead reviewer and editor  
Dr Rowena Johnson - Editor, reviewer, document production and formatting  
Dr Richard Turck - Editor and guideline reviewer

Guideline Authors and Contributors

Ms Kaylee Allan  
Dr Jules Blackham  
Dr Christine Blane  
Dr Adam Brown  
Dr Anthony Carey  
Mr Tim Chesser  
Ms Debbie Cleary  
Mr Alistair RM Cobb  
Dr Graham Collin  
Dr Neil Collin  
Dr Kate Crewsdon  
Ms Laura Crowle  
Dr Amit Goswami  
Dr Scott Grier  
Mr Luke Harries  
Ms Helen Harvey  
Dr Katy Hill  
Dr Timothy Hooper  
Dr Nicholas Howes  
Mr Mike Kelly  
Mr Umraz Khan  
Dr Katherine Livingston  
Professor David Lockey  
Mr Anthony Macquilllan  
Ms Joanna Maggs  
Dr Patrick Morgan  
Mr Stephen Morris  
Mr William Neary  
Dr Steven Novak  
Dr Simon Odum  
Dr Adrian Pollentine  
Dr Nicholas Preston  
Miss Anne Pullyblank  
Mr Andrew Pullyblank  
Mr David Sandeman  
Mr David Sanders  
Ms Victoria Stanley  
Dr Ian Thomas  
Miss Katherine Warren  
Mr Crispin Wigfield  
Dr Tim Wreford Bush  
Dr Nirosha DeZoysa

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Welcome to STAG Edition 1

Our trauma network has now been in operation for six years. It has been gratifying to see the enthusiasm and hard work of all of those involved in the care of trauma patients translated into improvements in care throughout the patient pathway, well documented by regular TARN quality data.

Many of the improvements have been related to system development rather than major changes in the clinical management of patients. Standard operating procedures and guidelines are a key part of standardising practice, educating juniors and those new to our system and preparing trauma staff for less common scenarios. Many are based on national guidelines and describe common practice in most UK trauma networks – others are influenced by our regional geography and the location of our speciality services.

They are an essential component of network documentation but they also take a while to stabilise and embed themselves in our practice. The authors of these guidelines have done an excellent job of collecting, revising and presenting the core operating material on which our major trauma centre and trauma units depend. These guidelines and their successors will positively influence trauma practice and ensure that our trauma patients have the best chance of an improved outcome after entering any part of our trauma network.

Professor David Lockey
Clinical Director, Severn Major Trauma Network.
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Patient Pre-Alert
Major Trauma Centre Automatic Acceptance Policy

1. This policy will relate to patients from Trauma Units and Local Emergency Hospitals within The Severn Major Trauma Network area following major trauma.

2. The Severn Major Trauma Network must accept all severely injured patients in a timely manner.

3. This policy applies seven days a week.

4. Capacity constraints cannot be used over clinical priority to turn-down or delay patients.

5. The final responsibility for the implementation of this policy lies with the on-call Major Trauma Consultant (Trauma Team Leader).

6. Transfer of the patient is to be organised by the referring hospital.

Introduction and Purpose of the Policy

Following the introduction of Regional Major Trauma Networks, Major Trauma Centres are required to have automatic acceptance of patients requiring treatment for major trauma injuries.

The purpose of this policy is to provide direction and guidance for actions from key individuals and organisations within The Severn Major Trauma Network to reduce the challenge and improve the patient pathway and quality of care. To do this it will:

- Ensure the automatic acceptance of trauma patients within the Severn Trauma Network from Trauma Units to the Major Trauma Centre.
- Ensure that all relevant parties are aware of their specific roles and responsibility, and prevent the acceptance and transfer of patients being delayed.
- Describe the procedure where capacity to accept severely injured patients is exceeded.
Application: To Whom This Policy Applies

This policy will relate to patients from Trauma Units and Local Emergency Hospitals within The Severn Major Trauma Network area following major trauma. This policy applies to referring Trusts hospitals, Ambulance Trusts and local air ambulances. It is the responsibility of North Bristol NHS Trust staff to ensure that that this policy is followed from first contact by an outside agency.

The policy will be implemented by personnel in A&E, Intensive Care, High Dependency Units and General Wards.

The final responsibility for the implementation of this policy lies with the on call Major Trauma Consultant (Trauma Team Leader) who accepts the patient. Departure from the policy would have to be justified to the Executive On call with clear and compelling reasons. Any departure from the policy must be documented in the patient notes or failing that, in a letter to the Director of Operations.

Principles

This policy applies 7 days a week.

All relevant clinical information is to be given to the receiving Trust.

The transfer of the patient is to be organised by the referring hospital, providing necessary escort arrangements, together with all necessary documentation including the Severn Major Trauma Network trauma patient record.

This policy should be read in conjunction with:

- The Severn Trauma Network repatriation policy
- SWASFT Major Trauma Triage Tool
In the case of an emergency transfer the referring hospital must contact the on-duty Major Trauma Consultant (Trauma Team Leader) with details of the patient. The referring hospital must also inform the Ambulance Service Coordination desk of the transfer and details of the patient. The transfer procedure must be carried out at Trauma Team Leader level. Full patient details including name of referring Trauma Team Leader to be recorded in the trauma booklet. The Severn Major Trauma Network patient trauma record follows the patient to the receiving hospital.

On arrival, the patient must be taken to the resuscitation room and trauma call procedures initiated.

**Automatic Acceptance Process For Emergency Transfers**

In the case of an emergency transfer the referring hospital must contact the on-duty Major Trauma Consultant (Trauma Team Leader) with details of the patient. The referring hospital must also inform the Ambulance Service Coordination desk of the transfer and details of the patient. The transfer procedure must be carried out at Trauma Team Leader level. Full patient details including name of referring Trauma Team Leader to be recorded in the trauma booklet. The Severn Major Trauma Network patient trauma record follows the patient to the receiving hospital. On arrival, the patient must be taken to the resuscitation room and trauma call procedures initiated.

**Capacity & Overflow Management**

The Severn Major Trauma Centre has a duty of care to the population covered by The Severn Major Trauma Network and must accept all severely injured patients in a timely manner. Timely is defined as according to the urgency of transfer as defined by the Trauma Team Leader only.

The NBT Major Trauma consultant on call has responsibility for decisions regarding capacity and the ability to accept patients from the Severn Major Trauma Network and from outside the network.

Where there are problems with capacity in specific areas of NBT (such as critical care) to accept patients from the Severn Major Trauma Network, it is the responsibility of the affected unit/department to inform the Major Trauma Consultant in a timely manner and to work together to resolve the situation expediently. Capacity constraints cannot be used over clinical priority to turn-down or delay patients.

If a request for patient transfer originates from a Trauma Unit within The Severn Major Trauma Network, it is the responsibility of the NBT Major Trauma Consultant to ensure that, if immediate major trauma centre care is not clinically required, then an alternative bed can be sourced in another Major Trauma Centre (in conjunction with the Ambulance Service Coordination centre).

The decision of whether a patient requires immediate major trauma centre care and therefore must be accepted is made by the Trauma Team Leader.

If no other Major Trauma Centre within a reasonable travel time can accept the patient in a timely manner the North Bristol NHS Trust must accept the patient.
1. Several prehospital teams routinely carry packed red blood cells and/or fresh frozen plasma or lyoplas.

2. The majority of patients receiving prehospital blood transfusion will need further blood and blood products on arrival in the Emergency Department.

3. All patients who have received prehospital blood transfusion will arrive wearing specific wrist bands for traceability. The patient identifier should be used for all pathology and imaging requests.

4. The prehospital team should provide a pre-transfusion blood sample; this will be sent using the pod system to the transfusion laboratory. 2 further crossmatch samples should be drawn and sent in the usual way.

Great Western, Wiltshire and Dorset & Somerset Air Ambulance teams routinely carry blood products and will perform prehospital blood transfusions when required. Each Air Ambulance carries 2 units packed red blood cells. They will in the future also carry fresh frozen plasma or lyoplas.

In the event that a patient who has received a pre-hospital blood transfusion is transferred to your hospital:

- Prior to arrival, you will receive a pre-alert (ATMIST) clearly stating that prehospital blood transfusion has been given.

- Any patient receiving prehospital blood will have a unique patient identifier (hospital number, name and date of birth) allocated to them in the prehospital phase. This will not be the patients actual name or date of birth. The unique identifier allocated in the prehospital setting should be used for all imaging and laboratory requests.

- The trauma team leader should confirm the unique prehospital identification number at the time of the ATMIST call; i.e. before the patient arrives in the Emergency Department; this will facilitate use of the correct number for pre-requesting laboratory and imaging investigations.
• The majority of patients who receive prehospital blood product transfusion will require additional blood on arrival in the Emergency Department.

• The prehospital patient identifiers and the actual patient details will be merged by the admissions team once the patient arrives at the location of definitive care. The prehospital team will provide blood transfusion specific accompanying documentation.

• On arrival, a pre-hospital Group & Save blood sample will be handed over; please assist the prehospital team to ensure the prehospital pre-transfusion blood sample is sent to the transfusion laboratory as quickly as possible. The South West Ambulance Service Prehospital Blood Transfusion SOP would normally expect this to be done using the pod system.

### Unique pre-hospital identification (compatible with NBT computer systems)

On wristbands, paperwork and pre-transfusion blood sample you will find unique prehospital identifiers.

**Hospital No:** Unique 7 digit number (6139XXX) – compatible with NBT computer system  
**Surname:** HEMS00001, HEMS00002 etc.  
**First name:** Unknown  
**Date of Birth:** 01-Jan-1900

The above information should have been passed to the trauma team leader with the initial ATMIST report. All imaging and laboratory requests should be requested using these details.

Even once the patient details are known, the prehospital identifiers and all associated investigations should continue to be used until the patient arrives at the location of definitive care e.g. Intensive Care, at which point the prehospital identifiers will be merged with the known patient details and all linked investigations and results will be transferred to the identified patient.

### Documentation

The following documentation will arrive with the patient: the prehospital team are responsible for ensuring it is correctly completed and copies lodged with the trauma team:

• Pre-hospital Blood Transfusion Record (includes prescription)  
• Blood Compatibility Form  
• Group & Save Request Form (with sample)  
• SWAST Patient Care Report (PCR or electronic Patient Care record)
ATMIST Handover

1. The ATMIST approach should be used to hand over all trauma patients

2. The program in appendix B (page 232) must be used to record the pre-alert for all major trauma patients.

3. All details on the proforma should be completed

Background

- The mnemonic ATMIST a method of clinical handover between pre-hospital and hospital teams
- It offers a structured format for handover and its aim is to improve communication with emergency departments when pre-alerting and upon arrival of a trauma patient.
- The ATMIST handover is expected to take less than 60 seconds

ATMIST

An ATMIST pre-alert is expected in the following circumstances:

- Any patient triaged as major trauma by the ‘Major Trauma Triage Tool’ – see Appendix A (page 231)
- Any patient where the trauma team is required outside the ‘Major Trauma Triage Tool’ criteria e.g. specific clinical concerns.

Upon receipt of an ATMIST pre-alert, the hospital team should record the handover on the ATMIST handover proforma sticker – see Appendix B (page 232).

Upon arrival of the patient in the emergency department, an ATMIST approach should again be performed to handover clinical information.
Pre-hospital Blood Transfusion

- If the patient has received a prehospital blood transfusion this should have been clearly stated during an ATMIST pre-alert.
- During this ATMIST pre-alert, the trauma team leader (TTL) should confirm the unique pre-hospital identification number (ie. Before arrival of the patient in the emergency department) – this will facilitate use of the correct number for pre-requesting laboratory and imaging investigations.

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ETA, mode of transport (land vs air), specialist resources required on arrival?

References

1. SWAST CG 05 – ATMIST Patient Pre-alert and Handover System – 01/02/2013 – Clinical Guideline

2. SWAST CG 24 – Trauma Care: Accessing Trauma Services – 17/03/2017 – Clinical Guideline
   https://www.swast.nhs.uk/Downloads/Clinical%20Guidelines%20SWASFT%20staff/CG24_Trauma_Care_Accessing_Services.pdf
Inter-Hospital Transfer of Adult Major Trauma Patients

1. Patients likely to require transfer should be identified early in their Emergency Department admission to facilitate time-efficient transfer.

2. In cases where uncertainty exists, early communication with the Trauma Team Leader (TTL) at North Bristol NHS Trust (NBT) is encouraged.

3. Resuscitation and stabilisation of the patient should occur in parallel with preparation for transfer.

4. A dedicated team member should prepare and verify correct functioning of all transfer equipment & drugs.

5. Referral to the TTL at NBT should occur in parallel with patient preparation where possible.

6. The senior clinician caring for the patient should make this call, not necessarily the person undertaking the transfer.

7. Critically ill patients undergoing inter- and intra-hospital transfer should be accompanied by two trained, competent and experienced staff.

8. Ensure all radiology is electronically transferred to NBT so that it is available as the patient arrives at the MTC.

9. The default location for reception and handover will be Emergency Department Resuscitation area at NBT.

10. A formal handover must occur between the transfer team and receiving team Consideration should be given to using the SBAR or ATMIST structure.

11. All transfer documentation should use SWCCN documentation available in all trauma units.
Introduction

Adult major trauma patients presenting to Trauma Units within the Severn Major Trauma Network (MTN) frequently require inter-hospital transfer to facilitate specialist treatment at the Major Trauma Centre. National guidance from the Intensive Care Society [1] and Association of Anaesthetists of Great Britain and Ireland [2] has been used to create regional guidelines for all critical care transfers within the South West Critical Care Network (SWCCN) [3], the northern section of which corresponds to the Severn MTN.

These MTN guidelines should be read in combination with the SWCCN ‘Guidelines for the inter- and intra-hospital transfer of critically ill adult patients’. Standards for training, equipment, clinical governance, accompanying personnel and risk assessment, monitoring, safety, documentation and handover are all described and not repeated in this document.

Purpose of This Document

These guidelines:
- Apply primarily to the safe transfer of level 2 and level 3 critically ill adult major trauma patients
- Aim to ensure that transfer of these patients occurs with minimal risk and in the best interests of the patient
- Provide an easy-to-follow flow chart to facilitate safe and time-efficient transfer

Transfer Decision-Making

The Severn MTN guidance on patients requiring specialist treatment in the Major Trauma Centre should be followed. Patients likely to require transfer should be identified early in their Emergency Department admission to facilitate time-efficient transfer. Patients who meet SWAST Major Trauma Bypass criteria will almost all require transfer. In cases where uncertainty exists, early communication with the Trauma Team Leader (TTL) at North Bristol is encouraged.
Preparation for Transfer

See Appendix E for additional information (page 251)

- Identify patient requiring transfer on admission or as soon as practicable

- Resuscitation and stabilisation of the patient should occur in parallel with preparation for transfer
  - Care should be taken to ensure patients are safe to transfer (some patients requiring transfer may be unstable)
  - Unnecessary interventions that add time delay should be avoided where possible. E.g. arterial access is rarely essential but frequently delays transfer.
  - Ensure all tubes, lines drains etc are well secured, protected and attempt to minimise the risk of displacement during transfer.
  - A dedicated team member should prepare and verify correct functioning of all transfer equipment (including standard monitoring, portable ventilator, infusion pump(s), transfer bag, and drugs and emergency / rescue medications).
  - Prepare SWCCN transfer documentation (available in every Emergency Department)

- Contact TTL at North Bristol; this should occur in parallel with patient preparation where possible. The senior clinician caring for the patient should make this call, not necessarily the person undertaking the transfer itself.

- The senior clinician caring for the patient should then contact South Western Ambulance Service NHS Foundation Trust (SWAST) via the 999 service.

Patients requiring a time critical transfer and specialist treatment as part of the MTN will receive an “time critical” 8 minute response from SWAST [4]. Some patients are not time critical but require “immediate” ambulance attendance within 30 minutes of the call. Very few patients are expected to be suitable for “urgent” 1-4 hour response.

The person making the call will require the following information (see Appendix F, page 252)

- Type of transfer: Major Trauma Transfer
- Urgency of response: time critical (8 minutes), immediate (30 minutes), urgent (1-4 hours)
- Patient location [exact location within hospital]
- Receiving hospital and department
- Whether a paramedic vehicle is required. Most level 2 and 3 transfers are accompanied by 2 non-ambulance service escorts, so there is no absolute requirement for a paramedic crew which may speed up the response.
- Details of escort(s) being provided (for instance, doctor and nurse)
- Patient’s current condition (anaesthetised, etc)
- Medical devices being transported (ventilator, monitor, syringe pump(s), etc)
Package patient on ambulance trolley

- The patient must be secured to the trolley (ask ambulance crew for help)
- Pay attention to lines, tubes and drains to ensure their safety; these should be secured, protected and risk of blockage, displacement and removal minimised.
- Ensure monitor, ventilator and infusion pump(s) are securely fastened to the trolley
- Ensure patient’s dignity is protected and pay attention to temperature management

On departure update TTL with estimated time of arrival (SWAST crew are able to estimate this)

Ensure all radiology is electronically transferred to North Bristol NHS Trust so that it is available as the patient arrives at the MTC.

### Selection of Transport Mode

The SWCCN expect the majority of inter-hospital transfers to be undertaken by road. Within the Severn MTN, air transportation of patients will very rarely be quicker than road transportation except in exceptional circumstances.

### Accompanying Personnel

Critically ill patients undergoing inter- and intra-hospital transfer should be accompanied by two trained, competent and experienced staff.

The majority of adult major trauma patients requiring inter-hospital transfer will be level 2 and 3 patients with significant risk of deterioration, who require a nurse (or other registered healthcare professional) and medical escort (with the medical practitioner being from an anaesthetic or intensive care medicine background).

### Reception and Handover

The default location for reception and handover will be Emergency Department resuscitation area in Southmead Hospital. If an alternate location (such as theatres) is required, this will be clearly stated by the TTL and arrangements made for the patient to be met on arrival so the transferring team do not get lost.

A formal handover must occur between the transfer team and receiving team led by the TTL. Handover should be structured and concise. Consideration should be given to using the SBAR or ATMIST approach alongside written documentation.
OPERATIONAL GUIDELINES
1. Activation of the trauma team is based on anatomical and physiological parameters

2. This team should manage the initial assessment, resuscitation, imaging and co-ordination of disposal for trauma patients presenting to NBT

3. The decision to activate the trauma team is made by the senior doctor and Band 7 on duty following pre-alert from the ambulance service.

4. The trauma team is activated by ringing ‘2222’ and stating ‘trauma call’

5. The trauma team leaders should be available within 5 minutes of notification

6. All members of the trauma team should inform their respective speciality team members of incoming trauma and attend the resus area as soon as possible on receipt of the trauma call

7. All trauma team members must remain with the patient until appropriate disposal is achieved

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## Trauma Team Roles and Responsibilities

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<td>Anaesthetist 3rd On Call</td>
<td>Bleep: 9034</td>
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<tr>
<td>General Surgeon Reg On Call</td>
<td>Bleep: 9772 &amp; 9656</td>
</tr>
<tr>
<td>Orthopaedic Reg On Call</td>
<td>Bleep: 9750</td>
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<tr>
<td>Radiology Reg</td>
<td>Bleep: 9746</td>
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<tr>
<td>Radiographer</td>
<td>Bleep: 9740</td>
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<tr>
<td>Trauma Nurse Co-ordinators</td>
<td>Bleep: 9747, 9748, 9749</td>
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<tr>
<td>ED Nurse 1</td>
<td>ED Nurse 2</td>
</tr>
<tr>
<td>Porter</td>
<td>Bleep: 9567</td>
</tr>
<tr>
<td>Matron ED</td>
<td>Bleep: 9744</td>
</tr>
<tr>
<td>Senior Nurse ED</td>
<td>Bleep: 9743</td>
</tr>
<tr>
<td>Receptionist</td>
<td>Bleep: 9742</td>
</tr>
</tbody>
</table>

**Other specialties may be called as clinically indicated:**

- Neurosurgery Reg                            Dial: 45726
- Plastics Reg                                Bleep: 1311
- Cardiothoracics                             BRI via switchboard
- Haematologist                               Bleep: 9433
## Generic Trauma Team Role

### Start of Shift

Collect Speciality Trauma bleep and receive handover + relevant Speciality situational report.

### Trauma Call Activation

Inform respective Speciality team members/ Consultant/ Theatres of incoming Trauma – thereby allowing for proactive planning of personnel, resources and theatre space.

Attend Resus area of the Emergency Department as soon as possible on receipt of Trauma call.

The decision to activate the Trauma team is based on the expectation that the alerted team members will be present to receive the patient. There is no requirement for team members to ring the ED to discuss the case prior to the patient’s arrival.

**On arrival to the Emergency Department:**

- Identify yourself to the Trauma Team Leader.
- Give name, specialty and grade to the scribe
- Fill in your identification sticker and place in a visible place
- Confirm expected role
- Ensure adequate personnel protective equipment
- On arrival of trauma team, all team members should be on the patient’s left of the ED trolley, except the airway nurse and anaesthetist. The paramedics will then be on the patient’s right.

**Remain with the patient until appropriate disposal is achieved**

If you need to leave the Trauma Team environment – this *must* be discussed and be agreed by the Trauma Team Leader.
**Trauma Team Activation**

Activation of the trauma team is based on anatomical and physiological parameters. Mechanism of injury does not form the basis of the activation triage tool. A trauma team can be called at any stage of a patient’s journey. There is an automatic acceptance policy. A copy of South West Ambulance Service NHS Trust Major Trauma Triage Tool can be found in the appendix (see Appendix A, page 231).

<table>
<thead>
<tr>
<th>Anatomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Unsafe airway</td>
</tr>
<tr>
<td>- Flail chest</td>
</tr>
<tr>
<td>- Penetrating injury to head, neck or torso</td>
</tr>
<tr>
<td>- Severe pelvic injury</td>
</tr>
<tr>
<td>- Major crush injury to torso or upper thigh</td>
</tr>
<tr>
<td>- Limb amputation</td>
</tr>
<tr>
<td>- Two or more long bone fractures</td>
</tr>
<tr>
<td>- Paralysis from spinal cord injury</td>
</tr>
<tr>
<td>- Burns over 20% or potential airway burns</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abnormal Physiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Respirations &lt;10 or &gt;30 or other signs of respiratory compromise</td>
</tr>
<tr>
<td>- Pulse &lt; 50 or &gt;120</td>
</tr>
<tr>
<td>- Systolic blood pressure &lt; 90 mmHg</td>
</tr>
<tr>
<td>- Systemic signs of shock</td>
</tr>
<tr>
<td>- Head injury with Motor Score ≤ 4</td>
</tr>
<tr>
<td>- Any signs of respiratory distress, shock or reduced conscious level in paediatrics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Special Circumstances</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Multiple patients</td>
</tr>
<tr>
<td>- HEMS requested</td>
</tr>
</tbody>
</table>
The ethos is that this team manage the initial assessment, resuscitation, imaging and co-ordination of disposal be it theatre, ITU or ward for Trauma patients presenting to NBT. Each team member will have generic roles within this structure, as well as, providing individual expertise. The aim is that a consistent and predictable Trauma team response is provided to each trauma, where roles and responsibilities are well defined and adhered to by each member of the team.

There is a switchboard test call at 10:00am and at 16:00

### Call Activation

- Following pre-alert from ambulance service the senior doctor and Band 7 on duty will decide whether trauma team is activated: decision supported by the use of trauma activation guidelines.

- Ring x2222

- State Trauma call

- The Trauma Team leader and Senior Nurse will carry out a situational appraisal of the department with the Duty ED lead to allocate appropriate bays and resources.

- On arrival of patient the Trauma Team Leader must identify themselves to the Lead Prehospital clinician and receive handover.

- The salient points of this handover will be written on the Trauma Board to prevent repetition of information, using the ATMIST handover formula – see separate guideline. A sticker for ATMIST handover should be available and completed by the scribe.

- Each member of the trauma team should fulfil their roles unless the team leader dictates otherwise.

- Members of the trauma team must not leave resuscitation without discussion with the Trauma Team Leader (TTL).
Trauma Team Leader

Present in ED or available within 5 minutes of notification.
Start of Shift: Liaise with Lead Nurse, collect Trauma bleep and TTL folder, take Departmental situational report and meet with Trauma Team Nurse 1&2.

Trauma Team Activation

Pre-Hospital: Alert Call
- Take call / review call as details taken
- Take patient identifiers as available
- Decide with ED nursing shift lead whether to initiate Trauma Team Activation
- Call Switchboard to initiate Trauma Call – an ETA is not required
- If patient is transferred by Air then Security and Clinical site teams needs to be informed.

In-Hospital: Alert Call
- Can be initiated at any stage by the Trauma Team Leader for a patient within the Emergency Department.
- The decision to activate the Trauma team is based on the expectation that the alerted team members will be present to receive the patient. There is no requirement for team members to ring the ED to discuss the case prior to the patient’s arrival.
- All team members receiving a Trauma call are expected to alert their respective speciality teams of an incoming Trauma.
- (Thus theatre, radiology, ITU beds and blood product availability can be planned for by respective teams)

Consider:
- Early notification to Neurosurgery, Plastic Surgery, Interventional Radiology, Cardiothoracic Surgery, Urology and Vascular Surgery as required.
- Massive transfusion protocol activation

Trauma Lead

Pre-arrival
- Add Alert Call details to Trauma Board – update Trauma Team.
- Lead resuscitation, coordinate staff and resources.
- Ensure personal introductions by Team members and confirm roles.
- Ensure team wear personal protective equipment.
Patient Reception

- Ensure Resus clock and Video recorder started.
- Co-ordinate ATMIST handover from Pre-Hospital Team – add details to Trauma Board.
- Co-ordinate transfer to Resus Trolley.
- Manage Trauma Team response.
- Make decisions in conjunction with team members and relevant specialists.
- Prioritise investigations and treatments.
- Ensure imminent life threatening conditions are treated and direct rapid transfer to CT or Theatre.

Promote an environment of open communication with review of ongoing management priorities and plans, ensuring involvement of all team members.

Aim for CT within 15 minutes unless reasons prevent this
Consider CT in lieu of primary survey x-rays in some cases see “Imaging in Trauma Guidance”

Consider early use of:
- O Neg blood
- Massive Transfusion Policy
- Tranexamic acid 1g over 10 mins.
  - The maintenance dose, 1g over 8hrs (given within 3 hours of Trauma) should be given on return from CT in order to minimise infusions needed in the CT scanner, and to focus the team on preparation for the CT scanner.
- Combat Application Tourniquet – use and management.
- Consider eFAST – if this would enhance and not delay ongoing patient care.

Patient Transfer

Team members may be required to remain with the patient during transfer to CT or Theatre.
Whilst sliding the patient up or down into the head cradle, the TTL should hold the trauma mattress fixed in position whilst the trauma team slide the patient.
Trauma Team members must remain with the patient until appropriate disposal is achieved.
If any Team member needs to leave the Trauma Team environment – this must be discussed and agreed by the Trauma Team Lead.
Antibiotics, urinary catheter, arterial lines, tetanus, pregnancy test need early consideration but can be delayed if transfer to theatre for emergency surgery is required.
Resuscitation is managed as a dynamic process which is not dependent on geographical location.

Handover: The Trauma Team leader determines the Speciality to lead ongoing inpatient care.
Inform Blood Bank: When patient transferred and likely ongoing blood product requirements.
Speak to Relatives
Documentation: Review complete case note documentation and complete Hot Debrief form.
Debrief team
Orthopaedic Registrar

Key Roles

- Catastrophic Haemorrhage control
- Cervical Spine and Pelvic stabilisation
- Venous access
- Perform Secondary Survey

Patient Management

- Direct pressure Haemorrhage control as required, in extreme conditions for extremity bleeds – consider tourniquet use.
- Ensure C-spine collar in situ, correct size and placement
- Ensure Pelvic splint in situ, correct size and placement
- Ensure legs aligned with internal rotation – bandage ankles to maintain position

Venous Access

- Venous access – shared role – as directed by Team Leader
- Confirm patency of i.v. access
- Unless the patient has two patent i.v. access sites - Gain i.v./ i.o. access with 20mls blood samples for:- FBC, UE’s, LFT’s, Lipase, Clotting screen, X-match, Venous blood gas and Blood Glucose
- If possible, free cannula to be placed in the back of the left hand for the IV contrast.
- If the patient has two patent i.v. access sites then gain 20mls blood for samples from a femoral arterial puncture
- Ensure samples are labelled correctly and dispatched to the appropriate departments.

Perform baseline peripheral neurological examination, if RSI planned or just prior to log roll, as directed by Team Leader.

Splint any long bone fracture
Contribute to case discussion with the Team Leader, particularly where limb or lifesaving interventions are required.
Once the primary survey and immediate lifesaving interventions have been achieved, the Orthopaedic Consultant must be informed of the likely case progression. This may require the attendance of the Consultant to the Resuscitation Room or to theatre as appropriate.

Secondary Survey

Carry out secondary survey, when deemed appropriate and verbally report findings to Team Leader and designated scribe.

- Document all wounds, grazes and degloving.
- Evaluate each joint and long-bone for dislocation / stability / fracture.
- Neurovascular examination of all limbs.
- Record presence or absence of key pulses & neurological findings.
- Identify peripheral injuries that need to be included in the CT scan
- Splint fractures.
- Repeat neurovascular examination after splinting.

Any additional imaging requirements in addition to a CT Trauma series (review “Imaging in Trauma Guidance”) should be discussed. Requesting of departmental films can impede the rapid progress of patients to definitive or staging care – and must be agreed amongst team members to ensure co-ordinated care.

Patients who have anterior pelvic injuries may require a retrograde-urethrogram prior to insertion of urinary catheters – this is to be undertaken by the Orthopaedic Registrar.

Discuss Orthopaedic assessment / plan / needs / priorities with team leader. Case discussion should also consider the need for Vascular or Plastic Surgery specialty attendance, dependent on injury patterns.

Liaise with theatres, anaesthetic colleagues, bed manager and consultant for patients needing theatre and / or admission.

Assist with sending/ordering tests, liaising with specialists or performing procedures as training and ability allows e.g. chest drains, urinary catheter.

Post Trauma Call

Document all actions and findings with a clear plan in patient notes.

**Remain with the patient until appropriate disposal is achieved**

If you need to leave the Trauma Team environment – this *must* be discussed and be agreed by the Trauma Team Leader.
Surgical Registrar

Key Roles

• Assess Breathing and Circulation.
• Perform logroll examination.
• Determine need for immediate surgical intervention in theatres.

Patient Management

B – Breathing:
• Assess air entry, chest expansion, percussion and tracheal position to allow identification of significant chest pathology.
• Report findings to Trauma Lead, discuss, agree and institute appropriate interventions.

C - Circulation
• Venous access – shared role – as directed by TTL
• Confirm patency of i.v. access
• Unless the patient has two patent i.v. access sites - Gain i.v./ i.o. access with 20mls blood samples for:- FBC, UE’s, LFT’s, Lipase, Clotting screen, X- match, Venous blood gas and Blood Glucose
  If possible, free cannula to be placed in the back of the left hand for the IV contrast.
• If the patient has two patent i.v. access sites then gain 20mls blood for samples from a femoral arterial puncture
• Ensure samples are labelled correctly and dispatched to the appropriate departments.

Perform abdominal examination

Perform examination on log roll – ensure full exposure. Assess for occipital head trauma, thoracic/ lumbar spinal injury, examine posterior chest including auscultation, palpate flanks, perform rectal examination and assess posterior aspect of limbs.

Contribute to case discussion with the Team Leader. Discuss Surgical assessment/ plan / needs / priorities particularly: decision on Transfer to CT or Theatre - Communication with theatres role is shared with ITU. Case discussion should also consider the need for Vascular or Plastic Surgery speciality attendance, dependent on injury patterns.
Once the primary survey and immediate lifesaving interventions have been achieved, the Surgical Consultant must be informed of the likely case progression if patient has initial SBP <90, has complex multi-system injury or is likely to need early surgery. This may require the attendance of the Consultant to the Resuscitation Room or to theatre as appropriate.

Stay with the patient in Resus / CT until stood down by the team leader. Liaise with theatres, Anaesthetic colleagues, bed manager and Consultant for patients needing theatre and / or admission.

Assist with sending/ordering tests, liaising with specialists or performing procedures as training and ability allows e.g. chest drains, urinary catheter.

| Post Trauma Call |

Document all actions and findings with a clear plan in patient notes.

**Remain with the patient until appropriate disposal is achieved**

If you need to leave the Trauma Team environment – this *must* be discussed and be agreed by the Trauma Team Leader.
Anaesthetics 3rd On Call

Key Roles

- Ensure patient oxygenated and ventilated with no airway obstruction.
- Intubate when appropriate in discussion with the Team leader – ensuring baseline neurological examination performed beforehand.
- Control patient logroll
- Ensure safe patient transfer

Patient Management

A- Airway

Intubated patients
Take physical handover of ETT or LMA from pre-hospital team. Ensure end tidal capnography confirms placement.
Assess effectiveness of BMV/ Mapleson C ventilation in conjunction with surgical registrars assessment of Breathing
Attach to ventilator as soon feasible – with confirmation of effective bilateral ventilation.

Non-Intubated patients – requiring intubation
Intubate when appropriate in discussion with the TTL – ensuring baseline neurological examination performed beforehand, orthopaedic registrar will assess peripheral limb response, anaesthetist to assess pupil response and formal GCS.
Perform co-ordinated RSI with Nurse 1.
Ensure end tidal capnography confirms placement.
Assess effectiveness of BMV/ Mapleson C ventilation in conjunction with Surgical Registrars assessment of Breathing
Attach to ventilator as soon feasible – with confirmation of effective bilateral ventilation.

Non-Intubated patients
Communicate airway patency and issues to team leader / scribe.
Assess respiratory rate and inform team leader / scribe.
It is usually appropriate for the anaesthetist to talk to the patient and provide ongoing assessment of GCS and pupil size.
Reassure patient on arrival, explain what is happening, take AMPLE history and inform Team leader/scribe

- A Allergies
- M Medications
- P Past medical history
- L Last meal
- E Everything else relevant

E- Exposure
Once primary survey completed and when directed by the TTL the anaesthetist will control the log roll
Consider need for endogastric tube (nasal or oral).
Arterial lines may be indicated, to avoid delay to CT this can usually be done after CT or in the operating theatre. It should not delay either.
Contribute to case discussion with the TTL. Case discussion should also address ongoing fluid management, blood products and inotropic support. Discuss massive transfusion protocol use in the ED and manage its implementation once in theatre, informing blood of any changes to contact name and telephone number.
Once the primary survey and immediate lifesaving interventions have been achieved, the ITU Consultant must be informed of the likely case progression. This may require the attendance of the Consultant to the Resuscitation Room or to theatre as appropriate.
Communicate any requirements with theatres - role shared with surgical registrar. Liaise with additional anaesthetist as appropriate if care to be handed over for theatre etc.
Assist with sending/ordering tests, liaising with specialists or performing procedures as training and ability allows e.g. chest drains, urinary catheter.

Post Trauma Call

Document all actions and findings with a clear plan in patient notes.
Remain with the patient until appropriate disposal is achieved
If you need to leave the Trauma Team environment – this must be discussed and be agreed by the Trauma Team Leader.
Non Airway Nurse

Liaise with Trauma Team Lead, Senior ED Nurse and other Trauma Team Nurse. Review resus bays and ensure Resus checklists are completed and signed. Highlight and address any deficiencies.

Prior to Patient Arrival

Responsible for supporting Trauma Team Leader. infuser
Prepare for the trauma call with level one infuser run through when indicated, warmed iv fluids run through, chest drain sets out if suggested, scoop stretcher and pelvic binder to hand. Ensure equipment for gaining large bore IV access and taking bloods is available.
Ensure availability of O Neg Blood.
Meet patient at helicopter if required – co-ordinate porters/ transfer equipment.

Patient Arrival

Ensure clock started when patient arrives in Resus Bay
Assist in transfer to the Resus trolley
Position yourself to the patients left side
Have scissors ready, remove enough clothing initially to attach monitoring,
Clearly state first observations to team leader & scribe as soon as available.
Then continue to remove all clothing including underwear and store securely.
Check temperature
Cover with forced air warming blanket / blankets
Help with getting IV access and sending bloods off if required, set up intraosseous kit (ez-IO) if no/ difficult IV access. Attach patient to level one infuser if required.
Assist with log roll
Draw up drugs / administer as prescribed
Prepare for transfer to CT ASAP (within 10 minutes ideally) and/or theatre
Help with procedures as identified e.g. catheter, chest drain, and arterial line Dressings and splints of open fractures / significant wounds.
Ensure patient kept warm.
Post Trauma Call

Ensure you have documented all your interactions in the notes
Ensure you have signed for any drugs
Only leave the patient after liaising with the Trauma team leader
## Airway Nurse

Liaise with Trauma Team Lead, Senior ED Nurse and other Trauma Team Nurse. Review Resus bays and ensure Resus checklists are completed and signed. Highlight and address any deficiencies.

### Prior to Patient Arrival

- Responsible for assisting with the initial assessment and management of airway supporting anaesthetist.
- Assist in preparing any drugs requested by anaesthetist.
- Check all appropriate airway equipment is available and working
- Check suction available and working

### Patient Arrival

- Position yourself to patient’s right side
- Assist in transfer to resus trolley
- Reassure and establish a rapport with patient
- Assist anaesthetist with airway patency and ventilation passing adjuncts as necessary
- Prepare any drugs needed by anaesthetist (check drugs with them or Nurse 2) Assist during log roll
- Prepare arterial line equipment if requested

### Post Trauma Call

- Ensure you have documented any of your interactions
- Ensure you have signed for any drugs
- Only leave patient after liaising with the Trauma team leader
Radiographer MSK

Place cassettes under the trolley to speed up initial x-rays. Liaise with TTL or nurse in charge if team members are not wearing lead. Liaise with team leader if team members are obstructing your chance to x-ray to prioritise actions.

Radiologist

Liaise with CT radiographer to clear the CT Scanner and communicate with Resus when scanner is likely to be available. Attend the trauma call whenever possible as your expertise will be valuable in reviewing x-rays, eFAST scans and early recognition of interventional radiology requirements and planning of imaging (CT vs US). Most trauma patients will need early CT, national guidelines are = complete the CT and have the initial report within 30 mins of arrival in ED. A standardised reporting proforma is used to ensure rapid reporting.
A complex job but vital. Ensure you are being given the information you require and inform the team leader if not.

Prior to Patient Arrival

Ensure Receptionist is on-hand for rapid patient registration
- Ensure paperwork is available for documentation
- Ensure bags/documentation available for patient property
- Ensure team sign onto white board on arrival
- Document team member’s presence on Trauma Board: including speciality, grade e.g. ST3 and supervising consultant.
- Ensure tabards/role labels available – encourage members to place labels visibly in center of chest.

Patient Arrival

Ensure clock has been started when patient arrives in the Resus Bay. Get Patient Care Record (PCR) handover from Paramedics.
Ensure all patient details correct and NOK information is documented. Ensure patient wrist labels are secured on the patient. List and store safely any patient belongings

Responsible for documentation of observations, events and interventions
- Document all prehospital drugs and fluids – times and amounts.
- Document initial vital signs and then every 5 mins in unstable pt and every 15 mins otherwise. This role continues into CT and until discharged from ED.
- Maintain a chronological record of all events e.g. time of venflon, CXR, FAST, move to CT etc.

Inform the team leader if key observations have not been taken e.g. Temp or GCS.
Inform the team leader every 15 mins that pass, the aim is to be in CT within 15 mins when appropriate ask and document reasons for any delays.
Keep a log of the running total of blood products transfused – this role may be done by a specified nurse member responsible for the level one infuser. In a massive transfusion after every 4-5 units prompt the TTL of need for adjuncts (such as calcium or insulin / dextrose).
Post Trauma Call

- Ensure all documentation is complete
- Liaise with police if any property handed over for evidence
- Ensure all drugs/fluids signed for by appropriate person
- Only leave the patient after liaising with the trauma team leader
ConvenMon for the Registration of Patients with Uncertain Details

1. MRN and patient identifiers are issued using the mode of arrival, date and time information in a specific format detailed within the guideline.

2. Deviation from this process could lead to significant patient harm

3. Even once patient information is known, the MRN, name and DOB from the ED should remain in use until the patient has reached the location of definitive care.

Unknown Patient Registration Guidelines

Any patient who attends the Emergency Department Major Trauma Centre at Southmead Hospital for whom their demographic details are unknown or uncertain in any way, should be registered as an unknown patient.

The naming convention for unknown patients should follow the form:

• (Surname) MODE OF ARRIVAL DATE OF ARRIVAL TIME OF ARRIVAL
• (Forename) UNKNOWN

(where mode of arrival is “Air, Land” whichever is applicable, and date and time have no colons or backslashes in).

• Date of Birth: 01/01/1900

Thus, a patient arriving on 10th March 2015 at 14:37 hours by helicopter should be registered as: AIR100320151437, UNKNOWN DOB 01/01/1900

This will allow an MRN to be generated which will also ensure the patient is found in ICE, allowing the ordering of pathology, blood and x-rays / CT scans.

It is imperative that the patient remains registered as an unknown until such time as the patient moves to an area of definitive care, eg Intensive Care Unit, ward environment, EVEN IF THE PATIENT DETAILS BECOME AVAILABLE.

Full merger of patient details from unknown to known will be accompanied by full merger of the ICE details, blood transfusion record, and radiology.

Failure to adhere this policy will cause the potential for extreme patient jeopardy, the possibility of “NEVER EVENT” occurrence, or at least the need to inappropriately re-bleed the patient.
Emergency Department & Critical Care Major Trauma Drug Bags

1. The drug bags should be kept in the locations identified in the following pages.

2. The drug bags should be sealed with a tamper proof seal once restocked

3. Where controlled drugs are used from within the drug pouches, it is the responsibility of the individual using those drugs to ensure they are appropriately prescribed, signed for in a controlled drug register and communicate the need to replace or restock.

4. It is the responsibility of each clinical service to ensure contents are replaced as used and drugs within date prior to each use. The mechanisms to achieve this may vary but should include the ability to audit restock and expiry status of contents as well as trace those individuals responsible for each restock or maintenance of the bags.

5. The drug bags should be available on activation of the trauma team in all major trauma calls, prior to arrival of the patient.

6. The bags should be available during the transfer or movement of any patient within or from the ED or critical care environments.

Emergency Department Major Trauma Drug Bag

Drug bag should be stored in the locked controlled drug cupboard in Resus 1 and/or 2

<table>
<thead>
<tr>
<th>Drug</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine</td>
<td>10mg / ml</td>
</tr>
<tr>
<td></td>
<td>1 x 20ml vial</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drug</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam</td>
<td>1mg / ml</td>
</tr>
<tr>
<td></td>
<td>1 x 5ml ampoule</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drug</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>10mg / ml</td>
</tr>
<tr>
<td></td>
<td>2 x 1ml ampoule</td>
</tr>
</tbody>
</table>
The ED drug bag contents may change over time, but should contain all key drugs to safely perform emergency anaesthesia for all types of major trauma patients.

Note the ED also have a separate SOP covering the management of controlled drugs within the drug bag in the ED - clinicians should familiarise themselves with this.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Concentration</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>50µg/ml</td>
<td>1 x 10ml ampoule</td>
</tr>
<tr>
<td>Propofol</td>
<td>10mg/ml</td>
<td>1 x 20ml ampoule</td>
</tr>
<tr>
<td>Metaraminol</td>
<td>10mg/ml</td>
<td>1 x 1ml ampoule</td>
</tr>
<tr>
<td>Rocuronium</td>
<td>10mg/ml</td>
<td>2 x 5ml ampoule</td>
</tr>
<tr>
<td>Suxamethonium</td>
<td>50mg/ml</td>
<td>2 x 2ml ampoule</td>
</tr>
<tr>
<td>Lorazepam</td>
<td>4mg/ml</td>
<td>1 x 1ml ampoule</td>
</tr>
<tr>
<td>Tranexamic Acid</td>
<td>100mg/ml</td>
<td>2 x 5ml ampoule</td>
</tr>
</tbody>
</table>
### Intensive Care Unit Drug Bag

**Emergency drug bag kept in the Pod D fridge**

<table>
<thead>
<tr>
<th>Medication</th>
<th>Quantity</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenosine 3mg / ml</td>
<td></td>
<td>3 x 2ml ampoule</td>
</tr>
<tr>
<td>Adrenaline 1:10000</td>
<td></td>
<td>2 x pre-filled syringe</td>
</tr>
<tr>
<td>Adrenaline 1mg/ml</td>
<td></td>
<td>2 x 1ml ampoule</td>
</tr>
<tr>
<td>Amiodarone 300mg</td>
<td></td>
<td>1 x pre-filled syringe</td>
</tr>
<tr>
<td>Atropine 600µg/ml</td>
<td></td>
<td>2 x 1ml ampoule</td>
</tr>
<tr>
<td>Calcium Chloride 10%</td>
<td></td>
<td>10mg</td>
</tr>
<tr>
<td>Chlorphenamine 10mg/ml</td>
<td>1 x 1ml ampoule</td>
<td></td>
</tr>
<tr>
<td>Glucose 50%</td>
<td></td>
<td>1 x 50mls</td>
</tr>
<tr>
<td>Medicine</td>
<td>Concentration/Container</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------</td>
<td></td>
</tr>
<tr>
<td>Ipratropium nebuliser</td>
<td>250µg/ml, 2 x 1ml</td>
<td></td>
</tr>
<tr>
<td>Magnesium sulphate</td>
<td>5g/10ml, 1 x 10ml ampoule</td>
<td></td>
</tr>
<tr>
<td>Naloxone</td>
<td>400µg/ml, 2 x 1ml ampoule</td>
<td></td>
</tr>
<tr>
<td>Salbutamol</td>
<td>2.5mg in 2.5ml, 2</td>
<td></td>
</tr>
<tr>
<td>Sodium Bicarbonate</td>
<td>8.4%, 1</td>
<td></td>
</tr>
<tr>
<td>Tranexamic Acid</td>
<td>100mg/ml, 2 x 5ml ampoule</td>
<td></td>
</tr>
<tr>
<td>Propofol</td>
<td>1%, 2 x 20ml ampoule</td>
<td></td>
</tr>
<tr>
<td>Suxamethonium</td>
<td>50mg / ml, 2 x 2ml ampoule</td>
<td></td>
</tr>
<tr>
<td><strong>Rocuronium</strong> 10mg / ml</td>
<td>2 x 5ml ampoule</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td><strong>Atracurium</strong> 10mg / ml</td>
<td>2 x 5ml ampoule</td>
<td></td>
</tr>
<tr>
<td><strong>Metaraminol</strong> 10mg / ml</td>
<td>1 x 1ml ampoule</td>
<td></td>
</tr>
<tr>
<td><strong>Ephedrine</strong> 30mg / ml</td>
<td>1 x 1ml ampoule</td>
<td></td>
</tr>
<tr>
<td><strong>0.9% saline</strong> 10mg</td>
<td>4 x 10ml</td>
<td></td>
</tr>
</tbody>
</table>

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Rocuronium 10mg/ml, 2 x 5ml ampoule; Atracurium 10mg/ml, 2 x 5ml ampoule; Metaraminol 10mg/ml, 1 x 1ml ampoule; Ephedrine 30mg/ml, 1 x 1ml ampoule; 0.9% saline 10mg, 4 x 10ml.
Tranexamic Acid (TXA) in Major Trauma

1. Tranexamic Acid (TXA) is indicated in the majority of seriously injured patients and all patients with suspicion of, or clinical signs of major haemorrhage.

2. It should be administered as early as possible and within the first 3 hours in all cases.

3. Complications associated with TXA administration are rare, but include risk of venous thromboembolism, hypotension on rapid bolus administration, anaphylaxis (rare).

4. Contraindications include: established disseminated intravascular coagulopathy, known allergy, known ureteric obstruction.

Background

Tranexamic is a synthetic derivative of lysine that inhibits fibrinolysis by blocking the lysine binding sites on plasminogen in the clotting pathway.

The 2010 Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage 2 (CRASH-2) was an international study of 20,207 trauma patients with or at risk of significant haemorrhage. Patients were randomised to double-blind treatment with either tranexamic acid or matching placebo, given within 8 hours of presentation. Tranexamic acid was associated with a 1.5% absolute reduction in mortality compared to placebo, with no increase in the risk of vaso-occlusive events.

The greatest benefit is seen when TXA is administered within the 1st hour after injury, but benefit remains up to 3 hours after injury.

Many patients arriving at hospitals in the Severn Trauma Network will have received TXA in the prehospital setting. The minority that have not should receive TXA, where no contraindications exist as early as possible in the ED admission.

Indications

- TXA should be given to ALL seriously trauma patients with blood loss as evidenced by systolic blood pressure of < 90mmHg or heart rate >110 bpm.
• Major trauma patients with normal physiology should be administered TXA where major injury is assumed to be present on mechanism, clinical examination and radiological findings.

• The best patient tariff recommends TXA within 3 hours of injury

• For any patient at risk of significant blood loss attending North Bristol NHS Trust within 8 hours of injury TXA should be administered if not already received.

Dose & Administration

• Initial loading dose: Tranexamic acid 1g is diluted in 100mls 0.9% saline. It is administered by intravenous infusion over 10 minutes. Infusion pump rate of 600ml/hour or a slow bolus over 10 minutes.

• Second dose: Tranexamic acid 1g diluted in 400mls 0.9% saline over 8 hours. Infusion pump rate of 50mls/hour.

Cautions

Caution should be taken when using TXA in patients with:
• Known allergy to tranexamic acid
• Known ureteric obstruction
• Established DIC

References

1. NICE Guidance: Significant haemorrhage following trauma: tranexamic acid
   https://www.nice.org.uk/advice/esuom1/chapter/Key-points-from-the-evidence

2. Gruen Russell L, Reade Michael C. Administer tranexamic acid early to injured patients at risk of substantial bleeding BMJ 2012; 345 :e7133
   http://www.bmj.com/content/345/bmj.e7133

3. The importance of early treatment with tranexamic acid in bleeding trauma patients: an exploratory analysis of the CRASH-2 randomised controlled trial. The Lancet 2011; 377: 9771, p1096-1101
   http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(11)60278-X.pdf

   http://www.thelancet.com/crash-2-2010
HEMS Direct to CT Pathway

1. HEMS teams familiar with Severn MTC may choose to accompany major trauma patients requiring a full trauma scan as per of their arrival procedure.

2. The pathway must be followed to minimise delays between patient arrival, imaging and handover

3. HEMS should identify any patients for the direct to CT pathway and contact the Trauma Team Leader / EM Red Phone

4. The patient remains under the clinical care of the HEMS team until formal handover in the resuscitation bay following imaging.

Direct to CT applies to the following emergency attendances:

• FAST positive patients through the Stroke Thrombolysis Protocol (not covered further in this document)
• Isolated CT Head for non-trauma patients (HEMS accompanied)
• Full trauma scan in stable major trauma patient (HEMS accompanied)

The ‘Direct to CT’ pathway is a series of steps that should be followed to ensure seamless patient arrival, imaging and handover and to minimise delays.

Before Patient Arrives at Emergency Department

HEMS should identify any patients where direct access to CT is appropriate

HEMS must contact the Trauma Team Leader (TTL) or ED Red Phone and inform of need for direct access to CT
• HEMS should confirm that the patient is stable for scan
• Patient name and DOB, accurate ETA and route of transfer must be provided

The doctor who receives the HEMS pre-alert must:
• Inform reception staff to book-in patient and order required imaging
• Inform CT radiographer and on-call Radiology Registrar that the direct to CT pathway is in place
HEMS crew/paramedics will proceed direct to CT through the ‘far door’.

HEMS crew can acknowledge the receiving clinician (normally the TTL), but no handover is to occur in pit stop. Wristbands will be applied, but no other interventions should be undertaken by the ED trauma team at this time.

HEMS staff will transfer patient off stretcher to CT scan (weight limit 200kg)

The patient remains under the clinical care of the HEMS team before, during and immediately after the scan until the formal handover occurs in the ED Trauma resus bay. The receiving clinician (TTL) may observe the CT to enable contact of further staff if required.

The handover process should not begin until patient in Resus bay; interference must be avoided. No members of the trauma team except the TTL and any trauma team members specifically invited by the TTL should attend CT.

HEMS staff will load the patient from scanner to ED stretcher following completion of CT imaging.

A porter is to be available to drive trolley from CT to Resus bay and leave through the ‘front door’ and proceed to expected patient resuscitation bay.

HEMS will formally handover (ATMIST) the patient to the receiving clinician/TTL in ED Resuscitation bay.
Death & Breaking Bad News in the Emergency Department Following Traumatic Injury

1. Effective & timely communication with patients and their relatives is a crucial element of effective trauma care.

2. A single point of contact should convey information to relatives and patients to avoid conflicting information and mixed messages.

3. Use of a named nurse and a private space within which to hold meetings is best practice for all trauma patients.

4. NBT supports the principle of witnessed resuscitation and family should be offered this if appropriate.

5. Relatives, including children should be encouraged to spend time with the patient prior to transfer to ICU or theatre.

6. All patients with a perceived devastating brain injury where no neurosurgical intervention is planned should be discussed with the ICU Consultant regarding admission to ICU for a period of neuro-prognostication.

7. Where ICU admission for neuro-prognostication is planned no discussion regarding organ or tissue donation should take place in ED. A specialist nurse in organ donation (SNOD) should be contacted to inform them of the admission to ICU.

8. In the rare situation of a decision being made to withdraw life sustaining treatment in ED, two senior clinicians must agree that this is appropriate. In these circumstances, prior to discussing organ donation with the patient’s relatives, a SNOD must be contacted by the trauma team leader.

9. Any discussion about organ donation should be undertaken as a collaborative approach involving the senior clinician, SNOD and a named link nurse.

10. Tissue donation should be considered following the death of any patient in the ED.
Effective and timely communication with relatives is crucial. Key points include:
Conversations with family members should take place in a room offering privacy and space with refreshment facilities available. Information should be provided in a timely and open manner including details of their relatives condition, possible outcomes, assurances their relative is not experiencing pain or distress and an indication when death is imminent. Regular updates of a patient’s condition should be provided. Where indicated, interpreters should be used

Communication between staff members is essential to prevent conflicting information being provided. A named link nurse to support relatives and act as an advocate for the relative(s) is essential

NBT supports the principle of witnessed resuscitation; this should be offered where appropriate. Offer relatives the opportunity to spend time with the patient before transfer to ITU or theatre, even if this is only for a brief period. Children should not be excluded as they may imagine a situation far worse than the reality.

Following death, relatives should be allowed to ‘say goodbye’. Offer support from appropriate faith or religious leaders (available via switchboard). This may provide support to relatives whilst the patient is in theatre or following death

Planned Withdrawal of Life-sustaining Treatment

Where withdrawal of life sustaining treatment is considered the following steps should be taken:
Any patient where withdrawal of life sustaining therapy is being considered should be discussed with the on call ICU Consultant so that an appropriate management plan and location can be agreed.

All patients with a perceived devastating brain injury where no neurosurgical intervention is planned should be discussed with the on call ICU Consultant regarding admission to ICU for a period of neuro-prognostication.
Where ICU admission for neuro-prognostication is planned this should be explained to relatives but no discussion regarding organ donation should take place. A SNOD should be contacted to inform them of the admission to ICU.

No discussion about organ donation should take place in the ED when an ICU admission is planned. Rarely a SNOD may initiate this discussion in the ED if felt appropriate by the SNOD and senior clinician responsible for the patient in the ED.
In the rare situation of a decision being made to withdraw life sustaining treatment in ED, two senior clinicians must agree that this is appropriate. This will normally be the Trauma Team Leader and ICU Consultant.

When withdrawal of life sustaining treatment is planned to take place in ED, a SNOD **must** be contacted by the Trauma Team Leader prior to discussing organ donation with the patient’s relatives. Every reasonable effort must then be made to wait for the SNOD to attend before initiating a discussion about organ donation with a patient’s relatives.

A SNOD should be contacted on the following pager - 07659 591 642, in all cases where organ donation is being considered. The Organ Donation Register should also be checked (01179 757 580).

If an approach for organ donation is undertaken in the ED a **planned, collaborative approach involving the senior doctor, SNOD and named linked nurse** should be undertaken.

Any discussion regarding organ donation **must** be separated from information regarding prognosis. This ‘de-coupling’ of ‘breaking bad news’ and an approach regarding organ donation allows relatives time to begin to understand the position their relative is in. Organ donation must not be raised until it is clear that relatives have understood and accepted the clinical situation.

A green folder containing information relating to organ and tissue donation can be found in the office behind ‘see and treat’. Information is also available on the intranet or from the SNOD.

Tissue Donation (corneas, heart valves) must be considered in all patients after death (24 hour National Referral Centre – 0800 432 0559).

**Following Death**

Verification of death must be completed as per NBT policy and documented on NBT verification of death paperwork

All deaths must be reported to the coroner by way of a hospital death report which should be completed by the TTL. Reception staff will fax this to the coroner.

Nursing staff must complete a deceased patient record which ensures GP’s are notified and information collated for follow-up and audit

In the event of a paediatric trauma/death, ‘Form A’ - notification of child death, must be completed. The consultant community paediatrician (contacted via BRI switchboard - 76100) and Ann Fry (named nurse for child protection- 0117 323 2363) must be contacted

Relatives should be given the ‘When Someone Dies’ leaflet. This contains practical guidance and details of support services. A member of the bereavement team will contact a deceased’s family for follow-up and support

Any further information or guidance required please speak to the ED nursing team who are experienced and trained in ED bereavement care.
References

1. End of Life Care for Adults in the Emergency Department, Royal College of Emergency Medicine Best Practice Guidance, March 2015

Airway & Anaesthesia
1. Emergency anaesthesia for the major trauma patient is a high risk intervention that has significant potential benefits.

2. The anaesthetist attending a major trauma will be a minimum of ST5 in their training and will have received appropriate orientation to this document and the resuscitation bays.

3. RSI is indicated when the benefits outweigh the potential risks – this is a clinical judgement. The decision to RSI will be made by the Trauma Team Leader and the trauma team anaesthetist(s).

4. It is strongly recommended that ketamine is used as the induction agent of choice in major trauma.

5. Vasopressors should be avoided in the acute phase of major trauma in all but the most exceptional circumstances; preference is for blood product transfusion and balanced anaesthesia.

6. In almost all trauma patients, it will not be appropriate or possible to wake the patient or reverse muscle relaxants once administered. In the event of airway difficulty, The relevant DAS algorithms should be adhered to.

7. In addition to standard intubating equipment, consideration of videolaryngoscopy and equipment for Plan B & Plan D CICV must be confirmed in all cases.

**Background**

Rapid sequence induction of anaesthesia (RSI) in major trauma is performed to prevent aspiration of gastric contents in patients who are inadequately starved; to stabilise physiology; and to facilitate investigation and treatment. The essential features of RSI are safety, pre-oxygenation, intravenous induction (using a pre-determined induction dose), insertion of a tracheal tube prior to mechanical ventilation of the lungs and transfer to radiology or definitive care. It is imperative to avoid hypoxia, hypercarbia, hypotension and aspiration during the procedure. Emergency anaesthesia for the major trauma patient is a high risk intervention that has significant potential benefits. If performed poorly, anaesthesia in the non-theatre environment for a patient population that often have unstable cardiovascular and respiratory systems can result in unnecessary morbidity and mortality.
The purpose of this standard operating procedure is to provide a consistent, standardised approach to emergency anaesthesia in major trauma, reducing the cognitive load and the potential for human error and avoiding significant patient harm.

The anaesthetist attending a major trauma will be a minimum of ST5 in their training and will have received appropriate orientation to this document and the resuscitation bays. They are part of the major trauma bleep, but can be contacted on bleep 9034 if they have not attended or a trauma call has not gone out.

**Indications for RSI**

RSI is indicated when the benefits outweigh the potential risks – this is a clinical judgement. The decision to RSI will be made by the Trauma Team Leader and the trauma team anaesthetist(s).

Possible indications for RSI include, but are not limited to, the following categories:

A. **Airway** – Obstruction or impending obstruction. This would include a reduced conscious level with loss of airway reflexes, seizures resistant to treatment or head injuries. A **Glasgow Coma Score (GCS)** less than 15 is an indication to consider RSI to optimise oxygenation and ventilation. A **GCS <9** is significant and mandates RSI in all but the most exceptional of cases.

B. **Breathing** – Oxygenation and ventilation are inadequate or potentially inadequate.

C. **Clinical course** – e.g. the patient with multiple contaminated open fractures that will be heading to theatre imminently; anaesthesia will facilitate further investigation and management.

In massive haemorrhage, anaesthesia will allow continued resuscitation, but consideration should be given to administration of blood products to counteract the instability of induction. In some circumstances anaesthesia can be administered for humane reasons, e.g. extreme pain from significant burn injuries, or highly agitated or combative patients in whom anaesthesia will facilitate further management.

In making the decision to perform an RSI, numerous risks must be considered:

- **Anticipated Difficult Airway**: any indication of a difficult airway pre-induction will have to be carefully considered.
- **Anxiety of the Intubator**: anxiety for any reason can affect judgement and performance; this will clearly hamper the RSI process and further increase the possibility of harm.
- **Personnel** - Are the most appropriate personnel available to perform the procedure? If not how long until they are available?
- **Resources** – Are any additional resources essential to the process that are not present?
Briefing:
• When responding to a major trauma the trauma team leader will provide a briefing of the inbound patient.
• It may be possible after the initial brief to determine if anaesthesia is required. At this time the RSI checklist can be used to guide preparation (Appendix G, page 253).
• It is the responsibility of the anaesthetist to check the presence of equipment they may wish to use.

Environment:
• The majority of major trauma patients are received into a resuscitation bay in the Emergency Department. (Appendix C, page 233) Ensure there is 360-degree access to the patient to allow for further interventions as required (e.g. thoracostomy)
• Low noise level – allows effective team communication.

Identify roles:
• Manual in-line stabilisation, if suspected cervical injury.
• 1st Intubator
• 2nd Intubator (Either Bleep 9030 anaesthetic consultant or TTL)
• Airway Nurse – airway equipment, cricoid pressure and external laryngeal manipulation.
• Drug delivery

Monitoring:
• Full monitoring (ECG, NIBP, SpO₂, EtCO₂). Ensure monitoring is switched on, particularly the End tidal CO₂ module as it takes 1-2 minutes to warm up.
• Do not delay RSI for insertion of arterial line.

Equipment

Suction:
• Confirm suction is working with appropriate sized “yankauer” suction catheter attached and placed on the right hand side of the patients’ head. It may be appropriate to arrange for a second suction unit to be available if significant, hard to manage, airway soiling is anticipated e.g. maxillofacial trauma.
Ventilator:
- The trauma resuscitation bays have a Dräger Oxylog 3000 ventilator.
- The ventilator should be tested prior to use.
- Confirm suitable initial settings for the patient: e.g. tidal volumes of 400mL, respiratory rate 18 breaths/minute, PEEP 5cmH₂O, on a Continuous Mandatory Ventilation setting. The aim is to achieve tidal volumes of 6mL/kg (ideal body weight) with a minute ventilation appropriate to the desired EtCO₂.
- Note the peak pressure at commencement of ventilation, adjusting pressure alarms accordingly. Change in peak pressure is an early indication of expanding pneumothoraces, or spontaneous breath attempts.
- Ensure correct tubing is attached and the circuit tested for any leaks.
- Ensure a self-inflating bag with oxygen tubing is immediately to hand, in case of ventilator failure.

Videolaryngoscope:
A CMAC videolaryngoscope is available; if it is not immediately available in the emergency department contact the anaesthetic co-ordinator (Bleep 9666) to borrow from Level 2 theatres. Arrange early to avoid delay.

Airway equipment: should be placed on top of the airway trolley ready for use.

Minimum layout:
- Laryngoscope x 2 [size 3 and 4 blade]
- Bougie - routinely used in all emergency department intubations.
- Tracheal tube with subglottic suction port, endotracheal cuff tested (7.0mm ID ETT for female and 8.0mm ID ETT for male).
- Catheter mount and HME filter
- 10 ml syringe
- Alternative smaller tracheal tube.
- 2 x nasopharyngeal airways
- 1 x oropharyngeal airway
- Bag-mask connected to O2 tubing, side stream EtCO₂ attached.
- (Mapleson “C” circuit available if desired)
- Nasal cannula

Confirm availability of:
- Airway “Plan B” – Supraglottic Airway device (I-gel)
- Alternative laryngoscope [alternative blade size/type].
- Anticipated difficult airway equipment e.g. C-Mac.
- Airway “Plan D” - Difficult airway kit [surgical airway]
Induction drugs and dose will be based on clinical assessment and practitioners experience of their use. This must include consideration of drugs recently given for analgesia and procedural sedation in the pre-hospital phase of care.

It is strongly recommended that ketamine is used as the induction agent of choice in major trauma due to its’ relative haemodynamic stability and wide therapeutic margin. A 10-20% context specific overdose is unlikely to cause harm.

**The following regimes are strongly recommended:**

- **Standard “3:2:1”** - Fentanyl 3mcg/kg, Ketamine 2mg/kg and Rocuronium 1mg/kg
  Consideration to slight delay (approx. 30-60 seconds) between drugs (dependent on the patient’s clinical condition) to allow the drugs to achieve maximal effect at the point of intubation

- **Hypovolaemic “1:1:1”** - Fentanyl 1mcg/kg, Ketamine 1mg/kg and Rocuronium 1mg/kg
  If severe hypovolaemia is suspected fentanyl may be omitted, in some circumstances it may be appropriate to administer a paralysing agent alone. Simultaneous administration of blood products to support blood pressure is strongly recommended rather than vasopressor/ inotrope use.

**Rescue drugs**

Vasopressors should be avoided in favour of appropriate induction/ maintenance doses and blood products. The use of vasopressors for the management of hypotension due to hypovolaemia in trauma is associated with increased mortality. In exceptional circumstances vasopressors and inotropes are available in the emergency department.

**Suggamadex is available from level 2 theatres if anaphylaxis to rocuronium is suspected.**

**Specific circumstances**

On occasion it may be appropriate to use a propofol/opiate based induction regime. E.g. Isolated head injuries.

**Procedural sedation to facilitate induction**

Some patients may be agitated and uncooperative. They will require incremental sedation to facilitate pre-oxygenation and induction. Small doses of the planned induction drug e.g. 10-20mg Ketamine boluses titrated to effect. 1-2mg Midazolam can be used, particularly in head injured patients. In all cases caution must be exercised and you must be in a position to immediately maintain the airway and provide ventilation.
Maintenance
Continued fentanyl boluses and Propofol infusions are available for maintenance of anaesthesia. The CT scanner is close to the resuscitation bays: Do not delay a transfer to scan to await infusions to be commenced. If not immediately available maintenance can be achieved with ongoing boluses of ketamine (10min intervals) and opiate. Alternatively, a fentanyl midazolam “bolus” regime can be used.

Regular administration of muscle relaxants is appropriate in major trauma patients.

Patient Preparation

Optimal positioning for patient:
- In the trauma patient with possible C-spine injury the head should be placed in the neutral position with manual in line immobilisation, and any spinal immobilisation (including collars) removed.
- The obese patient may require “ramping” with head and chest elevated above the level of the patient’s navel.

IV/IO Access:
- Ensure two large bore intravenous access are inserted, patent, flushed and accessible. Intraosseous devices can be used for all anaesthetic drugs in the event of inadequate IV access. Ensure all drugs are flushed in. Ensure IO insertion site is appropriate to the pattern of injury. e.g. humeral in presence of pelvic injury. An alternative option is insertion of a wide bore subclavian line.
- Simultaneous resuscitation with blood products may be required for haemodynamically compromised patients.

History & Examination:
Any history and examination are ideally performed before anaesthesia, but in some cases the urgency for airway control will take precedence. Minimum information prior to RSI should include:
- Glasgow Coma Score
- Pupillary size and response
- Any evidence of chest injuries. (Anticipating the need for thoracostomies).
- Abdominal tenderness and guarding
- Neurological function distal to significant limb injury
- Limb movement
Predicting a difficult airway:

- History of Ankylosing spondylitis, Rheumatoid arthritis, previous head and neck cancer/surgery
- Morbid obesity, prominent upper incisors, receding mandible.
- Facial trauma or excessive bleeding
- Neck trauma (haematoma), burns to neck or face.

Pre-oxygenation:

- For 3 minutes, by bag valve mask (BVM) or Waters circuit.
- If agitated: face mask with reservoir bag +/- incremental sedation (midazolam or ketamine, followed by subsequent reduction in induction drug doses).
- In instances of respiratory distress augmentation of ventilation with BVM can be used, but is often difficult.
- Pre-oxygenation with significant maxillofacial injuries should be done in a comfortable position for the patient, but such that they can rapidly be re-positioned to facilitate intubation.
- Apnoeic oxygenation via nasal cannulae. On induction of anaesthesia flow is increased to 15 l/min.

Conduct - Predicted Steps in Process

Decision to RSI

- Appropriate people alerted
- Pre-oxygenation commenced
- Equipment assembled
- Challenge response checklist (Appendix G, page 253)
- Induction drugs administered
- Nasal cannula to 15l/min
- Cricoid pressure (if used)
- Laryngoscopy and intubation
- Confirm tracheal tube placement and secure
- Cricoid pressure released
- Patient assessment performed
- Prepare for transfer
Perform a rapid re-assessment of Airway, Breathing, Circulation and Disability.
The following should be actioned and communicated to the TTL and scribe:

- Confirmation of tracheal tube position: Bilateral chest movement, auscultation, continued CO2 trace on monitor and direct visualisation at the time of intubation.
- Monitor values: SpO2, NIBP, ECG, EtCO2, peak ventilation pressures and minute ventilation.
- Set NIBP to a 1 to 2.5 minute cycle. This often requires repeating as the monitor resets when disconnected from the base unit.
- ANY subsequent changes to ventilator settings or maintenance drugs
- Complete RSI audit form.

Emergency Actions

Anticipated or Unanticipated Difficult Intubation:
- As per the difficult airway society guidelines (Appendix H, page 254)
- In the majority of trauma patients reversal of the muscle relaxant is not an option.
- “Can’t intubate, CAN ventilate”: a supraglottic device can be used temporarily.
  “Can’t intubate, CAN’T oxygenate”: A SURGICAL AIRWAY is an appropriate solution.
- Any additional “difficult airway” equipment, is available via the theatre co-ordinator or on-call anaesthetic assistant lead. Delay in procuring equipment needs to be balanced against the urgency of the anaesthesia requirement.

Desaturation:
- Confirm oxygen supply by tracing from cylinder to tracheal tube.
- Confirm correct tube placement with EtCO2 and auscultation of the chest
- Confirm adequate cardiac output – NIBP, pulse, EtCO2
- Exclude/ treat pathology:
  - Pneumothorax +/- tension (Often predictable, peak pressures/ minute ventilation on ventilator may suggest a problem)
  - Anaphylaxis
  - Bronchospasm of other cause e.g. asthma
  - Malignant hyperpyrexia
**Hypotension:**
Exclude the following causes of hypotension post induction:

- Drug induced vasodilation.
- Tension Pneumothorax.
  - Treatment involves finger thoracostomy anterior to the mid axillary line in the fourth intercostal space on the affected side.
  - If suspected and unilateral decompression does not relieve the problem repeat on the opposite side of the chest.
  - If performed in a sterile manner with skin prep the thoracostomy may be converted to a formal chest drain.
- Hyperventilation
  - In low cardiac output states raised intrathoracic pressure impedes venous return and hence a hypotensive state ensues. The effect can be reduced with reduction of PEEP, early bolus of blood products, and pressure limiting the ventilator.
- Myocardial impairment
  - Direct injury, hypovolaemia, pericardial effusion.
Emergency Surgical Airway

1. This guideline is to be used in conjunction with the Emergency Anaesthesia SOP to provide a consistent, standardised approach to performing an emergency surgical airway.

2. Emergency surgical airway may be needed either following failed intubation in the “can’t intubate can’t oxygenate” situation or where initial intubation is not possible and oxygenation is not possible by other means.

3. Surgical airway equipment should be removed from the drawer in the difficult airway trolley when it is anticipated that an airway will be particularly difficult.

4. The DAS unanticipated difficult intubation algorithm should be followed in call cases.

Background

The purpose of this standard operating procedure, in conjunction with the emergency anaesthesia SOP is to provide a consistent, standardised approach to performing an emergency surgical airway. This may need to be performed either following failed intubation in the “can’t intubate can’t oxygenate” situation or where initial intubation is not possible and oxygenation is not possible by other means.

Surgical Cricothyroidotomy

The surgical airway equipment should be removed from the drawer in the difficult airway trolley when it is anticipated that an airway will be particularly difficult. For example:

- Airway trauma
- Difficult anatomy
- Burns to face and neck precluding jaw movement
- Possible airway burns
- Severe maxillo-facial trauma

The technique suggested minimises two commonly encountered problems namely bleeding from the incision and loss of the incision into the airway before or during tube insertion. It differs slightly from the DAS algorithm.
Method

- Extend the patient's neck as much as feasible. In this setting, airway management should take precedence over the risk of cervical spine instability.
- Insert a number 22 scalpel blade horizontally into the cricoid membrane using a “stab / rocking” technique.
- Leave the blade in position until the tips of a tracheal dilator are pushed into the airway incision on either side of the blade and opened as widely as possible.
- Remove the scalpel blade, rotate the tracheal dilators 90 degrees (handle caudally, jaws cranially). Keep the jaws wide open throughout. This will facilitate easier passage of the endotracheal tube.
- Insert a 6.5mm cuff tracheal tube (over a lubricated intubating bougie if necessary) into the hole held open by the dilators.
- Inflate the cuff, confirm tube position in the normal way and commence ventilation.
- Fix the tube into position with a tie or Elastoplast.
- The procedure should take around 30 seconds.

Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults


1. Initial assessment of maxillofacial injury should be done by Emergency Department staff.

2. There must be an assessment for cervical spine injury. This must be clearly documented in the medical notes and discharge summary.

3. Specific imaging is required for maxillofacial injuries. Full imaging requirements are described in the guidelines below.

4. The on-call maxillofacial surgical team, based at the BRI, are available 24/7 through switchboard – full contact information outlined below.

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**Maxillofacial Contact Information**

On call Maxillofacial Surgical team available 24/7.

**Based at the BRI, but can assess patients at Southmead**

Please allow travel time as team may be required to operate at BRI, Children’s Hospital or Bath.

**Contact through switchboard**

Rota is with switchboard of Southmead and UHB.

If no reply from 1\textsuperscript{st} on call then move up to 2\textsuperscript{nd} on call then 3\textsuperscript{rd} (consultant) as team may be between hospitals or operating.

Registrar and Consultant on call 1700 – 0900h. Before then 1\textsuperscript{st} on call will discuss with available OMFS registrar/consultant at closest relevant hospital.

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**Mandibular Fractures**

Patient assessed by ED staff.

**Assessment for cervical spine injury:** If none, then document in medical notes and in discharge summary – as these may be all we get on transfer.

**Imaging:** OPG and PA mandible (lateral obliques of mandible left and right sides NOT acceptable instead).

**Definitive diagnosis made.**

**Discuss with on call OMFS team.**
Ideal surgical intervention is within 24 hours.

- If concomitant injuries for management at Southmead then maxillofacial team will need to operate there.
- Otherwise immediate transfer to BRI and commence intravenous antibiotics (co-amoxiclav 1.2g IV TDS) and preparation for surgery the next day.

The maxillofacial team will arrange CT for complex comminuted fractures and condyle fractures if further imaging required.

Complex Facial Trauma

10% chance of cervical spine injuries – this must be assessed and outcome clearly documented in medical notes and discharge summary.

Any patient undergoing CT scan for c-spine with facial injuries should have the same scan protocol extended cephalad to include the full face and cranium IN THE SAME SCAN (Fine cut hard tissue window CT from inferior border of mandible to vertex of cranium).

- This is a hard tissue sequence and whilst the soft tissues are represented poorly this is sufficient for maxillofacial needs and minimises radiation dose.

There is no need for additional soft tissue scans; adding craniofacial structures to hard tissue CT scans gives adequate information for operative planning and patient management and minimises radiation exposure.

- Radiography teams are often unwilling to increase radiation doses by automatically scanning the face; this delays intervention and management planning and also increases dose due to subsequent rescan later.

Admit at Southmead for 24 hour neurological observations if head injury or other injuries, or discuss with on call OMFS team as to whether to transfer to BRI if not concomitantly injured.

If soft and hard tissue injuries please do not arrange soft tissue closure by another team prior to maxillofacial team assessment. We will undertake this after complete assessment of injuries.
**Orbital Fractures**

**Imaging:** CT fine cut scans through the orbits and reconstructed in sagittal and coronal views. Ophthalmic and orthoptic assessment referral made. Discuss with on call OMFS team.

**IF retro bulbar haemorrhage** urgent OMFS review at Southmead or BRI. Otherwise review in 3-5 days maxillofacial clinic.

---

**Zygomatic Arch and Body Fractures**

**Patient assessed by ED staff.**

**Assessment for cervical spine injury:** if none, then document in medical notes and in discharge summary.

**Imaging:** PA face, Occipitomental (OM) 15 degrees, OM 30 degrees and submentovertex views

**Definitive diagnosis made.**

**Ideal surgical intervention is within 2 weeks.**

Discuss with SHO OMFS on call and arrange follow up 3-5 days later in maxillofacial clinic.

Instruct patient not to blow nose (as surgical emphysema can be caused periorbitally). Usually no antibiotics are required.

**IF orbit involvement** i.e. obvious clinical indications of eye / orbit involvement

- CT orbits with coronal and sagittal reformat if orbit involvement
- If any doubt then discuss with on call OMFS team who may choose to order at review appointment.

---

**Nasal Bone Fractures**

**Imaging not required**

**Review:** Maxillofacial clinic in 3-5 days
Naso-orbitoethmoid Fractures

Patient assessed by ED staff.
Assessment for cervical spine injury: if none, then document in medical notes and in discharge summary.
Imaging: Fine cut CT from inferior border of mandible to vertex of cranium.

Admit at Southmead for 24 hour neuro obs if head injury otherwise discuss with on call OMFS team as to whether to transfer to BRI if isolated injury.
Ophthalmic and orthoptic review.

Cranial Fractures

Imaging: Hard tissue windows cranial vertex down including skull base (and facial bones if involved) as part of CT brain.

Discuss with Neurosurgical team at Southmead.

If facial injuries also: discuss with OMFS team on call, who will need to assess on neurosurgical ward at Southmead.

Dentoalveolar Fractures

OPG (and/ or dental periapicals in the morning maxillofacial clinic). Call on call OMFS team as may require transfer to BRI for dental splinting.
Airway & Anaesthesia References

Emergency Anaesthesia for Major Trauma:

Emergency Surgical Airway:
1. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults
   https://www.das.uk.com/guidelines/das_intubation_guidelines

Oral and Maxillofacial Injuries:
   https://www.ncbi.nlm.nih.gov/pubmed/27162439#
THORACIC TRAUMA
Management of Chest Injuries in Major Trauma

1. Perform imaging urgently. Use CT for stable patients and Chest x-ray/eFAST for those with severe respiratory distress and/or haemodynamic compromise.

2. Chest decompression should be performed with finger thoracostomy followed by chest drain insertion; needle decompression is not adequate. Timing of chest drain insertion (following finger thoracostomy) will depend on clinical situation.

3. Treat open chest wounds (open pneumothorax) with a simple occlusive dressing (not 3-sided) and observe closely for development of tension pneumothorax.

4. Where indicated (following assessment), aim to insert epidurals for rib fracture analgesia within 6hrs.

5. Ensure that a large bore chest drain (32-36Fr) is inserted where needed for massive haemothoraces or haemo-pneumothoraces.

6. Without an appropriate onwards ‘chain of survival’ resuscitative thoracotomy would be a futile procedure and should not be performed.

7. The thoracic team must to be contacted urgently as soon as the decision has been made to proceed to thoracotomy.

Background

Major chest injuries and their prevalence:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tension Pneumothorax</td>
<td>1 in 250 (0.4%)</td>
</tr>
<tr>
<td>Open Pneumothorax</td>
<td>1 in 10,000 (0.01%)</td>
</tr>
<tr>
<td>Massive Haemothorax</td>
<td>1 in 1000 (0.1%)</td>
</tr>
<tr>
<td>Flail Chest (includes &gt;3 rib fractures)</td>
<td>1 in 50 (2.2%)</td>
</tr>
<tr>
<td>Cardiac Tamponade</td>
<td>1 in 1250 (0.08%)</td>
</tr>
</tbody>
</table>
Chest injuries contribute significantly to preventable death from major trauma. Identification of a significant chest injury relies upon information obtained from the mechanism of injury, patient physiology, clinical signs and radiological evidence.

A patient with multiple injuries (including the chest) should have their airway secured prior to performing any chest procedures in order to optimise oxygenation and ventilation. Concurrent volume resuscitation (with blood products) may be needed to prevent deterioration in a hypovolaemic patient’s physiological state with positive pressure ventilation.

Initial Assessment and Investigation

- Ensure airway patent, high flow O2 delivered and monitoring attached
- Primary Survey should seek the following:
  - Inspection - asymmetry of chest expansion, signs of external injury and wounds, paradoxical chest movements, respiratory rate and pattern.
  - Palpation – tenderness, tracheal deviation, crepitus. Remember to palpate posteriorly.
  - Percussion - dull or hyper-resonant percussion note (poor diagnostic accuracy)
  - Auscultation – asymmetry of air entry
- Consider immediate chest x-ray and/or eFAST (extended focused assessment with sonography for trauma) as part of the primary survey to assess chest trauma in adults (16 or over) with severe respiratory compromise. (NICE)
- Consider immediate CT for adults (16 or over) with suspected chest trauma without severe respiratory compromise who are responding to resuscitation or whose haemodynamic status is normal. (NICE)
- Consider chest x-ray and/or ultrasound for first-line imaging to assess chest trauma in children (under 16s). Do not routinely use CT as first-line imaging to assess chest trauma in this age group. (NICE)
- CT is the gold standard investigation and should not be delayed if physiology is stable.

Pneumothorax: Simple

- A non-expanding collection of free air in the pleural space leading to a degree of lung collapse.
- Features may include: crepitus, chest pain, hyper-resonance to percussion and decreased air entry on affected side.
- Large simple pneumothoraces should prompt chest drain insertion especially in presence of respiratory compromise.
• Small simple pneumothoraces, especially those only visible on CT, may be observed. This will depend, however, on the patient's condition and subsequent course. Chest drain insertion should be considered if:
  ▪ there are multiple injuries
  ▪ the patient is due to undergo prolonged anaesthesia/positive pressure ventilation
  ▪ the patient is due to be transferred a significant distance or by air, potentially resulting in delayed or impaired recognition of enlarging or tensioning pneumothorax.
• In major trauma, even small simple pneumothoraces must be vigilantly observed. Deterioration should prompt urgent treatment and exclusion of tension pneumothorax.

<table>
<thead>
<tr>
<th>Pneumothorax: Tension</th>
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</table>

• A progressively expanding collection of free air in the pleural space, usually due to a lung laceration which allows air to escape but not return, like a one-way valve. This increase in intrathoracic pressure is often exacerbated by positive pressure ventilation and is usually associated with cardiovascular instability/collapse.

• Features are the same as for simple pneumothorax as well as: haemodynamic instability, tracheal deviation away from affected side, mediastinal shift on chest x-ray, severe respiratory distress and increased central venous pressure.

• **In patients with a tension pneumothorax, perform chest decompression using open thoracostomy followed by chest drain.** (NICE)

• In patients with tension pneumothorax, perform chest decompression before imaging only if haemodynamic instability or severe respiratory compromise.

• Tension pneumothorax is more likely to occur with positive pressure ventilation. Onset in ventilated patients is usually rapid and accompanied by hypotension, tachycardia, falling oxygen saturations, falling cardiac output and increasing inflation pressures. Cardiac arrest will follow shortly if not identified and treated quickly.

• Needle decompression may be attempted as a first line intervention only on the rare occasion that tension pneumothorax is suspected but equipment is not immediately available for thoracostomy.

• Needle decompression should be performed using a 14G cannula in the 2nd intercostal space in the mid-clavicular line on the affected side. If decompression is unsuccessful then a second attempt may be made laterally in the 5th intercostal space, just anteriorly to mid-axillary line.
Needle decompression has a high failure rate (40-60%) due to many factors – cannula obstruction by blood, tissue, kinking and failure to reach pleural space. Hence, *thoracostomy is the first line intervention for Tension Pneumothorax.*
A large open defect in the chest wall (>1/3 diameter of tracheal lumen) resulting in equilibration between intrathoracic and atmospheric pressures. The lung is unable to properly inflate on affected side due to lack of negative intrathoracic pressure.

Also known as a ‘sucking chest wound’. Common causes include stabbing, blast or ballistic injuries. Accompanied by haemothorax 75% of the time and may progress to tension pneumothorax – especially after being covered.

Features include: Large sucking/bubbling chest wound and other features of (underlying) pneumothorax as described above.

Management consists of covering the wound with a simple occlusive dressing (not 3-sided) and observing closely for development of tension pneumothorax. (NICE)

**Indications for finger thoracostomy & chest drain insertion**

- Clinical evidence of tension pneumothorax
- Clinical or USS or CXR evidence of traumatic pneumothorax in an intubated and ventilated patient (it is reasonable to observe small pneumothoraces detected on CT, to avoid unnecessary drainage, unless the patient is to be transferred by air)
- Critical hypovolaemia (SBP <90 mmHg) and/or low SpO2 associated with chest injury
- Clinical or USS or CXR evidence of haemothorax (having established resuscitation)
- Cardiac arrest secondary to trauma (bilateral decompression indicated)

**NOTE:** A simple pneumothorax can rapidly progress to a tension pneumothorax after the application of positive pressure ventilation, indicated by unexplained hypoxia or hypotension, asymmetry of chest movements and high peak airway pressures. A right main bronchus intubation can be misinterpreted as a pneumothorax. The endotracheal tube (ETT) position should be checked prior to decompression of the chest.
The procedure is a 2-stage approach:

- The rapid decompression of the chest with a finger thoracostomy (should be achieved within 90 seconds of confirming ETT position).
- The careful placement of a chest drain in the appropriate position

Finger thoracostomy consists of the following basic steps:

- Preparation & Positioning
- Incision
- Blunt dissection
- Finger sweep

If chest drain insertion is indicated the above steps are followed by:

- Chest drain insertion
- Chest drain securing

---

### Procedure for Chest Drain Insertion

#### Finger Thoracostomy

**Preparation & Positioning (page 79, Figures 1-4)**

**Equipment required:**

- Sterile gloves and gown
- 2% chlorhexidine and gauze
- Large scalpel (i.e. size 22)
- Spencer Wells forceps (8”)
- Chest Drains (28-32Fr in Adults)
- Closed underwater seal (containing sterile water up to marker)
- Connecting tubing
- Suture (2-0 silk)
- Gauze, Large Tegaderm dressings and insertion stickers

Full monitoring must be applied (as per Association of Anaesthetists of Great Britain & Ireland guidelines) and oxygen delivered (15 l/min via non-breathing facemask in the spontaneously breathing patient).
Analgesia and Sedation:
- In awake patients local anaesthetic infiltration and procedural sedation with ketamine (0.2-0.5 mg/kg) +/- midazolam (1-2 mg) should be used.
- The recommended maximum dose of lidocaine is 3 mg/kg without adrenaline and 7 mg/kg with adrenaline. 20 ml of 1% lidocaine is safe in the majority of patients.

Positioning:
- With the patient supine or in semi-recumbent position, abduct the arm on the operative side to 90 degrees (or if able, place the hand behind the head).
- Cleaning the skin with 2% chlorhexidine.
- Identify the “triangle of safety” defined by the lateral border of pectoralis major, anterior border of latissimus dorsi and the 5th intercostal space.

Incision (page 79, figures 4 & 5)
- The incision should be made at the lower border of the target intercostal space.
- Dissecting over the upper border of the rib reduces the chance of damaging the neurovascular bundle that lies on the inferior border of each rib in the intercostal groove.
- A 3-5cm incision is made in line with the upper boarder of the 4th or 5th intercostal space in line with the rib below.
- The incision must be long enough to easily accommodate the gloved finger and Spencer Wells forceps.
- In very obese patients and those with is extensive surgical emphysema the distance to the thoracic cage will be increased and a longer incision may be required.

Blunt dissection (page 79, figures 6 & 7)
- Blunt dissection should be used to enter the pleural cavity to reduce the risk of damage to underlying structures.
- This should be performed with Spencer Wells forceps.
- For speed this can be achieved by holding the closed forceps at the central hinge, placing them into the incision, walking them off the superior aspect of the rib below and firmly pushing forward until the pleura is breached.
- The forceps should then be rubbed forward and backward along the superior boarder of the to strip the intercostal muscle from the periosteum.
- Finally opening the forceps wide in 2 planes before withdrawing to enlarge the tract.
- This may result in a hiss of air or gush of blood if the contents of the chest cavity are under tension. An open pneumothorax has now been created.
- The gap in the muscle and pleura must be sufficient to accept a gloved finger.
Finger sweep (page 80, figure 8)

- Gently insert a gloved finger along the tract into the pleural cavity (if it has been technically difficult the forceps can be left in situ to act as a guide for the finger).
- Once in the pleural cavity the finger is gently rotated to feel for the lung.
- If the lung is inflated and ventilating properly it will be felt to move against the gloved finger with each breath.
- The finger sweep also allows for the detection of other structures that may be palpable following significant trauma e.g. bowel (due to rupture of the diaphragm).
- Additionally, it may help free any adhesions present from previous pleural pathology.
- **Care should be taken during the finger sweep as fractured rib ends are exceptionally sharp and can result in injury to the operator.**
- If the thoracostomy is performed during active chest compressions the finger can be pinched during compression when the intercostal spaces close down.
- The finger thoracostomy is now complete. Do not dress or occlude the incision in an intubated patient.
- If the pneumothorax recurs and begins to tension the finger sweep will need to be repeated.
- If a chest drain is to be inserted a finger can remain in situ to keep the tract patent.

### Chest Drain

**Insertion**

In a spontaneously breathing patient the thoracostomy has created an open pneumothorax and this now needs to be sealed to allow the lung to expand effectively.

**This is accomplished by the insertion of a chest drain:**

- 28 Fr drain for males
- 24 Fr drain for females
- 20 Fr for slight / very thin patient

Grasp the end of the drain through its distal side port, with Spencer Wells forceps.

Maintain the tract through the chest wall with a finger

Slide the drain then slid into the pleural cavity alongside finger.

If inserting the drain for a pneumothorax the tip should be guided apically and anterior to the lung.

Haemothoraces should be drained with a drain placed posteriorly and inferiorly.

The drain should be gently inserted until all drainage holes are within the pleural cavity. The drain has centimetre markers to guide insertion distance.

The drain can then be connected to the underwater seal to check that it swings (with the respiratory cycle) and bubbles (if a pneumothorax is present), indicating ‘correct’ positioning.
Securing
The chest drain must be well secured. The drain should be anchored to the surrounding tissue with a strong suture (i.e. 2/0 Silk). If the incision is large, simple interrupted stitches may also be needed to close the wound. A horizontal mattress stitch should be placed (but left untied) at the time of insertion; this is used to aid closure of the wound once the drain is removed. A small gauze with a Y-cut should be placed over the incision site and drain and transparent, occlusive dressings (i.e. large tegaderm) applied on either side of the drain to create a trouser effect. An ‘omenta’ 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.

Further considerations
The position of the drain should be checked with CXR or CT
Critical hypovolaemia (SBP <90 mmHg in an adult) and a significant output of blood from the drain should prompt urgent thoracic referral as the patient may need an emergency thoracotomy in theatre.
A chest drain should never be clamped
If the procedure is not possible in the conventional position other sites can be considered. Of these, the 2nd intercostal space in the anterior mid-clavicular line is probably safest for thoracostomy and chest drain insertion.

Antibiotics
Prophylactic antibiotics are indicated for trauma related chest drain insertion, especially if related to penetrating chest trauma or when they have been placed through pre-hospital thoracostomies. North Bristol antibiotic guidelines suggest a single dose of Flucloxacillin (1 g) and Gentamicin (3 mg/kg) in those under 65 years old (Teicoplanin 400 mg and Gentamicin in penicillin allergic patients) and a single dose of Co-trimoxazole (960 mg) in those over 65 years old.

Unnecessary Thoracostomies
A small cohort of patients who have had thoracostomies, predominantly in the pre-hospital setting but occasionally in the Emergency Department (ED), when CT scanned show little evidence of pneumothorax or injuries to suggest significant underlying lung damage. Traditionally the default has been to place a chest drain through the thoracostomy with removal at an early stage. Due to the known complications of chest drain insertion including intraparenchymal placement, infection and pain, alternatives should be considered. In this cohort of patients a proprietary valved chest seal (e.g. Russell chest seal) can be used to ‘close’ the thoracostomy. The chest seal should remain in place for 12-24 hours, allowing time for observation and further x-rays, followed by formal closure of the thoracostomy if no problems have occurred. One might argue that the chest seal would allow any continued air leak to escape and therefore reformation of the pneumothorax would not occur until the thoracostomy was formally closed. With a near normal CT, minimal underlying lung damage and close observation of the wound and seal for bubbling etc. this scenario is unlikely. Close observation is key when using this approach and probably best undertaken in a high dependency area.
**Referral to the thoracic surgeons**

Thoracic referral is indicated where there is high output from the chest drain (>1500 ml initially or >150 ml/hr ongoing loss after the first hour), ongoing opacification from haemothorax on CXR (>25% of hemithorax) despite the insertion of a suitable chest drain or where there is a continuing air leak after 48 hours. Full indications for referral and the referral process can be found on page 82.

---

**Ongoing Management of Chest Drains**

**Documentation**

On completion of the procedure and once clinical observation and CXR or CT confirms the drain is in the correct position an entry should be made in the patient’s notes and insertion sticker completed. It is paramount to document; the indication for insertion; who made the decision; operator name and grade; mark at skin; how it is secured; whether a post removal closure suture is in situ and confirmation that the drain is in position on imaging.

**Ward Management**

A dedicated chest drain chart should be used for all patients with a chest drain in situ. This should include wound inspection (for infection), drainage volume and confirmation that the drain is swinging or bubbling.

The underwater seal must remain below the level of insertion at all times. The drain should never be clamped. Instead, the tubing should be kinked with fingers (i.e. to empty the underwater seal) and released as soon as possible. In the very rare event the drain does need to be clamped it should only be done by a senior, trained person who must remain with the patient until the clamp is removed. If the patient’s condition deteriorates at any point the clamp must be removed immediately.

**Removal**

For pneumothoraces the chest drain can be removed when the bubbling has stopped (swinging may still be present) and the CXR shows resolution.

Chest drains for haemothoraces can be removed when the output is less than 200 ml in 24 hours (or less than 2 ml/kg in 24 hours).

There is no need to clamp the drain prior to removal and it does not need to be timed with a particular phase of the respiratory cycle. A Valsalva manoeuvre is unnecessary.

The drain should be removed with a brisk firm pull and the wound closed with the previously placed horizontal mattress suture. If this is not present the wound should be kept closed while a suture is placed. This may require 2 people to prevent air entrainment. The wound should then be covered with a clear occlusive dressing.

A post removal CXR should be ordered and reviewed and a removal sticker completed.
Chest Drain Insertion

Figure 1: Patient Position

Figure 2: Equipment

Figure 3: Equipment

Figure 4: Triangle of Safety

Figure 5: Incision

Figure 6: Blunt Dissection
Figure 7: Blunt Dissection

Figure 8: Finger Sweep

Figure 9: Drain Insertion

Figure 10: Drain Insertion
Figure 11. Connection to underwater seal

Figure 12. Securing

Figure 13. Dressings

Figure 14. Omental Tag
Chest Drain Insertion and Management

Injury consistent with underlying lung pathology
OR
Clinical diagnosis of pneumothorax or haemothorax

Patient stable
• SpO₂ >98%, SBP >90mmHg, HR <100
• Likely to remain stable during CT?
• Caution in ventilated patients

Patient unstable
• Evidence of tension pneumothorax
• Cardiovascular instability despite fluid resuscitation

Imaging
• CT
• Consider CXR first

Imaging
• Ideally CXR first
• Proceed with chest drain insertion

Procedure:
• Always surgical blunt dissection
• 2 stage technique
  - Finger / open thoracotomy
  - Drain placement

Post Procedure:
• Chest drain swinging/bubbling
• Post insertion CXR
• Documentation including sticker
• Antibiotics

Ward Care:
• Chest drain ward chart & obs
• Appropriate analgesia
• Daily review by team

Thoracics Referral:
• Blood loss >1500 ml initially or >150 ml/hr after 1st hr
• >25% haemothorax opacification despite chest drain
• Persistent (>48 hr) air leaks
• Worsening surgical emphysema despite chest drain
• Flail chest (incl. sternum) in ventilated pt. (invasive or NIV)
• Resuscitative thoracotomy

Removal
• Pneumothorax
  - No longer bubbling & CXR resolution
• Haemothorax
  - <200ml/day (<2ml/hr in 24 hrs)
• Complete removal sticker

Patient unstable
• Evidence of tension pneumothorax
• Cardiovascular instability despite fluid resuscitation

Imaging
• Ideally CXR first
• Proceed with chest drain insertion

Procedure:
• Always surgical blunt dissection
• 2 stage technique
  - Finger / open thoracotomy
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• Resuscitative thoracotomy

Removal
• Pneumothorax
  - No longer bubbling & CXR resolution
• Haemothorax
  - <200ml/day (<2ml/hr in 24 hrs)
• Complete removal sticker
## Indications for Thoracic Surgeon Referral

**Ongoing blood loss from chest drains**
Consider if blood loss is >1500 ml initially or >150 ml/hr ongoing loss after the first hour of chest drain insertion. Earlier referral may be indicated if there is haemodynamic instability or decompensation on insertion.

**Haemothoraces**
Any haemothorax with >25% opacification of hemithorax despite placement of a suitably sized chest drain (28 Fr or above).

**Pneumothoraces**
Discussion is indicated in pneumothoraces with persistent air leaks (>48 hours).

**Surgical Emphysema**
Consider referral if there is progressive worsening of the surgical emphysema despite adequate drainage or where there is significant face/neck involvement.

**Rib Fractures**
NICE guidelines suggest rib fracture fixation in ventilated (either invasive or non-invasive) patients with a flail segment. Other indications include: >3 ribs fractured, multiple co-morbidities, difficulty weaning from ventilator, failure of regional and systemic analgesia strategies, and thoracotomy having been undertaken for thoracic injuries.

**Diaphragmatic Injuries**
Frequently due to blunt abdominal trauma with associated intra-abdominal pathology. Can potentially be repaired by general surgeons at time of laparotomy. Consider referral if associated with other thoracic injuries not requiring abdominal surgery.

**Resuscitative Thoracotomy**
*Immediate referral indicated as soon as the decision to perform it has been made. Refer direct to the on-call consultant thoracic surgeon via switchboard at the BRI.* If cardiac surgery input is required this will be arranged following the initial referral.

---

## Thoracic Surgical Referral Process

**Emergency referral (resuscitative thoracotomy)**
Direct to on-call consultant thoracic surgeon via BRI switchboard (0117 923 0000).

**In hours**
Referrals can be faxed to thoracic team on 0117 342 3522 where they will be triaged that day by a consultant thoracic surgeon.

**Out of hours**
Initial referral to the on-call cardiothoracic registrar via the BRI switchboard. This route is only appropriate if urgent surgery may be required out-of-hours (i.e. overnight).
If not immediately available the on-call cardiac and thoracic consultant can be contacted via the BRI switchboard.
Massive Haemothorax

- A collection of blood in the pleural space, most commonly caused by rib fractures, lung parenchymal injury or injuries to veins and (less commonly) arteries.
- Features may include: signs of significant chest trauma, bruising, lacerations, penetrating chest injury and crepitus.
- Classic signs are: dullness to percussion, reduced air entry and reduced chest expansion on affected side. However, even in significant Haemothoraces, these signs can be subtle and difficult to detect given the likely presence of other pathologies such as pneumothorax or rib fractures. Hence, imaging tends to diagnose most Haemothoraces.
- In the absence of suspected spinal injury, patients with penetrating chest injuries should have an erect chest x-ray as an adjunct to the primary survey. As well as revealing pneumothoraces and rib fractures, it may show a fluid meniscus which would indicate at least 500mls of blood loss has occurred.
- CT is the gold standard imaging technique. Even very small collections of blood can be detected although the significance of CT-only detectable haemothoraces is unclear and some may not require treatment.
- Treatment consists of chest drain insertion as described in other sections of this document. This must be at least 32Fr and preferably 36Fr to avoid clot blockages.
- Insert wide bore IV access prior to drainage and consider adjuncts such as cell salvage devices – large volume blood loss should be anticipated.
- Referral criteria to the thoracic surgeons are outlines in the relevant section of this guideline.

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A – Left Haemopneumothorax

B – Right Haemopneumothorax
Chest injuries are a common occurrence following minor and major trauma. They are associated with pulmonary and cardiac complications, with certain patients being at particularly high risk. Appropriate analgesic management of these patients will reduce the rate of complications such as pneumonia.

This management will include the following components:

- **High risk** patient identification
- **Assessment of injury**
- **Multidisciplinary team input**
- **Regular monitoring – physiological markers and pain scores**
- **Analgesia strategy appropriate to patient and injury**

**High risk patient identification:**

Certain patient groups are associated with a higher rate of complications within the first 24 to 48 hours following injury. Early identification will guide management: reducing complication.

**High risk patient factors:**

- Age over 60
- Smokers and/or chronic respiratory disease
- Obesity or malnourished
- Reduced oxygen saturations, requiring therapy post injury
- Pre-injury anticoagulation
- Major trauma: Notably head injuries, abdominal injuries, fractures of the pelvis and multiple limb fractures.
- Multiple ribs fractured (> 2), flail segment, pulmonary contusion or other chest injuries.

**Assessment of Injury**

The assessment of injury will be guided by the mechanism of injury; the patient's pre-injury medical conditions; any high risk patient factors.

- Multiple rib fractures are commonly associated with underlying pulmonary contusions
- Fractures of the lower ribs (7-12) may be associated with upper abdominal injuries (spleenic and/or liver injuries) as well as diaphragmatic tears
- A first rib fracture indicates a high energy impact and other (severe) injuries should be anticipated
- **Flail chest** occurs when 2 or more adjacent ribs are fractured in more than two places. This creates a ‘floating’ segment of the chest wall which is unable to contribute to lung expansion. Paradoxical movements are often observed, as well as other signs of chest injury such as crepitus, tenderness, bruising and reduced chest expansion on affected side. Intubation and ventilation is often required for these patients – referral to ICU/HDU should be made.
Multidisciplinary team input
Patients with two or more high risk factors and/or requiring more than “simple” analgesia management should be referred to:
- In-patient respiratory physiotherapy Bleep 1395 or 9552.
- Acute pain service Bleeps 1509 or 9670 (07:30 to 17:30). Out of hours anaesthetics on call Bleep 9032.

In the elderly population it may be appropriate to involve a care of the elderly specialist team. Intensive care referral should be considered in those with significant injuries and multiple risk factors. Thoracic surgical should be made according to criteria set out in the relevant section of this guideline: ‘Indications for Thoracic Surgical Referral’

Regular monitoring
In addition to routine observations, the following should be recorded.
- Regular pain and sedation scores
- Pulse oximetry
- Oxygen therapy required
- Respiratory rate

Analgesia

Analgesia should be instituted as soon as possible after injury. It must be adequate to allow the patient to take deep breaths and cough. The pain score should be less than “2” on a “0” to “3” Verbal Rating Scale (VRS) (0=None, 1=Mild, 2=Moderate, 3=Severe).

1. Simple - 2 or less undisplayed fractures and no “high risk” factors
   Oral Paracetamol 1g 6 hourly
   Oral Ibuprofen 400mg 8 hourly (Naproxen second line)*
   Oral Codeine phosphate 60mg 6 hourly PRN
   * NSAIDs caution in those with risk of renal impairment, recurrent peptic ulceration or Aspirin sensitive asthma. Consider oral Tramadol** 50-100mg, 4-6 hourly.
   ** Tramadol should be avoided in patients with epilepsy or those taking MAOIs.

2. Moderate - Severe - “High risk” factors, pain scores >2, or ability to cough seriously impaired by pain:
   As per “Simple”, excluding codeine.
   Patient controlled analgesia (PCA) – available from Medi-rooms, Level2, Gate 20. Ext 48207 or 48206.
3. Severe - “High risk” factors, multiple rib fractures/ significant injury and unable to cough or comply with physiotherapy. 
As per “Moderate - severe”

PCA or regional anaesthetic technique e.g. thoracic epidural, serratus plane catheter or other appropriate technique: at NBT please refer to Regional Anaesthesia for Rib Fractures Policy or local trauma unit policy.

Regional Anaesthesia for Rib Fractures

1. Pain associated with rib fractures can result in atelectasis, pneumonia and respiratory failure. Effective analgesia reduces the risk of complications.

2. Certain patient groups are at increased risk of complications. These patients should be identified early and referred to the acute pain team and physiotherapy.

3. Assess pain using the verbal rating scale (VRS) and escalate analgesia as per the rib fracture analgesia algorithm to achieve a VRS of 0 or 1.

4. All patients to be considered for a regional technique should be discussed with the 9030 bleep holder.

Background

Pain associated with rib fractures is often severe. Pain as well as the injury itself lead to hypoventilation, inadequate cough, atelectasis and may also lead to pneumonia and ventilatory failure requiring ventilatory support or mechanical ventilation. Complications from rib fractures occur in up to a third of patients. Effective, prompt analgesia aims to facilitate chest physiotherapy to restore deep breathing and an effective cough and has been shown to reduce morbidity and mortality.

Patients requiring regional anaesthesia should be discussed with the 9030 bleep holder (9034 out of hours). Regional anaesthetic techniques should be undertaken in medi-rooms, theatres or another appropriate clean area where there are the facilities and staff to look after them until they are stable enough to return to the ward. The insertion should ideally be performed within 6 hours of injury where appropriate. Undertaking regional blocks in ward based setting should be discouraged.
**Rib Fracture Analgesia Algorithm**

*Uncontrolled pain and presence of risk factors require more advanced analgesia*

**A. Risk Factors**
Presence of more risk factors predicts increased risk of complications

1. Age > 60
2. ↓SpO₂
3. Obesity/malnourished
4. ≥ 3 rib #, flail segment, pulmonary contusion or other chest injury
5. Smoker and/or chronic resp. disease
6. Anticoagulated
7. Major Trauma

**Notes**
≥ 2 risk factors ensure referred to
1. Acute Pain Team (Bleep 1509 or 9670)
2. Physiotherapy (Bleep 1395 or 9552)

**B. Pain Score**
Assess pain on deep inspiration and coughing on Verbal Rating Scale (VRS) or equivalent

<table>
<thead>
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<th>“No Pain”</th>
<th>“Mild”</th>
<th>“Moderate”</th>
<th>“Severe”</th>
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<tbody>
<tr>
<td>VRS</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>VAS</td>
<td>0-1</td>
<td>2-4</td>
<td>5-7</td>
</tr>
<tr>
<td>Abbey</td>
<td>0-2</td>
<td>3-7</td>
<td>8-13</td>
</tr>
</tbody>
</table>

**Notes**
1. Instigate analgesia ASAP to achieve VRS 0 or 1 (or equivalent VAS/Abbey score)

**C. Analgesia Strategy**
Escalate analgesia to achieve VRS of 0 or 1

**STEP 1**
Paracetamol
NSAID* (*Unless contraindicated)
Codeine/Tramadol

**STEP 2**
Paracetamol
NSAID
Opioid PCA
Consider Regional Technique

**STEP 3**
Paracetamol
NSAID
Opioid PCA
Regional Technique

**Notes**
1. Alternatives to consider: Lignocaine patch, ketamine infusion and/or gabapentin
2. Ensure antiemetics and laxatives are prescribed
3. ≥ Step 2 refer Acute Pain Team and Physiotherapy
As per the algorithm initial patient assessment should include.

• Identification of risk factors that predict a poor outcome.
• Pain score assessment of chest wall pain in response to initial analgesia.

Patients to be considered for a regional technique should be discussed with the 9030 bleep holder 24/7

Suitable referrals will be delegated to the most appropriate trained individual. This may be: 3rd on call anaesthetic registrar, Theatre 3 anaesthetist, daily blocks anaesthetist or Intensive Care consultant/trainee.

Regional Techniques

Consideration of fracture distribution, contraindications and operator expertise will influence choice of regional technique between thoracic epidural, paravertebral, serratus anterior plane or erector spinae plane catheter.

All catheter techniques should be performed with appropriate consent, full asepsis, IV access, if two catheters are required ensure local anaesthetic dose limits are not exceeded.

Procedure Notes:

• All infusion catheters should be clearly labelled.
• All procedures should be documented in the patient’s notes.
• All administered doses of local anaesthetic should be prescribed and signed for on the drug chart.
Serratus Anterior Plane Catheter

Position:
Supine with arm abducted or brought across to contralateral shoulder.
Alternatively lateral position with “bad-side up”

Equipment:
Pajunk Sonolong 100mm Nerve Catheter (or Pajunk E-catheter 51mm/83mm for slim patients).
High frequency linear US probe

Technique:
Full aseptic technique inc. US probe cover i.e. as per insertion of a central line
0.5% Chlorhexidine to skin
Transverse scan at T5, mid-axillary line
Lignocaine to anaesthetise skin
Hydrodissect plane immediately superficial to Serratus Anterior and deep to Latissimus Dorsi
Place catheter and secure with sterile transparent dressing.
Erector Spinae Plane (ESP) Catheter

**Position:**
Lateral position with “bad-side up”

**Equipment:**
Pajunk Sonolong 100mm nerve catheter
High frequency linear US probe. Curvilinear may be required for larger patients.

**Technique:**
Full aseptic technique inc. US probe cover i.e. as per insertion of a central line
0.5% Chlorhexidine to skin
Sagittal scan to identify transverse process at desired level. *(Tip: scan to identify the “square tombstone profile” of the transverse process. Compare medially the “sawtooth” pattern of the laminae; and laterally the rounded profile of the rib).*
Lignocaine to anaesthetise the skin
Hydrodissect plane immediately superficial to transverse process, deep to overlying erector spinal muscle group.
Place catheter and secure with sterile, transparent dressing.

2. Erector Spinae Plane infusions may result in spread of local anaesthetic to the epidural space. All infusions should therefore be delivered with a yellow Bodyguard 545 Epidural Pump and managed in accordance with the “Adult Epidural Infusion Policy CP8a”.

3. Use of elastomeric local anaesthetic infusions e.g. Surefuser devices should be in accordance with the “Use of Local Anaesthetic Infusion Pumps Policy CP 27”.

4. Only the following clinical areas/wards can accept patients receiving local anaesthetic infusions via electronic pumps: Medirooms, ICU, 7B, 26B, 33B and 34B.

5. Serratus Plane Catheters should be maintained in situ for a maximum of 4 days. Epidural, Paravertebral and Erector Spinae Plane catheters should be removed after 3 days. Catheters should only be left in situ for longer after a careful consideration of benefit versus risk and consequences of catheter-related infection.

6. Ensure the Acute Pain Team are aware of all patients via PainTeam@nbt.nhs.uk or Bleeps 1509 or 9670
Cardiac Tamponade

• This is a life threatening event. Increasing fluid (blood) and pressure in the pericardial sac reduces atrial and ventricular filling, ultimately reducing cardiac output. It is a common cause of traumatic cardiac arrest, especially where there is a penetrating injury to the chest.
• Rapid diagnosis is key and is largely based on high index of clinical suspicion rather than any classic signs or symptoms. Signs of cardiac tamponade are either non-specific or difficult to detect.
• Classic Signs include: hypotension, tachycardia, elevated JVP and muffled heart sounds. This is usually in the presence of a penetrating cardiac injury.
• Patients with cardiac tamponade often present in traumatic cardiac arrest and a decision must be made whether to perform and ED resuscitative thoracotomy.

Resuscitative Thoracotomy

**NOTE:** Resuscitative thoracotomy should be carried out by a skilled clinician who has had specific training and experience. Trauma team leaders are expected to gain formal training in this procedure. The aim is to open the pericardium within 2 minutes of making the decision to proceed. If a resuscitative thoracotomy is anticipated the clinician(s) who will be performing it need to be defined before the patient arrives in the ED.

**Urgent thoracic referral is indicated as soon as the decision is made to proceed to thoracotomy.**

Indications

**The indications for resuscitative thoracotomy in the ED are:**

• The patient has sustained a penetrating wound that could involve the heart AND has been in cardiac arrest (any rhythm) for less than 10 mins
  ▶ Wound to anterior chest, between the nipples
  ▶ Wound to posterior chest, between the scapulae
  ▶ Wound to upper abdomen (epigastrium)
  ▶ Wound to the neck

• Traumatic cardiac arrest (for less than 10 mins) secondary to hypovolaemia from abdominal or pelvic haemorrhage where proximal vascular control is needed
Traumatic cardiac arrest associated with blunt chest trauma carries a very high mortality. The appropriateness of a resuscitative thoracotomy in this situation should be very carefully considered as the risks (i.e. ‘sharps injury’ from rib fractures) are likely to outweigh the benefits. The only exception to this is cardiac arrest caused by cardiac tamponade due to blunt myocardial rupture. This can be identified using echocardiography and these patients may benefit from the procedure.

**Procedure - The ‘Clamshell’ Thoracotomy**

**Equipment Required – See Annex B, Figure 1**
- Large scalpel
- Spencer Wells forceps
- Tuff Cut scissors,
- Gigli saw
- Sharp tipped scissors for opening of the pericardium.
- Sutures, skin staplers and a Foley urinary catheter may be useful for managing any cardiac injuries found.
- Specific thoracotomy sets are available and have the advantage of containing rib spreaders (e.g. Finochietto).

**Preparation**
Position the patient in the supine position if not already done so. Intubation and IV access should be performed by other members of the trauma team and not delay the thoracotomy.

External chest compressions are often ineffective in this context and should not hamper the procedure. Time should not be wasted on full asepsis, but rapid application of chlorhexidine to the skin is appropriate.

**Procedure – See Page 96, Figures 2-5**
Bilateral thoracostomies (3-5 cm each) should be performed as described above. The procedure can be stopped at this stage if an underlying tension pneumothorax is decompressed and cardiac output returns.

Using a scalpel the thoracostomies should be connected with a deep skin incision following the intercostal space (‘swallow tail’). Two fingers should then be inserted through the thoracostomy to hold the lung out of the way while cutting through all layers of the intercostal muscles and pleura towards the sternum using Tuff Cut scissors. This should be performed on left and right sides leaving only a sternal bridge between the two anterolateral thoracotomies.
The sternum can usually be cut using Tuff Cut scissors. If this is unsuccessful, use the Gigli saw (serrated wire) as follows; pass Spencer Wells forceps under the sternum, grasp one end of the Gigli saw with the forceps and pull back under sternum, connect saw handles and with smooth, long strokes cut through the sternum from inside out.

**Caution:** the Gigli saw wire can spring through the sternum causing injury to the practitioner. Placement of a Spencer-Wells forcep over the external sternum will prevent this.

Open the ‘clamshell’ using the self-retaining retractors/rib spreaders from the full thoracotomy set. If not available, the incision can be held open manually by one or two gloved assistants. The retractor should be opened to its full extent to provide adequate exposure of the chest cavity with access to all areas. If exposure is inadequate it is likely the incisions will need to be extended posteriorly. Additionally, the pericardial sac is usually connected to the underside of the sternum by the sternopericardial ligaments. These can be gently stripped using fingers to allow full access to the front of the pericardium.

Lift the pericardium with forceps and make a long midline longitudinal incision using scissors (sharp tipped). This approach minimises the risk of damage to the phrenic nerves. Making the incision too short will prevent full access and cause kinking of the heart on its pedicle.

Evacuate any blood or clot present then inspect the heart rapidly but systematically for the site of bleeding (including the posterior aspect)

**One of three scenarios is now likely:**
- The heart will begin to beat spontaneously with a return of cardiac output. Any cardiac wounds should be closed as described below
- The heart begins to beat slowly with reduced cardiac output. In this situation wounds should be closed quickly and internal cardiac massage commenced
- The heart remains in asystole. In this case wounds should be quickly closed and internal cardiac massage commenced. Flicking the heart may produce a return of spontaneous output

A two-handed technique is preferred for internal cardiac massage. One hand is slid behind the heart, keeping it flat, and the other placed on top. Blood is ‘milked’ from the apex upwards at a rate of approximately 80 beats per minute. Whichever technique is used ensure that the heart remains horizontal during massage. Lifting the apex of the heart too far out of the chest causes kinking of the great vessels and prevents venous filling.

An assistant should compress the aorta against the spinal column using a hand placed posterior to the left lung to maximise coronary and cerebral blood flow. This is also the technique for gaining proximal control where abdominal or pelvic haemorrhage is the cause of cardiac arrest.
Control of bleeding

Holes less than 1 cm can usually be occluded temporarily using a finger or gauze swab. If this is successful no other method should be attempted before the arrival of the thoracic surgeon. If bleeding cannot be controlled with finger/gauze compression it may be necessary to close the defect with large sutures (vertical mattress with 2/0 Silk) or skin staples taking care to avoid the coronary arteries that are normally fairly visible.

If defibrillation is required use internal paddles with an initial energy level of 10 J. If these are not available, replace the clamshell chest wall flap in its anatomical position (no suturing or wound closure required) and defibrillate using conventional external pads.

If the procedure is successful the patient may begin to wake. Provision for immediate anaesthesia may be needed. Return of spontaneous circulation (ROSC) will be associated with bleeding, particularly from the internal thoracic (mammary) arteries and intercostal vessels. Large ‘bleeders’ may be controlled with artery forceps or sutures.

Referral to the thoracic surgeons

The thoracic team must be contacted urgently as soon as the decision has been made to proceed to thoracotomy. In the event that ROSC occurs rapid transfer to theatre for further interventions and surgery is indicated.

RCEM Position Statement on Resuscitative Thoracotomy in Trauma Units (TUs)

Trauma Networks must ensure:

• That they have published guidance on the indications for resuscitative thoracotomy in trauma
• That each TU has developed locally appropriate guidelines for the ongoing care and transfer of these patients in the event of a successful outcome. Options would include:
  ‣ The TU general surgical team performing damage control surgery locally.
  ‣ A dedicated 24/7 pre-hospital retrieval service in the network who would support the transfer of the patient from TU to MTC
  ‣ Transfer of a cardio-thoracic surgeon from the MTC to the TU.
  ‣ Appropriately resourced and trained immediate transfer of the ventilated patient with an open chest to the MTC by the TU team.

Without an appropriate onwards ‘chain of survival’ resuscitative thoracotomy would be a futile procedure and should not be performed.
Resuscitative Thoracotomy

Figure 1. Equipment

Figure 2. Incision

Figure 3. Cutting through the sternum

Figure 4. ‘Delivering’ the heart

Figure 5. Optimal view with retraction
Management of Chest Injuries in Major Trauma:


HAEMORRHAGE AND CIRCULATION
Major Haemorrhage Protocol

1. Major haemorrhage is defined as any of the following:
   a. Actual or anticipated requirement for > 4 units RBC in 1 hour with ongoing need for transfusion
   b. Greater than 1500mL blood loss in one episode with or without haemodynamic / cardiovascular instability.
   c. New cardiovascular instability considered to be related to acute haemorrhage
   d. Situation where more than 1 – 1.5 blood volumes may need to be transfused either acutely or within a 24 hour period

2. A consultant clinician or most senior non-consultant grade clinician pending the arrival of a consultant should lead clinical care if the major haemorrhage procedure is activated.

3. The major haemorrhage procedure is activated by dialling ‘2222’ and stating ‘I am activating the Major Haemorrhage Alert for location, extension xxxx’, and stating which clinical team(s) are required.

4. The following investigations should be requested:
   a. Blood gas (preferably arterial)
   b. Crossmatch blood samples x 2, request 4 units minimum
   c. FBC, clotting screen, fibrinogen, urea, electrolytes, creatinine, LFTs, calcium, draw a sample for ROTEM (see below)

4. Shock packs 1 will be issued containing 4 x PRC & 4 x FFP [shock pack 1]. Shock pack 2 containing 4 x PRC, 4 x FFP, 1 x platelets will need to be requested if needed for ongoing transfusion. Group specific products should be given where possible. Ongoing product support to be discussed with haematology registrar or consultant.

5. Tranexamic acid 1g slow IV should be given in the initial stages of resuscitation as per guideline ‘T14-2B-119 Tranexamic Acid’

6. A member of the clinical team should be identified as ‘co-ordinator’ for communications. All phone communications should start with ‘this call relates to the major haemorrhage in location X’

7. Call blood bank to stand down only when haemorrhage is under control.
Major haemorrhage is any situation where immediate delivery of blood is required for a patient with rapid blood loss. All clinical and laboratory staff can activate the procedure if immediate emergency delivery of blood is necessary.

The procedure is activated with one phone call:
- Call 2222 & state “Major Haemorrhage, (location), extension (xxxxx). State which clinical team(s) are needed as well
- Switchboard will call blood bank and connect you to them
- Provide blood bank with patient identification details as per trust policy
- If patient unknown, ED will register unknown patients as per separate SOP
- Patient gender should be stated in all cases
- If prehospital blood transfusion has occurred, you should confirm the pre-allocated HEMS number transfusion. This number should be used for ALL samples and documentation until the patient has reached their final ward destination, are in a stable condition and not requiring further urgent transfusion. (See Prehospital Blood Transfusion SOP).

Upon activation, switchboard will mobilise the following staff:

<table>
<thead>
<tr>
<th>Role</th>
<th>Bleep Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trauma Team Leader</td>
<td>9745</td>
</tr>
<tr>
<td>Trauma Scribe</td>
<td>9741</td>
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<tr>
<td>ED Matron</td>
<td>9744</td>
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<tr>
<td>Clinical Site Manager</td>
<td>9147</td>
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<td>Trauma Nurses</td>
<td>9747/9748</td>
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<td>Trauma Co-ordinator</td>
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<tr>
<td>3rd On Anaesthetic Registrar</td>
<td>9033</td>
</tr>
<tr>
<td>Orthopaedic Registrar &amp; SHO</td>
<td>9750 / 9753</td>
</tr>
<tr>
<td>Surgical Registrar</td>
<td>9772</td>
</tr>
<tr>
<td>Radiology Registrar</td>
<td>9746</td>
</tr>
<tr>
<td>Blood Transfusion Laboratory Clinician</td>
<td>9433</td>
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<tr>
<td>Supervisory Porter</td>
<td>9567</td>
</tr>
<tr>
<td>Blood Porter</td>
<td>1010</td>
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<td>Theatre Co-ordinator: 1535</td>
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<tr>
<td>Anaesthetic Co-ordinator</td>
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<tr>
<td>CT Radiographer</td>
<td>9732</td>
</tr>
<tr>
<td>Major Trauma Radiographer</td>
<td>9740</td>
</tr>
</tbody>
</table>
Packed red blood cells, fresh frozen plasma and platelets should be ordered in the form of “shock packs” containing multiple units of products (section 2). Cryoprecipitate or specialist products must be requested explicitly.

A specific member of the team should be designated as “Co-ordinator” at the clinical location to co-ordinate communication during the major haemorrhage. This will normally be the TTL but may occasionally be delegated.

**Call blood bank to stand down when haemorrhage is under control. Only blood bank should stand down porters.**

### Definitions

**Major haemorrhage can be defined as suspicion of active haemorrhage plus any of:**
- Actual or anticipated requirement for > 4 units RBC in 1 hour with ongoing need for transfusion
- Greater than 1500mL blood loss in one episode with or without haemodynamic / cardiovascular instability
- New cardiovascular instability considered to be related to acute haemorrhage
- Situation where more than 1 – 1.5 blood volumes may need to be transfused either acutely or within a 24 hour period

### Immediate Approach in Major Haemorrhage

The initial approach is Damage Control Resuscitation: control haemorrhage rapidly and maintain or return to physiologically and haemodynamically acceptable parameters, correct coagulopathy, avoid hypothermia / acidosis times if possible.

A consultant clinician should lead clinical care if the major haemorrhage protocol is activated. The aim is to provide damage control resuscitation as necessary and arrest bleeding if possible.

**Laboratory investigations to request**
- Blood gas (arterial preferable, venous OK if arterial delayed / not possible)
- 2 x Crossmatch samples, request 4 units
- FBC
- Coagulation screen
- Fibrinogen
- Urea & electrolytes
- Liver function tests
- Calcium
- Take blood for ROTEM
After arrival of shock pack 1, further shock packs (typically Shock Pack 2) must be requested. Shock packs after Shock Pack 1 will not be automatically issued. Where possible, group specific products should be given.

- Pack 1 contains 4 units PRC & 4 units FFP
- Pack 2 contains 4 units PRC, 4 units FFP, 1 pool of platelets
- Shock Pack 2 should be requested first if there is suspicion of thrombocytopenia or platelet dysfunction (e.g. concurrent treatment with aspirin, clopidogrel or other platelet inhibitors)

Tranexamic Acid:
Early administration (within the first 3 hours following initial injury and as soon as possible) is vital for efficacy and to achieve mortality benefit.

Loading dose
- 1 g
- Give over 10 minutes

Maintenance infusion
- 1 gram over 8 hours:
- Mix 1g in 500mL of Sodium Chloride 0.9% or Glucose 5% and infuse over 8 hours. (It can also be diluted into 50mL total volume and infused at a lower rate)

Blood product ratio
- In patients with severe trauma a 1:1 ratio of PRC:FFP should be employed in the initial resuscitative phase
- Following administration of 4 units of PRC and 4 units of FFP
  - Give further blood products based on initial results
  - Give platelets and cryoprecipitate empirically if bleeding ongoing and no results available
  - Recheck all baseline investigations at 1 hour or sooner if concern regarding coagulopathy or non-response to initial treatment.
  - Continue PRC and FFP in 1:1 ratio until results available

Giving blood products
- Group O negative blood is available for immediate use from the blood fridge in Level 2 Theatres
- Remember to give through warming device - Level 1 Infusor ideally
Transfusion Targets:

- If Hb < 70 g/dL give PRC
- If INR > 1.5 give FFP 15 mL/kg
- If fibrinogen < 1.5 g/L give cryoprecipitate (or fibrinogen concentrate if available) if this has not been achieved following FFP. The usual dose for an adult is 2 pooled units
- If platelets < 75x10^9/L (or < 100x10^9 /L in polytrauma or neuraxial injury), give 1 adult unit platelets. One bag of platelets is an adult therapeutic dose (ATD), pooled from 5 or 6 donors, and should therefore be administered every 4-5 bags of RBC (and FFP). Shock pack 2 contains 1 bag of platelets with further bags being ordered separately if needed.
- If ionised Ca^{2+} < 1 mmol/L give 10 mL 10% calcium chloride. N.B caution with peripheral administration - extravasation injury is hard to detect and can be disabling later in the patient journey
- If K^+ > 5.5 mmol/L give 10 IU insulin in 50 mL 50% glucose

Physiological Targets:

- Once surgical or interventional radiological control of bleeding is achieved aggressive attempts should be made to normalise blood pressure, acid-base status, coagulopathy and temperature
- Vasopressors should be avoided if possible. However, if hypotension persists as a result of vasodilatation from inflammatory processes (e.g. systemic inflammatory response syndrome – SIRS) vasopressors may be required, but the patient must be adequately fluid resuscitated first

Monitor:

- Clinical response continuously
- FBC, coagulation, fibrinogen, urea & electrolytes, liver function, calcium & ROTEM at least hourly until bleeding stops.
Clinical Communication in Major Haemorrhage

Identify a named, specific member of the clinical team as “Coordinator” for communication.

Coordinator should:

- Inform blood bank immediately of patient details (name, Trust number, Date of Birth, clinical area, contact details and products required (normally Shock Pack 1)
- Identify clinician leading resuscitation - normally a consultant
- Phone blood bank to request any subsequent shock packs
- Phone switchboard to stand down when appropriate
- Identify a specific individual to contact for subsequent case review (notify blood bank)
- All phone communications should start with “this call relates to the major haemorrhage in (location)”. If there is difficulty contacting blood bank contact switchboard via 2222 to advise
- Ongoing product support to be discussed with haematology registrar (haemostasis registrar in hours, or on call registrar out of hours)

Identify a scribe to record time of requests and product/result receipt in patient notes.
Thromboelastometry (ROTEM)

Thromboelastometry provides a real-time measure of interaction between platelets, clotting factors and the fibrinolytic system in a whole blood sample. Formation of clot and clot strength is presented as a graphical result with specific measurements of characteristics as a table below the graph. Targeted delivery of blood products can be achieved based on the clotting characteristics observed. As a result, thromboelastometry improves patient outcomes and decreases inappropriate transfusion of blood products.

At North Bristol, ROTEM can be found on Level 2 Theatres next to the blood fridges and in obstetrics. Specific training on how to use the ROTEM machine is required to ensure accurate results. Do not use the machine until you have completed the required training. This is vital as inaccurate or incorrect test results could lead to inappropriate transfusion decisions and avoidable patient harm.

Several assays can be performed side by side, giving a range of normal values to inform blood product administration. At NBT we use “EXTEM” and “FIBTEM” tests only. (Other centers may use different or additional tests such as “INTEM” or “APTEM”)

**EXTEM**: This test mildly activates haemostasis via the physiological activator tissue factor. The result is influenced by extrinsic coagulation factors, platelets and fibrinogen.

EXTEM is used for decisions regarding the administration of fresh frozen plasma, coagulation factors (cryoprecipitate), fibrinogen or platelets.

**FIBTEM**: This test is for the fibrin part of the clot. FIBTEM irreversibly inhibits platelets in the sample, allowing for rapid detection of fibrinogen deficiency.

The following pages contain a brief guide to normal and abnormal ROTEM trace interpretation.

**Caution**: Normal ROTEM results can be seen in patients with mechanical bleeding or significant coagulopathy caused by hypothermia, acidosis, warfarin and other oral anticoagulant medications, von Willebrand’s disease, platelet inhibitors and platelet dysfunction.
A normal result is displayed above. Note the plot amplitude extends beyond the green dotted line in EXTEM result - this line indicates the expected normal minimum clot amplitude. If the plot does not extend beyond this lines the result is probably abnormal. The table below describes and indicates normal ranges for measured parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Range</th>
<th>Unit</th>
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<tr>
<td><strong>Coagulation Activation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clotting Time (CT) (synonym r)</td>
<td>Time from test start to 2mm amplitude</td>
<td>EXTEM: 38-79</td>
<td>Seconds (s)</td>
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<tr>
<td>Clot Formation Time (CFT) (synonym = k)</td>
<td>Time from 2 mm amplitude to 20 mm amplitude</td>
<td>EXTEM: 34-159</td>
<td>Seconds (s)</td>
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<tr>
<td>-angle</td>
<td>Angle between baseline and tangent to the clotting curve through the 2 mm point</td>
<td>EXTEM: 63-83</td>
<td>degree (°)</td>
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<tr>
<td><strong>Clot Firmness</strong></td>
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<tr>
<td>Maximum Clot Firmness (MCF) (synonym MA)</td>
<td>Maximum amplitude reached during the test</td>
<td>EXTEM: 50-72</td>
<td>Millimetres (mm)</td>
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<tr>
<td></td>
<td></td>
<td>FIBTEM: 9-25</td>
<td>Millimetres (mm)</td>
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<tr>
<td>A10</td>
<td>Clot firmness (mm amplitude) 10 mins after CT Other time points may be used e.g. A15 (15 mins), A30 (30 mins)</td>
<td>EXTEM: 43-65</td>
<td>Millimetres (mm)</td>
</tr>
<tr>
<td>FIBTEM: 7-23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clot Lysis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clot Lysis Index at 30 minutes (CLI30)</td>
<td>Ratio of amplitude and MCF, 30 mins after CT Other time points may be used e.g. CLI15 (15 mins), CLI 45 (45 mins)</td>
<td>EXTEM: 94-100</td>
<td>%</td>
</tr>
<tr>
<td>Maximum Lysis (ML)</td>
<td>Maximum lysis detected during run time, described as difference between MCF and lowest amplitude after MCF, described in % of MCF.</td>
<td>EXTEM: &lt;15</td>
<td>%</td>
</tr>
</tbody>
</table>
* Delayed clot activation may also be due to insufficient fibrinogen or low platelets; consider whether the patient may need these products instead / in addition to FFP.

### Reversal of Anticoagulation, Anti-Platelet Drugs and Coagulopathy

**Heparin**

Severe bleeding associated with IV unfractionated heparin (UFH) should be treated with IV protamine at a dose of 1 mg per 100 IU UFH given in the preceding 2-3 hours.

Low molecular weight heparin (LMWH) can only be partially reversed with protamine. Severe bleeding related to subcutaneous LMWH should be treated with IV protamine at a dose of 1 mg per 100 units of LMWH administered within the previous 8 hours. If no response a second dose of 500 micrograms per 100 units can be tried.

**Note:** Excess protamine will itself induce a coagulopathy.

**Warfarin**

Warfarin inhibits the activation of vitamin K dependent clotting factors: Factors II, VII, IX and X as well as protein C and protein S.

In major haemorrhage associated with warfarin, rapid reversal can be achieved by replacing vitamin K (5 mg IV) and administering Prothrombin Complex Concentrate (PCC). The dose of PCC ranges from 25 to 50 mcg/kg, dependent on the INR, and is available from the transfusion laboratory.
Direct Oral Anticoagulant Agents (DOACs)

The primary modes of action of DOACs are by direct Factor Xa inhibition (rivaroxaban, apixaban, edoxaban) or direct thrombin inhibition (dabigatran)\(^3\).

Routine coagulation tests cannot quantify the level of anticoagulation but may be useful as a qualitative indicator of drug presence for dabigatran. Dabigatran prolongs the APTT and may affect the PT; a normal APTT indicates no clinically relevant anticoagulation effect of dabigatran. The assays used at NBT are insensitive to rivaroxaban. The effect of apixaban on PT and APTT is unknown\(^{10}\).

For patients taking dabigatran suffering life-threatening or intracranial haemorrhage Idarucizumab (Praxbind) can be administered. The dose of Idarucizumab is 5g (2 x 2.5g vials administered by bolus or infusion over 5 to 10 minutes each).

Following administration, a clotting screen should be taken. Should the APTT remain prolonged discuss with the on-call Haematologist - a second 5g dose can be considered depending on the clinical situation. A flowsheet with more detailed guidance is included in Appendix M (page 262).

Recent evidence suggests high-dose PCC may reverse anticoagulation in patients treated with Factor Xa inhibitors but not direct thrombin inhibitors\(^4\). All cases of DOAC-associated major haemorrhage should be discussed with a Haematologist.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warfarin</td>
<td>Vitamin K</td>
</tr>
<tr>
<td>Dabigatran 110mg bd</td>
<td>In intracranial haemorrhage, Idarucizumab (Praxbind) can be administered. The dose of Idarucizumab is 5g (2 x 2.5g vials administered by bolus or infusion over 5 to 10 minutes each).</td>
</tr>
<tr>
<td>Dabigatran 150mg bd</td>
<td>As protein binding is low, dabigatran can be dialysed. Lack of national consensus on treating haemorrhage. Consult haematologist</td>
</tr>
<tr>
<td>Rivaroxaban</td>
<td>Rivaroxaban is not reversible. Early trial data suggests bleeding effects completely reversed by PCC (very limited experience). Otherwise, supportive care only. Lack of national consensus on treating haemorrhage. Consult haematologist</td>
</tr>
<tr>
<td>Apixaban (all doses)</td>
<td>No antidote. Transfusion of FFP should be considered. Activated charcoal may be an option in overdose or accidental ingestion. If bleeding cannot be controlled consider recombinant Factor VIIa. Lack of national consensus on treating haemorrhage. Consult haematologist</td>
</tr>
</tbody>
</table>

Aspirin & Clopidogrel

Patients taking aspirin have a low risk of increased bleeding.

Patients taking P2Y12 receptor inhibitors (clopidogrel, prasugrel) are at higher risk of bleeding. These agents are less readily reversed by platelet administration and current evidence would support tranexamic acid as the treatment of choice.

Platelet transfusion may be used in addition; suggest x2 adult therapeutic doses when bleeding is considered to be anti-platelet agent associated and the risk of bleeding is assessed to be greater than the risk of thrombosis.
Note blood samples must be given directly to a member of laboratory staff, not left at reception.

Role of Porters

Emergency call from switchboard to Porters Lodge stating “Major Haemorrhage Protocol Activation”

Porter located and dispatched immediately to blood bank to collect BLOOD BOX.
THIS PORTER IS NOT TO STAND DOWN UNTIL GIVEN PERMISSION

Porter delivers blood box to clinical area. Collects blood samples and takes to blood bank

Blood samples delivered to laboratory. Wait at laboratory to collect next blood box or for further instructions.

Stand down instruction from laboratory

Senior porter can assign porter to other duties
Notify reception staff and coagulation staff that major haemorrhage protocol has been activated:

- Reception staff must take major haemorrhage samples immediately to blood bank, coagulation and biochemistry laboratories
- Issue blood products in temperature controlled blood boxes
- Perform Clauss fibrinogen on all coagulation samples
- Start audit sheet and complete minimum details
- Call haemostasis registrar (on call registrar out of hours) if 2nd shock pack issued (give registrar any blood results available)
- Consider calling in additional staff on call if out of hours
- Call clinical location when blood products have been collected by porter
- Contact clinical location triggering major haemorrhage protocol if no communication from location for 30 minutes - enquire if stand down is appropriate
- When stand down activated contact porters so that porters can be stood down

Role of Haematology Medical Staff

Haematology Consultant (or on call registrar out of hours) contacted by switchboard when 2222 call is activated. Haematology Consultant should also be contacted by blood bank

- After issue of 2nd shock pack
- If unusual product requests made
- Registrar should attend or make contact with blood bank approximately 30 minutes after 2222 call activation
- If major haemorrhage is still in progress they should then contact the clinical location
- Advise on additional product support and investigations based on guidelines
- Key role is to ensure appropriate blood product therapy has been given and to advise on ongoing management of any coagulopathy
- Ensure clinicians at location have registrar or consultant contact details
- Discuss with consultant haematologist at discretion or if recombinant Factor VIIa considered
Packed Red Cells

- Crossmatched blood should be used if it is available or if time allows.
- Use group O RhD negative PRCs if extremely urgent until group specific PRCs are available. Inform Transfusion immediately if this has been removed from the blood fridge so that it can be replaced.
- Group specific PRCs can be issued in major bleeding without performing an antibody screen as patients will have minimal circulating antibodies and a low risk of reaction.
- A full cross-match is not needed after 8 units have been given in < 24 hours.
- All women will be issued O RhD negative products and all men O RhD positive. PRCs should be transfused within 4 hours of being removed from the fridge. If unused they must be returned to a monitored fridge within 30 minutes of removal.
- If the patient has been transferred with appropriately packed blood from another hospital this may be used provided ID details match. Transfusion must be informed of details of all units transfused and unused units must be sent to the transfusion laboratory.
- Use intra-operative cell salvage (“cell saver”) whenever possible in all cases of major bleeding. Indications and contra-indications for intra-operative cell salvage are discussed further in Appendix L: Intra-operative cell salvage (page 261).

Fresh Frozen Plasma, Platelets and Cryoprecipitate

- Group AB plasma and group A or B non high-titre platelets may be used initially. Group compatible units will be used once the patient’s blood group is known.
- Two units of platelets are routinely available in NBT. Further units will be requested on activation of Major Haemorrhage by the Transfusion laboratory and are available within 1 hour from NHS Blood & Transplant (based at Filton, Bristol).

Traceability

- It is a legal requirement for the final fate (transfused or discarded) of all blood components released from the laboratory to be known. The Trust Transfusion Policy must be followed.
Each event triggering this protocol should be recorded on an audit form (see Appendix N: Audit Forms, Page 263) by a member of the clinical team and reviewed by the relevant department. This should include all cases where blood loss and therefore transfusion requirement was less than anticipated.

Within Theatres, the audit form should be completed by the 3rd On-Call Anaesthetic Registrar, or delegated to another member of the clinical team, following completion of clinical care. These forms should be returned to Dr Amit Goswami, Consultant Anaesthetist.

Within Emergency Department, the audit form should be completed by the senior attending clinician following completion of clinical care. In cases of Major Haemorrhage in Trauma this will be the Trauma Team Leader. These forms should be returned to Dr Simon Odum, Consultant in Emergency Medicine, either directly or via the box placed in Resus Bay 1.

For cases where patients transition from the Emergency Department to Theatres audit forms should be completed for both locations to ensure local learning.

Transfusion record all cases of Major Haemorrhage and review these in a monthly meeting. To ensure all cases of Major Haemorrhage are captured completed audit forms will be compared to records in Transfusion. In the case of audit forms not completed retrospective note review will be carried out.

In addition to presentation at Departmental level using existing Mortality and Morbidity Meetings and Clinical Governance meetings the results from these audits will be collected on a six-monthly basis and presented at the Trust Transfusion Committee meeting to ensure appropriate and effective application.

All incidents that lead to delays or problems in the implementation of this guideline, including the provision of blood, must be reported through the AIMS system (by completing a DATIX form on the Trust intranet) and investigated using the audit form as a starting point. The Trust Transfusion Team will report to the Serious Hazards of Transfusion (SHOT) scheme and/or Medicines and Healthcare Products Regulatory Agency as required.
1. Stable penetrating trauma with suspected cardiac tamponade should be transferred to theatre to await cardiothoracic team for thoracotomy.

2. Indications to call the cardiothoracic team immediately include:
   a. Any trauma call or pre-alert indicating significant haemorrhage from cardiothoracic injury or significant blunt thoracic injury.
   b. Identification of any injury requiring ED thoracotomy.
   c. Any patient with penetrating trauma to torso.

3. Indications for resuscitative ED thoracotomy by Trauma Team Leader include:
   a. Penetrating trauma without pulse and less than 15 minutes of loss of output. Time from cardiovascular collapse is more important than presence of absence of cardiac electrical activity.
   b. Penetrating trauma with suspected cardiac tamponade with deterioration and loss of cardiac output before arrival of cardiothoracic team.

4. For an ED thoracotomy, the TTL must request assistance from theatres but should proceed to thoracotomy without delay.

5. In the event of the Trauma Team Leader performing a thoracotomy, the ED Registrar will take over the role of TTL and the ED Consultant on-call will be called in.

6. The Cardiothoracic Registrar must be informed of every trauma patient with non-life threatening chest injury whether blunt or penetrating.

7. There are three mechanisms to call the cardiothoracic team. For ‘Code Red’ patients, the CT Registrar is notified via switchboard.
Penetrating cardiac injury is rare, and frequently unsurvivable. It is most common in males and is usually non-accidental. Any patient presenting with wounds in the "cardiac box", left axilla, base of neck or upper abdomen are at risk of cardiac injury; in these patient groups cardiac injury should be actively excluded.

The majority of low velocity penetrating cardiac injuries will lead to cardiac tamponade. Occasionally blood will not be contained by the pericardium and will instead collect in the chest cavity itself leading to progressive respiratory compromise and/or haemodynamic instability due to massive haemothorax. In these patients, classical signs of cardiac tamponade may be absent and they may initially present in a stable condition.
Cardiac Tamponade Algorithm

Ensure:
Airway patent
High-flow O₂ Delivered
Monitoring Attached
(See Emergency Anaesthesia guideline)

Clinical Features Suggestive of Cardiac Tamponade:
- Penetrating or blunt chest / abdo trauma
- Hypotensive / Tachycardic, raised JVP
- Pulsus paradoxus (>10mmHg fall in BP with inspiration)
- Kussmaul’s sign – raised JVP on inspiration (not always seen)
- TTE or other radiological evidence of cardiac tamponade

IF CLINICAL FEATURES AS ABOVE:
LIKELY CARDIAC TAMPONADE

Life-Threatening Emergency:
MAINTAIN CARDIAC OUTPUT
Head down
IV Fluid resuscitation

PERICARDIOCENTESIS:
ONLY to be performed if ALL following criteria satisfied:
Outside MTC and
• Nobody competent in thoracotomy
• Surgeons not immediately available
• Patient is in extremis
• High probability of tamponade

Aspirate as much as possible

Definitive management

Prepare for:
EMERGENCY THORACOTOMY IN ED (unstable, periarrest)
or
IN THEATRE (if stable)
Stable Penetration Trauma, Suspected Cardiac Tamponade

Suspected cardiac tamponade, maintaining output on arrival and immediate assessment:
• Move to theatre to await CT team for thoracotomy
• CT Reg and CT consultant will be called as soon as injury identified – either by pre-hospital alert or on primary survey
• Trauma team leader to accompany and wait with patient
• Prepare for thoracotomy in theatres with theatre staff.
• General Surgical Registrar to attend theatre also
• Consultant General Surgeon on call if on site to be notified and immediate assistance requested. If not on site then to be called in from home.

The trauma team leader should proceed with clamshell thoracotomy for relief of tamponade if cardiac output is lost before arrival of the CT Registrar.

Penetrating Thoracic Trauma - Deteriorating Patient

Patient with suspected cardiac tamponade who quickly deteriorates in the ED resus after arrival:
• Trauma team leader may proceed to ED thoracotomy based on patient presentation and speed of deterioration
• CT Registrar and CT Consultant will be called as soon as injury identified either by pre-hospital alert or on primary survey.
• General Surgical Registrar to attend ED
• Consultant General Surgeon on call if on site to be notified and immediate assistance requested.

ED Thoracotomy by Trauma Team Leader

The indications for resuscitative thoracotomy in the ED are:
• Penetrating wound that could involve the heart AND has been in cardiac arrest (any rhythm) for less than 15 mins
  ‣ Wound to anterior chest, between the nipples
  ‣ Wound to posterior chest, between the scapulae
  ‣ Wound to upper abdomen
  ‣ Wound to the neck
• Traumatic cardiac arrest (for less than 15 mins) secondary to hypovolaemia from abdominal or pelvic haemorrhage where proximal vascular control is needed
Traumatic cardiac arrest associated with blunt chest trauma carries a significant mortality. The appropriateness of resuscitative thoracotomy in this situation should be carefully considered as the potential risks are likely to outweigh the benefits. The only exception to this is cardiac arrest caused by cardiac tamponade due to blunt myocardial rupture. This can be identified using transthoracic echocardiography.

**Trauma team leader will perform thoracotomy**

- The trauma team will be present, including the General Surgical Registrar
- The incision will be clamshell. Anterolateral thoracotomy risks incomplete access to the site of injury and is a more technically challenging though less invasive procedure and should only be performed by those with specific skills and training in its use.
- The purpose will be to release tamponade and control cardiac bleeding – no other procedures will normally be undertaken.
- Cardiothoracic (CT) Registrar and CT Consultant will be called as soon as an injury requiring ED thoracotomy is identified – either by pre-hospital alert or on arrival to ED.
- For an ED thoracotomy, the TTL must request assistance from theatres to enable a scrub nurse to assist in the ED and bring any additional equipment needed.

**Two types of thoracotomy kit kept in the ED:**

- One will be labelled ‘TTL thoracotomy’ and will carry a limited number of instruments
- One will be a full thoracotomy set for use by the CT team when required
## Indications to Call the Cardiothoracic Team

### On Pre-Alert of Patient (Before Arrival)

- Prealert from pre-hospital emergency service: call CT Registrar and Consultant
- Prealert from SWASFT crew indicating significant haemorrhage from cardiothoracic injury – SEE CALL OUT MECHANISM A
- SWASFT crew prealert suggesting significant blunt thoracic injury or penetrating trauma to torso

### Indications to Call Cardiothoracic Team After Patient Has Arrived

**Haemodynamically unstable patient with:**
- Penetrating trauma to torso with suspected internal thoracic injury
- Blunt thoracic injury with associated physiological derangement
- Acute ECG changes related to myocardial trauma
- Chest drain inserted for trauma with ongoing air leak or blood loss

**Non-life-threatening cardiothoracic injury identified during the primary or secondary survey:**
- The CT registrar will be informed of every trauma patient with non-life-threatening chest injury whether blunt or penetrating.
- Liaison will be between the General Surgical Registrar and the CT Registrar. If the General Surgical Registrar is in the theatres then the TTL may liaise with CT or nominate someone appropriate to do this.
- Contact will be via the normal pager system currently in place
- The CT Registrar will review the relevant images
- The management plan decided in discussion with the CT Registrar will be clearly documented in the notes and the contact details for the CT Registrar recorded.
- The drug chart will be completed by the general surgical SHO
- There will be a daily review of in-patients with CT injury by the CT team
- The CT registrar will be contacted by the ICU for advice regarding ongoing management of thoracic trauma issues and may be requested to review the patient, other than the daily WR, if clinically indicated.

**For all unstable patients with CT injury, the TTL may also call (depending on injuries identified pre-hospital or on arrival in the ED):**

General Surgical Registrar  +/- General Surgical Consultant +/- Vascular Registrar
Mechanism to Call the Cardiothoracic Team

A: Major Haemorrhage Patients

A “Code Red” call will result in the CT Registrar being notified via switchboard

- The instruction will be “Code Red trauma call for cardiothoracics”
- The CT Registrar will immediately inform their Consultant on call
- There will be no discussion with the TTL about the need to attend. The assumption is that for “Code Red” via HEMS, they leave immediately for SMH
- This call will also apply to non-HEMS patients where immediate life threatening thoracic injury, likely to require a thoracotomy, is suspected by the Consultant TTL from the pre-hospital alert information or is identified on clinical examination in the primary survey.

CT Registrar and Consultant are to confirm receipt of the call and ETA via TTL mobile 07703886400 or the ED red phone emergency phone number 01179506862

If the TTL changes the “code red trauma call” after arrival and assessment of the patient the CT team will be notified ASAP regarding change, although they may still need to attend within 30 minutes.

- This contact will be via switchboard direct to mobile phones of the team.

B: For All Other Significant Cardiothoracic Trauma

FAST bleep for trauma patient via 2222 mechanism for all other significant cardiothoracic trauma as suspected pre-arrival or identified on arrival

- The instruction to switchboard will be trauma call Cardiothoracic Registrar
- There will be no discussion with the TTL about the need to attend. The assumption is that they leave urgently for SMH.
- CT Registrar to confirm receipt of the call and ETA via TTL mobile 07703 886400 or the ED red phone emergency phone number – 0117 9506862

C: Non-Life-Threatening Cardiothoracic Injury Identified During Primary or Secondary Survey

Contact will be via the operator who will bleep the CT Registrar
On arrival, the CT Registrar or Consultant are to go to Bay 1 ED Resus Room to manage the patient there, or be direct to Theatres.

- They will park vehicle on the ED ramp and enter via the ambulance doors
- They will be asked to sign in with the time of arrival on the trauma sheet for audit purposes, as are all other trauma team members

Performance Standard for All Patients with Cardiothoracic Injury Admitted to ICU

- All patients with cardiothoracic injuries will have a named CT consultant providing shared care on ICU
- Daily review (7/7) of in patients with CT injury by CT team
- There is a designated CT Registrar able to provide this cover for trauma patients at the MTC via switchboard at UHB
- The CT Registrar will be contacted by the ICU for advice regarding ongoing management of thoracic trauma issues and may be requested to review a patient other than on the daily Ward Round if clinically indicated due to complications or patient deterioration

Team Leader

In the event of the TTL performing a thoracotomy – the ED Registrar will take over the role of TTL. The impact on the ED is likely to be significant

The ED Consultant on call will be called in and the escalation policy for the ED followed to ensure that other ED patients are not compromised.

Review and Governance

All thoracotomies will be reviewed in the Major Trauma Centre M&M meetings.

Ongoing CBD / Skills Update

The Trust will provide a yearly update for TTL’s including a practical session. Additionally, General Surgical Registrars and Emergency Medicine Registrars rotating through SMH Major Trauma Centre should have thoracotomy training.
1. If injury mechanism, assessment or investigations raise concerns of significant vascular injury or ischaemia the on-call vascular consultant should be contacted via switchboard.

2. If hard signs of arterial injury are present, surgical exploration is required, with repair and restoration of perfusion within six hours.

3. Fasciotomies should be performed liberally if there is any significant concern that compartment syndrome may occur in an extremity distal to a vascular injury.

4. CT angiography is the primary diagnostic study in a major trauma patient with a suspected vascular injury.

5. If a local hospital without a surgeon with vascular expertise is managing a life threatening vascular injury, the network on-call vascular surgeon should be contacted early via the NBT switchboard to offer advice or attend in person.

### Background

Fewer than 10% of patients with polytrauma have associated vascular injuries but these can cause significant mortality and morbidity. A high degree of suspicion of vascular injury and specific exclusion by the trauma team is required.

Vascular injuries can be progressive and dynamic, making them potentially challenging to detect. For example, contained (e.g. retroperitoneal) or concealed (e.g. muscle compartment) haemorrhage may not be readily apparent at the time of the primary survey, or a contused artery initially may be patent but could later thrombose leading to delayed onset limb ischaemia.

Control of haemorrhage and restoration of perfusion are key to the resolution of vascular injuries. At all times consider the possibility of co-existing acute coagulopathy of trauma; the management of this must be in parallel with the control of anatomical vascular injuries.
The on-call vascular consultant at NBT should be contacted through switchboard in the following circumstances:

- Pre-hospital history includes hard signs of vascular injury or acute limb ischaemia
- Evidence of significant vascular injury from the mechanism, clinical assessment or imaging

The on call vascular consultant should be contacted as soon as possible to enable planning for theatre for emergency vascular care when required.

### Indications to Contact the On-Call Vascular Consultant

### Diagnosis of Vascular Injury

#### History

**Important components of the history include:**

- Mechanism of injury
- Blood loss
- Existence of underlying vascular disease

#### Examination

<table>
<thead>
<tr>
<th>Hard Signs</th>
<th>Soft Signs:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active pulsatile bleeding</td>
<td>History of severe bleeding</td>
</tr>
<tr>
<td>Shock with ongoing bleeding</td>
<td>Diminished distal pulse</td>
</tr>
<tr>
<td>Absent distal pulses</td>
<td>Injury of anatomically related structure</td>
</tr>
<tr>
<td>Signs and symptoms of acute ischaemia</td>
<td>Multiple fractures and extensive soft tissue injury</td>
</tr>
<tr>
<td>Expanding haematoma</td>
<td>Injury in anatomical area of major blood vessel.</td>
</tr>
<tr>
<td>Thrill or bruit</td>
<td></td>
</tr>
</tbody>
</table>

Extensive soft tissue swelling may make evaluation difficult but a diminished or reduced distal pulse is due to arterial occlusion until proven otherwise.
**CT angiography** is the primary diagnostic study in major trauma patients with suspected vascular injury or limb ischaemia.

Even in the presence of hard signs, preoperative imaging may help guide surgical decision making and may be performed if the patient’s haemodynamic condition allows.

**Situations may include:**
- Difficulty determining precise site of injury  e.g. skeletal injury especially the mangled limb, long wound tracts parallel to course of vessel or multiple pellets from shot gun wounds.
- Patients with pre-existing peripheral arterial disease
- Clinical concern that hard signs may be due to extensive bone & soft tissue injury without actual vascular injury
- Planning approach to thoracic outlet injuries

Metallic foreign body (e.g. retained knife blade, pellets & bullets) will produce artefact on CT angiography - preoperative digital subtraction intra-arterial angiography or on table angiography may be more appropriate modes of imaging in these cases.

If preoperative imaging is indicated it must be undertaken rapidly to reduce ischaemic time to a minimum - CT should be complete within 30 minutes of arrival in the MTC.

**Patients with haemorrhagic shock and an unidentified bleeding source** require immediate assessment of the chest, abdominal cavity and pelvis both clinically and with CT (otherwise CXR + FAST scan if CT cannot be accessed within acceptable time-frame)

Patients who are suspected clinically of having thoracic or abdominal bleeding who have a high risk mechanism of injury require CT even if haemodynamically stable

Patients with soft signs of vascular injury may require further assessment with a low threshold for imaging
### Haemodynamically Stable Suspected Extremity Vascular Injuries

<table>
<thead>
<tr>
<th>Normal Vascular Examination and Ankle Brachial Pressure Index (ABPI) of &gt;0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>No further vascular input required.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abnormal Vascular Examination or an ABPI of &lt;0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial imaging required: CT angiography within 30 minutes of arrival in the ED.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vessel Injury and Distal Circulation Compromise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact the network on call vascular surgeon as soon as possible. Further imaging may not be required to confirm management. Circulatory compromise secondary to displaced, angulated long bone fractures and / or joint dislocation e.g. mid shaft femoral or supracondylar humeral fracture should have the injury realigned or relocated as quickly as possible. This will require appropriate analgesia +/- sedation with neurological and vascular examination documented both before and after any manipulation. If following manipulation distal circulation has returned to normal, further vascular intervention may not be required.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hard Signs of Arterial Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with hard signs of arterial injury should be surgically explored and vessels repaired. Surgical restoration of perfusion must be performed in less than six hours. Fasciotomies should be performed liberally if there is any significant concern that compartment syndrome may occur (prolonged ischaemia or significant soft tissue injury)</td>
</tr>
</tbody>
</table>
Massive Extremity Haemorrhage

Patients will not bypass their local hospital that has the capacity to stop uncontrolled ongoing massive extremity haemorrhage.

Life-Threatening Haemorrhage

Life-threatening haemorrhage will be treated in the nearest trauma unit. Once haemorrhage control has been achieved, they will be admitted to the major trauma and arterial centre for ongoing management. See management guidelines below.

Patients Admitted to Trauma Unit Where Vascular Injury Becomes Evident Following Inpatient Admission

If the patient has been admitted to their local hospital and their vascular injury only becomes evident whilst an inpatient, the non-availability of a surgeon with vascular expertise should not delay care - the priority is control of bleeding and/or restoration of distal limb circulation.

Recommended treatment:

- The role of the local surgeon with vascular experience is to repair, reconstruct or ligate the artery or vein that is bleeding (veins are usually safer ligated).
- The network on call vascular surgeon should be contacted early via the NBT switchboard and will either:
  - **Offer advice**: bleeding can be profuse without injury to a major vessel. Many vessels can be simply ligated and this is well within the remit of a surgeon of any speciality
  - **Attend in person**: Unless there is a vascular surgeon on site
  - **Transfer Patient**: This only becomes an option once the haemorrhage is controlled and the patient is haemodynamically stable.
**Haemorrhage Control in Vascular Extremity Injury**

### Initial Control of Non Junctional Extremity Haemorrhage

A stepwise approach should be used:

- **Direct pressure, limb elevation and splintage** are simple and effective methods are often the only measures required to acutely control haemorrhage (especially in upper limb haemorrhage).

- Where the steps above do not adequately control haemorrhage, the addition of proximal pressure to the vascular junction above the site of vascular injury is the next appropriate step.

- If following rapid staged management of major limb haemorrhage has been attempted, Combat Application Tourniquets should be applied to the proximal limb.
  
  The time span for removal should be as short as possible but can be 2-4 hours. Tourniquets, if applied:
  
  - Should be as distal as possible over the proximal part of the limb only. (Presence of 2 bones in the distal limb renders most tourniquets ineffective).
  
  - Tourniquets should be released at approximately 1 hour intervals for a period of a few minutes to allow limb reperfusion where possible; re-application following release may not be necessary once clot has formed.
  
  - Where a single tourniquet is ineffective (commonly on proximal femur), a second, more proximal tourniquet should be placed. Once haemorrhage is effectively controlled, tourniquets should be repositioned as distally as feasible.

- In common with all major haemorrhage, tranexamic acid should be administered within 3 hours of initial injury and standard major trauma principles should be followed.

### Initial Control of Junctional Haemorrhage

Junctional haemorrhage occurs at the site of transition from torso to extremity, i.e root of neck, shoulder, axilla, perineum, buttocks, gluteal area and the groin.

- **Direct Pressure**: should be applied as early as possible. Haemostatic gauze (chitosan) should be packed into significant defects and direct pressure applied.

- **Where expertise is immediately available, direct clamping or temporary ligation may be possible.** E.g. application of arterial forceps to lacerated junctional femoral artery injury. Definitive repair or ligation with subsequently be required.

- **Damage control surgical intervention in the ED maybe required**: these measures may include resuscitative thoracotomy, pelvic packing or REBOA.
• Junctional haemorrhage may be extremely challenging to adequately control and all patients should be prepared for urgent transfer direct to theatre for operative haemorrhage control. Liaison with the theatre coordinator and theatre teams should commence as early as possible.

• In lower torso junctional haemorrhage, a pelvic binder should be applied in all cases. (Co-existing pelvic fractures with consequent risk of massive haemorrhage is common in blunt lower torso trauma, pelvic binder may reduce bleeding and increase haemostasis).

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**Definitive Care of Vascular Injuries**

Vascular intimal defects will heal without complication in about 90% of patients. The risks and benefits of antiplatelet or anticoagulant agents needs to be balanced against the risk of bleeding (e.g. head and / or solid organ injuries) on a case by case basis.

**Thoracic:**

**Hard signs of intra thoracic bleeding require thoracotomy** - in the Emergency Department if the patient is in extremis or has arrested within previous 10-15 mins - see separate Thoracic Injuries guidelines. Thoracic surgeons at University Hospitals Bristol should be informed via switchboard and will attend as soon as possible.

**Thoracic arterial injuries that become evident on CT imaging** should be discussed with the on call vascular, interventional radiology and thoracic surgical consultants.

**Abdomen:**

**Endovascular embolization should be treatment of choice for bleeding from blunt abdominal trauma (if available). Early discussion with Interventional Radiology advised.**

If abdominal bleeding is not treatable endovascularly or if there are other abdominal injuries requiring surgery, then early control should be with damage control surgery and abdominal packing as required.

Ongoing active bleeding intraoperatively despite packing is an indication for aortic cross clamp.

**Pelvis:**

Patients with pelvic ring disruption in haemorrhagic shock require immediate pelvic stabilisation. CT angiography should be undertaken to examine extent of associated arterial and venous injuries. Early involvement of Interventional Radiology and discussion with pelvic surgeons is advised.

Patients bleeding from the pelvis despite stabilisation and endovascular control/embolization require early pre-peritoneal packing (not intraperitoneal laparotomy in the first instance).
Extremities:

Extravasation, pseudoaneurysm, occlusion or arteriovenous fistula of major arteries within the upper limb and thigh (common femoral, superficial femoral and popliteal artery but not the profunda femoris artery) should usually be managed by open surgery. Temporary intravascular shunts to arterial and large vein injury should be considered in a damage control situation.

In patients without progressive shock, the presence of extravasation, pseudoaneurysm, occlusion or arteriovenous fistula within the profunda femoris artery or crural arteries may be amenable to observation (if artery occluded) or endovascular embolization (extravasation, pseudoaneurysm, or arteriovenous fistula).

Major Haemorrhage, Circulation and Vascular Trauma References

Cardiac injuries, including resuscitative thoracotomy:
1. EAST Guidelines: Emergency Department Thoracotomy

Traumatic Vascular Injury Management:


5. Prehospital control of life-threatening truncal and junctional haemorrhage is the ultimate challenge in optimizing trauma care; a review of treatment options and their applicability in the civilian trauma setting. S. E. van Oostendorp et al. Scand J Trauma, Resus & EM, 2016, 24:110

6. Management of bleeding following major trauma: an updated European guideline Critical Care 2010 14:R52

7. Standards of Practice and Guidelines for Trauma Radiology in Severely Injured Patients, The Royal College of Radiologists Dec 2010

8. Epidemiology of urban trauma deaths; a comprehensive reassessment 10 years later. World J Surg 2007 31;1507-1511 Cothren CC, More EE, Hedegaard HB, Meng K

ABDOMEN & PELVIS
1. All patients with suspected abdominal injuries who remain cardiovascularly unstable in spite of full resuscitative measures should undergo immediate emergency damage control laparotomy.

2. Most stable patients with abdominal trauma will benefit from CT imaging to identify visceral injury or bleeding sites. CT scanning will determine best management - conservative, interventional radiology, or surgical repair.

3. In the presence of a pelvic fracture, a binder should be in place before laparotomy is performed.

4. Damage control surgery or interventional radiology procedure should be undertaken concurrently with haemostatic resuscitation.

5. In the haemodynamically stable blunt abdominal trauma patient, abdominal CT with IV contrast should be performed to identify and assess injury severity.

6. Patients with CT evidence of high grade injury are more likely to require operative management, however treatment decisions depend on stability of patient and not grade of injury.

7. If high-grade liver injuries are present on CT, consider contacting the on-call hepatobiliary surgeon at University Hospital Bristol.

8. In patients with a low risk pelvic fracture and no evidence of urethral injury on physical examination, it is reasonable to make one attempt at passage of a Foley catheter.
General Principles in Management of Abdominal Trauma

Primary Survey

The aim of the primary survey in abdominal trauma is to identify patients needing immediate damage control laparotomy: patients with suspected abdominal injuries and uncontrollable haemorrhage in spite of full resuscitative measures should undergo early damage control laparotomy.

In the presence of a pelvic fracture, a binder or external fixator should be in place before laparotomy is performed

Unstable patients with diffuse peritonitis, evisceration or impalement after abdominal trauma should also undergo surgery as soon as possible after arrival in the Emergency Department. If CT scan cannot be completed within 15 mins of arrival, consider transfer of patient to theatre for emergency laparotomy.

Secondary Survey

Secondary survey should aim to identify additional signs indicating the need for operative management of conditions that may not have been identified on imaging or during primary assessment.

The abdomen should be examined in all regions identified below, particularly in the context of penetrating trauma.

Signs to identify on secondary survey:

- Abrasions, bruising or seat belt sign - 11.9% of patients with "seat belt" contusions require subsequent laparotomy
- Periumbilical (Cullens) or flank (Grey-Turners) ecchymosis
- Genital or perineal ecchymosis (pelvic or urological injury)
- Lower thoracic rib crepititation (association with hepatic/splenic injury)
Where damage control surgery is required, immediate transfer to theatre should be arranged and massive haemorrhage protocol activated.

**Damage Control Surgery**

Damage control surgery (DCS) has been shown to reduce mortality in severely and multiply injured patients. DCS involves immediate operative control of haemorrhage and gastrointestinal contamination; intraperitoneal packing, decontamination and temporary abdominal closure achieved concurrently with haemostatic resuscitation, patient warming and management of coagulation. The resuscitation phase continues during transfer and following arrival on the intensive care unit.

Once the patient is stabilised on intensive care, further operative management can be undertaken to achieve definitive treatment of the patient’s injuries.

**The aim is to complete the laparotomy within an hour and for the patient to be transferred to ICU.**

In theatre the patient should be exposed from nipples to knees so groins are exposed if needed for vascular surgery. A laparotomy, thoracotomy and major vascular set should be available at start of procedure.

A generous midline abdominal incision should be used. Trauma laparotomy should be performed in a standard fashion by packing the four quadrants and evaluating the intra-abdominal organs in a systematic fashion, and when indicated, exploring the retroperitoneum.

Injuries to the gastrointestinal tract should be evaluated and repaired in a systematic manner. Control of intra-abdominal haemorrhage should be the first priority to minimise the need for transfusion, followed by control of gastrointestinal contamination.

Please refer to NBT Damage Control Laparotomy protocol for detailed guidance.

A focused team brief occurs at the start of surgery lead by the TTL.

Situation reports occur every 10 minutes to ascertain haemodynamic state of patient and surgical progress.

At an hour if haemodynamic stability has not been achieved, a second opinion is sought from the TTL or ICU consultant to ascertain whether continuing surgical intervention is appropriate.
Diagnostic Laparoscopy

Diagnostic laparoscopy is rarely useful in major trauma except for inspecting the diaphragm in thoraco-abdominal wounds, although some studies suggest it may be useful in evaluating the depth of wound tracts and identifying visceral injury in patients with equivocal peritoneal penetration.

Selection of Abdominal Trauma Patients for Non-Operative Management

Penetrating Abdominal Trauma

Laparotomy is not routinely indicated in haemodynamically stable patients with abdominal stab wounds without signs of peritonitis or diffuse abdominal tenderness (away from the wounding site) in centres with surgical expertise.

Laparotomy is not indicated in haemodynamically stable patients with abdominal gunshot wounds if the wounds are tangential and is no peritonism.

Blunt Abdominal Trauma

Laparotomy is not indicated in the haemodynamically stable patient without peritonitis presenting with an isolated blunt hepatic or splenic injury or abdominal free fluid without evidence of solid organ injury.

Management should consist of imaging followed by serial examinations, ideally by the same surgeon or trainee if possible.

Solid Organ Injuries

In the haemodynamically stable blunt abdominal trauma patient without peritonitis, an abdominal CT scan with intravenous contrast should be performed to identify and assess the severity of injury to the liver and spleen.

The initial management of patients with blunt hepatic or splenic trauma should be mandated by their haemodynamic status rather than their grade of hepatic injury.

The severity of hepatic injury or splenic injury (as suggested by CT grade or degree of haemoperitoneum), neurologic status, age of more than 55 years, and/or the presence of associated injuries are not absolute contraindications to a trial of non-operative management in a haemodynamically stable patient.
Management of Liver Injuries

The initial management of patients with blunt hepatic trauma should be mandated by their haemodynamic status rather than their grade of hepatic injury.

The AAST grading system is most useful for predicting the likelihood of success with non-operative management, which is higher for low-grade injuries (Grade I, II, III) compared with high-grade injuries (Grade IV, V). Patients with Grade VI injuries are universally haemodynamically unstable, mandating surgical intervention.

If high-grade liver injuries are present on CT please contact the on-call hepatobiliary surgeon at University Hospitals Bristol. Haemodynamically unstable patients require urgent, damage control laparotomy.

Control of hepatic haemorrhage is approached in a step-wise fashion. Initial control of bleeding is performed with manual compression, portal clamping or perihepatic packing. Ongoing mild-to-moderate bleeding from the parenchyma can be controlled using topical haemostatic agents, electrosurgical techniques, and ligation of the parenchymal vessels. If there is difficulty in controlling bleeding please contact the hepatobiliary surgeon on call at University Hospital Bristol; more severe injuries may require liver suturing techniques or hepatic artery ligation may be needed. If these techniques fail, the segment of liver may need to be resected.

Non-operative management is the treatment of choice for haemodynamically stable patients with hepatic injury. It consists of observation and supportive care with the adjunctive use of arteriography and hepatic embolisation.

Patients who are haemodynamically stable but demonstrate extravasation from the liver on (CT) have higher failure rates with non-operative management. These patients should undergo arteriography and possible liver embolisation followed by observation and serial haemoglobin determination.

Follow-Up Care:
There are few data to guide the routine care and follow-up of patients with hepatic injury who have been managed non-operatively. No definitive recommendations have been established regarding the need or timing of follow-up imaging, need for or duration of bed rest, timing of return to daily activities and/or exercise, time to initiate prophylactic or therapeutic anticoagulation.
A length of stay between 3-5 days depending on grade of injury would be appropriate for patients with isolated hepatic trauma. It is a common recommendation that patients avoid strenuous activities for six weeks. For patients with higher grade injuries, strenuous physical activity is restricted for a longer period of time up to three months.
Management of Splenic Injuries

The initial management of patients with splenic trauma should be mandated by their haemodynamic status rather than their grade of injury.

Haemodynamically unstable splenic injury patients need urgent laparotomy or radiologic splenic embolisation.

The decision to perform splenectomy versus splenic salvage (ie, splenorrhaphy, partial splenectomy) is made based upon the grade of injury, associated injuries, patient condition and experience of the surgeon. The small future risk of overwhelming post-splenectomy sepsis needs to be balanced against the more significant risk of recurrent haemorrhage.

When considering splenic salvage, the surgeon must determine whether the patient can tolerate rebleeding and reoperation for the small, but real, risk of recurrent haemorrhage. Splenectomy is often a more appropriate choice for patients with multiple injuries or comorbidities who may not tolerate a significant or recurrent episode of hypotension or a second surgical procedure.

Splenectomy is more appropriate for patients requiring urgent surgical management of other significant injuries that preclude taking the extra time needed for splenic salvage. In the setting of damage control, delayed splenic salvage can be considered (within 24 to 48 hours) for low-grade splenic injuries, provided that the bleeding is controlled with packing. Splenectomy is the safest option, given that most patients who require damage-control surgery are on the brink of physiological collapse and will poorly tolerate recurrent haemorrhage.

Non Operative Management and Embolisation:

Haemodynamically stable patients with blunt or penetrating splenic injuries may be initially observed safely. Patients who meet the criteria for observation but who require intervention to manage extra-abdominal injuries (eg, leg fracture stabilisation) can also be safely observed.

The duration of observation should be based upon the grade of splenic injury, nature and severity of other injuries, and the patient’s clinical status.

The largest case series published (24,000 participants) showed an observation period of three days identifies at least 95 percent of patients who would require some form of intervention. Of all patients who required surgical intervention in this series, 90% required surgery within 24 hours, 94% by 48 hours, and 95% by 72 hours. Higher-grade injury (≥III) generally requires longer observation periods. Those with Grade IV injuries have a 53% chance of failure of non-operative management. The authors’ recommendation was for observation for 3-5 days depending on grade of injury.
There is debate over the difference in the rate of survival, length of hospital stay or length of ICU stay in patients who have successful non-operative management versus those that fail non-operative management. The most recent data shows failure of non-operative management to have a detrimental effect.

**Contraindications to Non-Operative Management:**
Relative contraindications include a high ISS, higher AAST grade splenic injury (Grades III-V), age >55 years, presence of a moderate to large haemoperitoneum, active contrast extravasation, refusal of blood transfusion in the setting of pre-existing anaemia, portal hypertension, or altered neurologic status precluding adequate serial abdominal examination.

**Embolisation:**
Splenic embolisation is available 24/7 at North Bristol NHS trust. Where available, embolisation is potentially most useful when employed selectively in transient responders to resuscitation or haemodynamically stable patients who have CT findings that include active contrast extravasation, splenic pseudoaneurysm, or large volume haemoperitoneum.

Splenic embolisation is associated with risks including bleeding, pseudoaneurysm formation at the arterial puncture site, splenic infarction, splenic/subdiaphragmatic abscess, inadvertent embolisation of other organs (eg. kidneys) or lower extremities, allergic reaction to contrast and contrast-induced nephropathy. In spite of these risks, embolisation is less invasive and significantly reduces morbidity in correctly selected and managed patients.

Patients who fail observation require either splenic embolisation, or operative management. Common reasons include: haemodynamic instability, diffuse peritoneal signs, falling haemoglobin attributed to splenic haemorrhage.

**Post splenectomy vaccination**
Immunisation is recommended for asplenic patients, since splenectomy impairs opsonisation of encapsulated organisms. All splenectomy patients should be immunised at the time of discharge, regardless of the postoperative day if they have not already received the appropriate vaccinations.

Asplenic patients should receive a booster dose of HiB/Men C vaccine and a single dose of pneumococcal polysaccharide vaccine. They also receive yearly influenza vaccinations.

**Advice to patient**
A recent systematic review suggested to advise patients to rest at home for 3 weeks and avoid high-risk activities (e.g. contact sports, mountain biking, skiing etc) for up to 3 months. However, there is a lack of consensus on this with recommendations varying from 3 weeks to 6 months. There is some evidence to suggest higher grade injuries take longer to heal.
CT abdomen is the most sensitive non-invasive imaging test for identifying specific intra-abdominal injuries in haemodynamically stable patients with blunt injury. Findings should be evaluated in the context of the patient’s clinical condition. Intraperitoneal free air, vascular beading, abrupt vessel termination, or extra-luminal contrast are highly suggestive of injury.

Patients with CT findings suggestive of bowel injury require urgent laparotomy.

Those patients who have sustained penetrating injury which has not breached the peritoneal cavity or blunt trauma with no CT findings suggestive of injury may be treated conservatively.

Maintain a high index of suspicion for bowel injury if initial CT findings do not show free fluid or free air. Persistent lactic acidosis an indication for laparotomy.

Operative Management of Bowel Injuries.
Patients who are haemodynamically stable with limited extra-abdominal injuries should undergo definitive management of their bowel injuries at initial exploration.

In damage control surgery (DCS), repair of gastrointestinal injury should be delayed until after haemodynamic stabilisation, (typically within 24 hours). Contamination is controlled by stapling off bowel ends and resecting damaged bowel. Formation of a defunctioning stoma is delayed until definitive surgery. Repair should be undertaken no later than 48 to 72 hours after injury.

The anterior and posterior surfaces of the stomach should be inspected for signs of contusion or laceration. The posterior surface can be examined after opening the lesser sac. Ligating a few of the short gastric arteries will facilitate exposure. Small gastric perforations can be identified by injecting air into the nasogastric tube to insufflate the stomach and then filling the abdomen with saline to cover the stomach while observing for air bubbles. Alternatively, methylene blue can be instilled into the stomach via the nasogastric tube and the stomach inspected for leakage.

The entire bowel and mesentery, beginning from the ligament of Treitz, should be examined. All abnormalities should be thoroughly evaluated and tagged (eg, bowel clamp), but definitive repair should not be undertaken until the entire length of bowel has been examined.

Evaluation of duodenal injury requires mobilising the duodenum from its retroperitoneal attachments. The pancreas, which is commonly injured as well, should also be examined. Duodenal and pancreatic injuries are discussed in detail separately.

If there is evidence of large bowel injury, the involved region of the colon should be fully mobilised to allow inspection of the colon circumferentially.
Active mesenteric arterial bleeding can usually be controlled with simple ligation. Embolisation may be appropriate for patients with a transient response to resuscitation.

Due to the rich collateral blood supply to most areas of the small intestine, limited ligation of mesenteric arterial vessels will not result in bowel compromise. Multiple ligations, proximal arterial branch ligation, or mesenteric resection may necessitate resection of the associated bowel. Once mesenteric bleeding or injury have been controlled viability of the bowel should be assessed.

A defunctioning stoma may be required in the presence of an open bony injuries to any body part to limit contamination.

Management of Pancreatic and Duodenal Injuries

Damage control to manage duodenal injuries involves rapid closure of the injured segment or resection of full-thickness injury without re-establishing continuity. For suspected pancreatic duct injuries, wide drainage is used, but if injury is distal, a quick distal pancreatectomy can be performed. In these injuries or where there is uncertainty, the oncall consultant in hepatobiliary surgery at University Hospitals Bristol should be contacted.

Bleeding from the pancreas distal to the head of the pancreas can usually be controlled with packing; however, high grade injuries to the head of the pancreas, may also involve the duodenum, and are often associated with bleeding that cannot be controlled by packing. In these cases resection without reconstruction may be needed.

To resect the proximal duodenum and pancreas, the pylorus, pancreatic neck, and proximal jejunum are stapled across and transected, the common bile duct is ligated, and the biliary tract is drained using tube cholecystostomy Closed suction drains are placed to control duodenal and pancreatic secretions. Following resuscitation and stabilisation, definitive resection and reconstruction (Whipple) can be performed by the hepatobiliary team at UH Bristol.

For high grade injuries to the upper GI tract please contact the Upper GI surgical team at the Bristol Royal Infirmary.
Management of Renal Injuries

History and examination: the mechanism of injury may suggest a renal injury (rapid deceleration injury or direct blow to flank). Most renal injury in UK is due to blunt trauma but examine to exclude penetrating trauma. Consider pre-existing renal disease (eg single kidney). Record any changes in haemodynamic stability – any change may indicate significant renal injury.

Diagnostic: Check urine for haematuria in all patients with suspected renal injury both visually and by dipstick. A significant renal injury (eg PUJ disruption, segmental arterial thrombosis) may still be present in the absence of haematuria. Baseline serum creatinine should be noted to assess for existing renal injury or impairment. Check haemoglobin levels.

Imaging: CT with contrast and delayed images if the patient is stable will evaluate the grade of renal injury, the presence and uptake of contrast by the contraleteral kidney and will image other retroperitoneal structures.

Indications for imaging with CT:
- Blunt trauma patients with visible haematuria or non visible haematuria and haemodynamic instability
- Patients with history of a rapid deceleration injury and/or significant other injuries
- All patients with a history of abdominal/lower thoracic penetrating trauma

Management

Conservative management:
- Blunt renal injuries – in the presence of haemodynamic stability most renal injuries can be managed expectantly. Grade 1-3 managed with bed rest and observation. Grade 4-5 if haemodynamically stable and have no other indications for exploration can be managed expectantly with bed rest and observation.
- Penetrating renal injuries – in the presence of haemodynamic stability and where there are no other indications to explore, renal injuries can be managed conservatively.
- In both circumstances, repeat imaging of significant renal injuries (Grades 3-5) 48-72 hours after presentation is required to re assess progress and potential complications.
**Interventional radiology:**
Angiography with selective embolisation is the first line option in the absence of other indications for immediate open surgery.

Indications for angiography:
- Embolisation for active haemorrhage
- Pseudoaneurysm
- Vascular fistula

The aim is to reduce the need for open surgery and potentially a nephrectomy. In cases of multi trauma or high operative risk the main renal artery may be embolised as definitive treatment or followed by interval nephrectomy.

**Surgical management:**
Indications for open surgery:
- Continuing haemodynamic instability due to renal injury which is unresponsive to fluid resuscitation
- Expanding or pulsatile peri-renal haematoma identified at exploratory laparotomy
- Exploration for associated injuries
- Vascular grade 5 injuries if embolisation is not suitable or fails

Parenchymal Grade 5 injuries may be managed conservatively if they are stable. The need for intervention increases in cases with ongoing requirement of blood and fluid, large peri-renal haematoma (>3.5cm) and the presence of contrast extravasation.

The overall aim of exploration after renal trauma is control of haemorrhage and renal tissue salvage. Stable haematoma detected during exploration should not be opened. Intra-operatively, renal reconstruction should be attempted only when haemorrhage is controlled and there is enough viable renal parenchyma.

Non-operative management is the treatment of choice in most renal injuries.

**Follow up:** The risk of complications increases with renal injury grade. Repeat imaging should be undertaken at 48-72 hours in grade 3-5 to reduce the risk of missing complications. Repeat imaging is required if there is fever/loin pain/change in Hb. Long term, nuclear medicine scans are undertaken after significant renal injury to assess functional recovery.
Urological Injuries

All patients suffering high-energy trauma must have examination of the perineum and genitalia including a rectal examination and the findings documented in the medical records.

Urethral injury is rare in isolated acetabulum, ilium or sacrum fractures. Other low risk fractures include: single ramus fractures and ipsilateral rami fractures without posterior ring disruption.

In patients with a low risk pelvic fracture (see above) and no evidence of urethral injury on physical examination (blood at meatus or presence of haematuria), A single, gentle attempt at catheterisation, by an experienced doctor, is permissible. A 16F soft, silicone catheter should be used.

The procedure and the presence of clear or blood stained urine must be documented in the medical records.

If the catheter will not pass or passes and drains only blood, do NOT inflate balloon. Withdraw catheter and perform a retrograde urethrogram. The finding of blood stained urine mandates a retrograde cystogram via the catheter.

If a urethral catheter cannot be passed, a suprapubic catheter will need to be inserted either percutaneously or via open cystotomy if the patient is required to have an emergency laparotomy.

If there is a urethral or bladder injury, the on-call urologist should be informed immediately so that a treatment plan can be formulated and documented.

The placement of a suprapubic catheter may alter the timing of pelvic fracture surgery and so the pelvic fracture service should be involved at an early stage.

A percutaneous, suprapubic catheter should be placed using a Seldinger technique under ultrasound control by a doctor experienced in this technique. The skin insertion point MUST be in the midline and should be 3 to 4 fingers-breadths above the symphysis. A 16F silicone catheter should be used.

In females, suspected urethral injury mandates discussion with urology; urethrogramy is not indicated in the emergency department.

Bladder injuries are associated with pelvic fracture or a blow to an overdistended bladder. They may be intraperitoneal (requires surgical repair) or extraperitoneal (may be managed conservatively).

If a bladder injury is suspected, haematuria is cardinal sign, place a urethral catheter (consider associated urethral injury – see above) and leave on free drainage. A CT with contrast done for
trauma assessment may identify large bladder ruptures but will not exclude small leaks. To exclude small perforation a stress retrograde cystogram is required (minimum 350ml dilute contrast) via a urethral catheter. Irrigation should not be used in the presence of bladder perforation.

Patients with microscopic haematuria, but without apparent significant genitourinary injury, should be referred for routine outpatient urology follow-up.

### Management of Major Blood Vessel Injuries

Damage to major blood vessels will require urgent referral to the on-call vascular surgeon. See separate vascular injuries guideline.

### Abdominal Wall Closure

#### Laparostomy

Following trauma surgery, a decision to close the abdomen with or without skin closure depends upon the ability to approximate the fascial edges, the amount of intra-abdominal contamination, the potential for anastomotic breakdown, and the need to perform a second-look operation.

In patients undergoing damage control surgery and in those with a planned second-look operation to assess bowel viability, the abdomen should be left open and a temporary abdominal closure used. Leaving the abdomen open may also be more prudent in patients who are at risk for abdominal compartment syndrome.

The preferred method of this at North Bristol NHS Trust is with a negative pressure system (Ab Thera trademark KCI). The system is kept in theatres on both level 2 and level 3. The plastic liner is placed over the abdominal contents into the paracolic gutters. 2 sponge layers are applied and the pressure is usually set at 125mmHg. It can be set lower if there is concern about bleeding. However, the intention is that packing should control the bleeding before application of the dressing.

If re-look laparotomy does not occur to undertake definitive surgery, the dressing should be changed every 48 hours, up to 72 hours maximum. In the absence of a requirement for further surgery, the presence of a laparostomy is to reduce oedema, prevent intra-abdominal hypertension and reduce contamination. If an abdomen is left open the aim is to close it within 10 days. After this it is unlikely that fascial closure will be achieved.

The preferred method of closure within this period is primary closure but sometimes a mesh is necessary to bridge the fascial gap. The choice of mesh in this situation is a vicryl mesh.
Management of the open abdomen should be consultant lead. The leads for the open abdomen at NBT, Miss Burt and Miss Pullyblank are available for advice.

**Long term management of the open abdomen**

If fascial closure is not achieved then the dressing is changed to a conventional VAC dressing. Insertion of a vicryl mesh to bridge the fascial defect will aid changing to conventional Vac Rx. It is essential that the mesh and bowel are protected with Adaptic touch (trademark) or equivalent before applying the sponge foam. Once the wound has granulated then healing can be facilitated by a Skin graft.

Longer term, the patient may require abdominal wall reconstruction as they will be left with a muscle defect and incisional hernia.

### Additional Considerations

#### Antibiotics

Prophylactic intravenous antibiotics should be given to all patients who require trauma laparotomy. Antibiotic prophylaxis should be as specific as possible and directed at the site of injury. If upper and lower tract injuries are suspected, or the site and severity are unknown, broad-spectrum coverage is appropriate.

For patients who require abdominal exploration, a single dose of prophylactic antibiotics given within one hour of incision is appropriate. In the face of hollow viscus injury, antibiotics can be continued, and provided there has been no delay in identification and surgical management, no more than 24 hours should be needed.

#### Venous Thromboembolism Prophylaxis

Where possible, all hospitalised patients with traumatic injuries should receive at least one mode of VTE prophylaxis. Use a combination of pneumatic compression devices and low molecular weight heparin. Patients at risk who do not have a contraindication to antithrombotic therapy should receive pharmacologic prophylaxis irrespective of their mobility.
Patients not known to have immunity against tetanus should receive prophylaxis if they sustain a tetanus prone wound. Tetanus prone wound is defined as:

- Wounds or burns that require surgical intervention that is delayed for more than six hours
- Wounds or burns that show a significant degree of devitalised tissue or a puncture-type injury, particularly where there has been contact with soil or manure
- Wounds containing foreign bodies
- Compound fractures
- Wounds or burns in patients who have systemic sepsis
Management of Pelvic and Acetabular Fractures

North Bristol NHS Trust Major Trauma Centre standards of practice are based on:

- British Orthopaedic Association Audit Standards for Trauma “The Management of Patients with Pelvic Fractures”, January 2018

The Trust is fully compliant with all of the above guidelines.

Key Points and guidance which follow are drawn from the above national guidance as well as expert experience and consensus from the specialist pelvic and acetabular service and North Bristol NHS Trust. Where standards of care exceed or surpass the above guidelines, this is clearly stated in the guidelines which follow.

### Key Points

1. All patients with suspected pelvic fractures should have a pelvic binder applied as part of their initial management if not already applied prehospital.

2. The trauma team should confirm correct application and position of pelvic binder during initial primary survey in the Emergency Department.

3. Patients presenting with cardiovascular instability secondary to pelvic injury need prompt volume resuscitation in addition to the correct application of a pelvic binder. This resuscitation should follow the NBT Major Haemorrhage protocol. Resuscitation should take place in one location wherever possible to minimise delays.

4. Patients with suspected pelvic fractures from high-energy trauma should have a CT scan with IV contrast including head, chest, abdomen and pelvis on admission. This should include a head to toe scanogram.

5. Imaging (trauma scan) should be performed prior to theatre as this is essential to any decision making.

6. Decisions regarding ongoing treatment (ITU, theatre for packing / ex fix and/or interventional radiology) should be discussed between TTL, Orthopaedic and IR consultants directly and not go through junior colleagues on their respective teams.
7. All polytrauma patients require a binder-off X-ray after resuscitation, even in the presence of a ‘negative’ CT scan because a well-applied pelvic binder can mask a catastrophic pelvic ring injury.

8. The primary treatment of patients sustaining pelvic injury who are haemodynamically unstable is pelvic stabilisation (with initial binder placement) and resuscitation. If a patient remains unstable, they may require pelvic packing in theatre.

9. The only indication for IR selective embolisation is patients remaining unstable, with active arterial bleeding on imaging, who do not need to go to theatre for any other reason. The presence of arterial blush on the initial scan is not an absolute indication for IR. A decision to go down any of these paths must not delay the need for prompt resuscitation with blood products, guided by dynamic measures of clotting (e.g. ROTEM).

### Emergency Management of all Pelvic and Acetabular Fractures

- These guidelines apply to all suspected pelvic ring injuries **except for simple pubic rami fractures**.

- Pelvic fractures (except for simple pubic rami fractures) warrant trauma team activation.

- Suspected pelvic ring injuries should have a pelvic binder correctly applied as early as possible, ideally in the prehospital phase of initial patient care.

- The trauma team should ensure correct position and presence of pelvic binder. The pelvic binder should be centered over the greater trochanters.

- Minimal patient handling must apply until the pelvis is “cleared”; the trauma team **should not test for pelvic mechanical stability**.

- Inspect and document any injuries to the perineum, rectum and vagina in all cases of suspected pelvic ring fracture.

### Vertical Shear Injury

In addition to application of a pelvic binder, skeletal traction using a distal femoral traction pin (protecting the knee joint) should also be applied as soon as possible and while still within the Emergency Department as decided by the on-call orthopaedic consultant.
Lateral Compression Injury

This rarely requires emergency stabilisation. There is no contraindication to applying a pelvic binder but other sources of haemorrhage should be sought. Pelvic binder should be removed once the diagnosis is made and haemodynamic stability is established.

Haemodynamic Instability Associated with Suspected Pelvic Fracture

- Patients presenting with cardiovascular instability secondary to pelvic injury need prompt haemostatic (i.e. blood component) resuscitation in addition to the correct application of a pelvic binder.

- The major haemorrhage protocol should be activated and shock packs 1 + 2 as requested. Blood components should be transfused as per the major haemorrhage protocol until cardiovascular stability is restored.

- Resuscitation should take place in one location wherever possible to minimise delays.

- All patients require IV tranexamic acid as soon as possible and ideally within an hour of injury. See separate guideline.

- All patients with blunt polytrauma undergoing damage control laparotomy should have imaging of the pelvis before surgery (X-ray or CT). A pelvic binder should be in-situ during surgery and this should not be removed for a post binder pelvic X-ray until the patient is haemodynamically stable.

- Following pelvic binder application concurrent with haemostatic resuscitation via the major haemorrhage protocol, primary treatment of patients sustaining pelvic injury who are haemodynamically unstable is surgical pelvic stabilisation.

- The primary treatment of patients sustaining pelvic injury who are haemodynamically unstable is pelvic stabilisation (with initial binder placement) and resuscitation. If a patient remains unstable after shock pack 2, they may require pelvic packing in theatre.

- The only indication for IR selective embolisation is patients who remain unstable, with active arterial bleeding on imaging, who do not need to go to theatre for any other reason. The presence of arterial blush on the initial scan is not an absolute indication for IR. A decision to go down any of these paths must not delay the need for prompt resuscitation with blood products, guided by dynamic measures of clotting (e.g. ROTEM).
Decisions relating to subsequent or ongoing treatment (e.g. theatre for packing / external fixation / interventional radiology / ITU) should be discussed between trauma team leader, Orthopaedic and Interventional Radiology Consultants directly. These decisions must not be communicated or taken by non-consultant grade doctors on their respective teams.

These cases are rare and should be reviewed by governance structures within major trauma and relevant specialities to promote shared learning and guide future treatment decision making.

### Imaging in Suspected Pelvic Ring Fracture

- Imaging should **always** be performed prior to theatre as this is essential to any decision making.

- Patients with suspected pelvic fractures from high-energy trauma should have a CT scan **with IV contrast** including head, chest, abdomen and pelvis on admission. This should include a head to toe scanogram.

- In the very rare case when CT scanning cannot be performed then an AP pelvic radiograph must be performed prior to theatre.

- CT scanning of the entire spine, is recommended in all cases of displaced pelvic ring injuries and acetabular fractures.

- All polytrauma patients require a “binder off” X-ray after resuscitation, even in the presence of a ‘negative' CT scan because a well-applied pelvic binder can mask a catastrophic pelvic ring injury.

- A team member competent in application of a pelvic binder and with the skills, knowledge and competence and resources to manage acute decompensation of a trauma patient should be present for removal of binder and during acquisition of “binder off” x-rays due to rare but potentially dangerous risk of patient deterioration following removal of pelvic binder. The binder should be immediately re-applied if this occurs.
Management of Specific Injuries

### Urological Injuries

- All patients suffering high-energy trauma must have examination of the perineum and genitalia including a rectal examination and the findings documented in the medical records.

- Urethral injury is rare in isolated acetabulum, ilium or sacrum fractures. Other low risk fractures include: single ramus fractures and ipsilateral rami fractures without posterior ring disruption.

- In patients with a low risk pelvic fracture (see above) and no evidence of urethral injury on physical examination (blood at meatus or presence of haematuria), a single, gentle attempt at catheterisation, by an experienced doctor, is permissible. A 16F soft, silicone catheter should be used.

- The procedure and the presence of clear or blood stained urine must be documented in the medical records.

- If the catheter will not pass or passes and drains only blood, do NOT inflate balloon. Withdraw catheter and perform a retrograde urethrogram. The finding of blood stained urine mandates a retrograde cystogram via the catheter.

- If a urethral catheter cannot be passed, a suprapubic catheter will need to be inserted either percutaneously or via open cystotomy if the patient is required to have an emergency laparotomy.

- If there is a urethral or bladder injury, the on-call urologist should be informed immediately so that a treatment plan can be formulated and documented.

- The placement of a suprapubic catheter may alter the timing of pelvic fracture surgery and so the pelvic fracture service should be involved at an early stage.

- A percutaneous, suprapubic catheter should be placed using a Seldinger technique under ultrasound control by a doctor experienced in this technique. The skin insertion point MUST be in the midline and should be 3 to 4 fingers-breadths above the symphysis. A 16F silicone catheter should be used.
Early diagnosis of an open pelvic injury is essential. It is mandatory to involve the on call general surgical consultant and/or gynaecologist as soon as the diagnosis is made.

- Prior to formal debridement wounds should be handled only to remove gross contamination and to allow photography, then dressed with a saline-soaked gauze (or haemostatic gauze if required) and covered with an occlusive film. ‘Mini-washouts’ outside the operating theatre environment are not indicated.

- Open pelvic fractures associated with wounds to the lower abdomen, groin, buttocks, perineum, anus (including sphincters) and rectum require urgent assessment by a consultant general or colorectal surgeon and wound debridement. Clinically and/or radiologically proven or suspected injuries to the anus and/or rectum may initially require construction of a defunctioning stoma. Nursing care of wounds to the perineum or buttocks may also require a defunctioning stoma. This should be placed away from the potential surgical wounds required for pelvic reconstruction.

- Wounds should be debrided:
  - Immediately for highly contaminated wounds (agricultural, aquatic, sewage) or when there is an associated vascular compromise.
  - Within 12 hours of injury for all other open injury patterns

- Definitive soft tissue closure or coverage should be achieved within 72 hours of injury if it cannot be performed at the time of debridement

- Basic principles of care of open fracture care apply:
  - antibiotic prophylaxis for infection
  - pelvic stabilisation by external fixation.

**Acetabular Injuries**

**Combined Acetabular and Pelvic Ring Injury**

It is important to distinguish between pelvic and acetabular fracture, as the latter injury does not require external fixation, which will be ineffective and may interfere with later definitive surgical fixation. Acetabular fractures and fracture-dislocations can sometimes be made worse by application of a pelvic binder.
**Hip Dislocation**

Examine for signs of hip dislocation, joint incongruity, associated femoral head or neck fracture and neurological injury. Perform AP radiograph. Should be reduced within 6 hours and placed on skeletal femoral traction. Occasionally an anti-rotation boot is also required if the joint is very unstable. It is mandatory to perform a detailed neurological and vascular assessment of the limb(s) before and after reduction of a dislocation. If the hip is irreducible, remains highly unstable or a new neurological lesion develops after reduction, urgent advice should be sought from one of the pelvic and acetabular surgeons.

**Ipsilateral Acetabular Fracture and Femoral Fracture**

When stabilising the femoral fracture, avoid any incisions around the hip if possible, to avoid compromising later acetabular surgery. Alternatives to standard anterograde femoral IM nailing include temporary skeletal traction, external fixation, plate fixation or retrograde femoral nailing. If possible, please discuss the surgical plan with us.

**Imaging**

**Plain X-rays:** AP pelvis, Judet oblique views of whole pelvis

**Spine:** CT scanning of the entire spine, is recommended in all cases of acetabular fracture. A combined pelvic and acetabular fracture will require AP pelvis radiograph plus inlet/ outlet views and Judet oblique views of the whole pelvis.

**DVT Prophylaxis**

Start Clexane 40mg s/c od (or other LMWHeprarin) within 24 hours of admission unless there is a contraindication, such as allergy to heparin, intracranial haemorrhage, an unstable spinal fracture or persisting haemodynamic instability.

We advise the addition of a proton pump inhibitor (e.g. omeprazole 20mg PO/NG BD) or ranitidine 150mg PO/NG BD for gastric protection. NSAIDs should be stopped and not used for analgesia.
The patient should have a full neurological examination recorded and the findings on rectal and vaginal examinations noted. It is essential the findings of the primary and secondary surveys are clearly documented.

All patients should undergo tertiary survey at 24 hours – see tertiary survey protocol.

Documentation

Referral From Trauma Units

Please refer patients with pelvic trauma as soon as possible, preferably by the next working day as our target is to transfer the patient within 48 hours of injury. Even if the patient is not fit for transfer immediately, it is important that we are made aware, to facilitate the further management. Late referrals of patients may compromise subsequent care or result in further delay in arranging transfer and treatment.

Use the pelvic injury referral form when referring a pelvic fracture. The form can be found in Appendix S (page 279).

Our initial point of contact is via the Orthopaedic Department at North Bristol NHS Trust on 0117 414 1623 who would then direct you to one of the pelvic surgeons (Mr Ward, Mr Chesser, Mr Acharya,). Out of hours, the on-call Orthopaedic Registrar can be contacted.

Out of hours through Southmead Hospital switchboard (0117 9505050), who will then contact the on-call trauma orthopaedic consultant.

A referral form outlining the pertinent information required when referring a pelvic and acetabular fracture can be found in Appendix S. It is expected that initial imaging will be completed in the referring hospital.

While arranging transfer of the patient, the appropriate investigations and treatment of associated injuries should be pursued. If it is necessary to keep the pelvic binder on for a longer period of time, the binder should be released intermittently and pressure areas must be checked and documented regularly every 24 hours. When removing pelvic binders, caution is advised as this may precipitate haemodynamic instability.

It is usually most appropriate for the patient to be transferred back to the referring hospital after pelvic surgery and we will arrange further outpatient follow up care at North Bristol where appropriate.

If you have any comments for clarification or suggestions for improvement, please let us know.
Abdomen & Pelvis References

Assessment and Management of Major Abdominal Trauma:


Pelvic and Acetabular Fractures Perioperative Checklist, Management and Referral

EXTREMITIES
Compartment Syndrome

1. All patients with a significant limb injury should be assessed specifically for compartment syndrome.

2. Compartment syndrome is a clinical diagnosis, disproportionate and persistent pain despite significant analgesia is the key feature.

3. If the clinical picture is unclear, compartment pressures may be measured.

4. Patients at risk of compartment syndrome should receive hourly nursing assessment of pain level, conscious level and response to analgesia with documentation of any regional anaesthesia given.

5. Acute compartment syndrome is a surgical emergency with surgical release performed within 1 hour of definitive diagnosis.

6. Following surgical decompression, the patient should be referred to the on-call plastic surgical team at Southmead Hospital within 12 hours.

Diagnosis of Compartment Syndrome

All patients with a significant limb injury should be assessed specifically for compartment syndrome. Limbs with both closed and open fractures can develop compartment syndrome. The diagnosis of compartment syndrome remains a clinical diagnosis. There is no definitive investigation to exclude compartment syndrome.

Symptoms of compartment syndrome include:
- Pain (out of proportion to injury sustained)
- Pain on passive stretch of muscles in compartment

Signs of compartment syndrome include:
- Tense (woody firm) compartments
- Paraesthesia
- Diminished or absent pulses
- Delayed capillary refill
- Neurological changes

In obtunded patients, or where the clinical picture is unclear compartment pressures may be measured (either a single or continuous measurement).
• If absolute compartment pressure exceeds 40mmHg, the affected compartments should be released unless other life threatening conditions take priority.
• If the difference between diastolic blood pressure and compartment pressure is 30mmHg or less, the affected compartments should either be released or continuously monitored depending on the treating consultant decision.

Pressure monitoring should not be performed if the clinical diagnosis is clear and performance should not delay surgical treatment.

**Documentation**

**Should include the following data**
- Time of injury
- Mechanism of injury
- Time of evaluation
- Neurovascular status of limb (before and after any manipulation)
- Radiological findings (before and after any manipulation)
- Level of pain
- Conscious level
- Response to analgesia
- Any regional anaesthesia given

Patients at risk of compartment syndrome should receive hourly nursing assessment of these symptoms. Pain scores that do not reduce in response to treatment warrants immediate senior clinical assessment.

**Management**

Acute compartment syndrome is a surgical emergency. Once definitively diagnosed, surgical release should be performed urgently (within 1 hour). Surgical treatment should not be delayed for any reason, including starvation status or bed availability.

**Immediate treatment**
- All circumferential dressings should be removed
- Elevate the limb to heart level
- Avoid all regional anaesthesia and patient controlled analgesia
- Evaluation every 30 minutes is required. If symptoms fail to improve, proceed to surgical decompression
- The alternative of continuous pressure monitoring should only be instituted by a Consultant
Surgical Treatment:

- Surgical treatment of lower leg compartment syndrome should be via a dual incision 4 compartment fasciotomy (as per BOAST / BAPRAS guidelines)

Figure 1: Recommended incisions for fasciotomy and wound extensions. From BOAST-4

(a) Margins of subcutaneous border of tibia marked in green, fasciotomy incisions in blue and the perforators on the medial side arising from the posterior tibial vessels in red.
(b) line drawing depicting the location of the perforators.
(c) montage of an arteriogram.

The 10cm perforator on the medial side is usually the largest and most reliable for distally-based fasciocutaneous flaps. Care should be taken when making the medial incision particularly, and should normally be made no more than one finger’s breadth posteriorly from the subcutaneous border of the tibia to avoid damaging these perforators.
If compartment syndrome occurs following a fracture and prior to definitive surgical stabilisation, temporary stabilisation should be performed following fasciotomy using appropriate methods (External fixation or temporary bridge plating).

Fasciotomy wounds should be dressed with saline soaked gauze

**Negative pressure dressings should be avoided immediately following fasciotomy**

**Onward Management**

- Following surgical decompression, the patient should be referred to the on call plastic surgical team at Southmead hospital as soon as possible and certainly within 12 hours to plan for transfer and coverage of fasciotomy wounds.
- If the patient still requires definitive fixation, they should be referred to the orthopaedic team (again, within 12 hours) who will liaise with the plastic surgeons.
- For those patients not requiring definitive orthopaedic fixation, referrals can be made to Plastics at Southmead for consideration of transfer (reviewed daily at 08:00) by email using this email address: nbn-tr.bristolplastics@nhs.net. Where more urgent discussion is required an on call SHO and Registrar are available at all hours through Southmead switchboard

Ideally arrange photos locally of the limb pre and post operatively which can be sent with the referral to aid planning.

- If there is any difficulty in contacting teams, the patient should be referred through the major trauma network via the Trauma Team Leader at North Bristol NHS Trust
Management of Open Fractures in Adults

1. Initial assessment and management should be undertaken in accordance with BOAST Guidelines on Open Fractures & NICE CG37 standards.

2. Administer antibiotics and analgesia as soon as possible, ideally within 1 hour of injury and in the prehospital setting if at all feasible.

3. The wound should be photographed, dressed with a saline soaked gauze dressing, and the limb splinted as soon as possible after arrival in the ED.

4. **All** open lower limb fractures should be transferred to Southmead MTC via the major trauma pathway **from ED to ED**.

5. **Isolated** open upper limb fractures should be admitted to their presenting hospital T&O department. If there are concerns regarding safe primary wound closure, then onward referral to the major trauma centre at Southmead should be at consultant to consultant level.

6. If transfer is required, there should be clear documentation of wound characteristics (ideally photographs), wound toilet, dressings and splintage. Photographic and radiographic images should be transferred to the Southmead PACS as soon as the decision for transfer is made.

7. In exceptional circumstances where surgical management of an open fracture must be delayed, appropriate management comprises debridement, stabilisation and dressing.

Immediate Management and Clinical Assessment

**Immediate Management:** Initial assessment and management should be undertaken in accordance with the BOAST guidance on open fractures.

**Clinical assessment of the fractured limb must occur within the ED and as soon as realistically possible after arrival in the ED.**

Vascular and neurological status of the limb should be regularly and systematically assessed, particularly after reduction or application of splintage.
Vascular Status

- Use hard signs (lack of palpable pulse, continued blood loss, or expanding haematoma) to diagnose vascular injury.
- Do not rely on capillary return or doppler signal to exclude vascular injury.
- If hard signs of vascular injury persist after any necessary restoration of limb alignment and joint reduction, immediate surgery for revascularisation is indicated.
- Do not delay revascularisation for angiography in people with complex fractures.

When assessing neurovascular status in a person with a limb injury, document for both limbs:

- Which nerves and nerve function have been assessed and when
- Sensation
- Motor function using the Medical Research Council (MRC) grading system
- Which pulses have been assessed and when
- How circulation has been assessed when pulses are not accessible.
- Document and time each repeated assessment.

Do not irrigate open fractures in the emergency department before debridement.

The wound is handled only to remove gross contamination and to allow photography, then covered in saline soaked gauze and an impermeable film to prevent desiccation.

The wound should be splinted including the joint above and below the site of fracture.

Antibiotics & Analgesia

**Antibiotics** (Flucloxacillin 1g and Gentamicin 5mg/kg or Teicoplanin 400mg and Gentamicin 5mg/kg if penicillin allergic) should be administered within 1 hour and in the prehospital setting if possible. This should be continued until 72 hours post injury or wound closure (whichever is soonest).

Consideration must be given to tetanus status.

Early, judicious analgesia should be administered as soon as possible. Regional techniques may mask the signs of compartment syndrome and should be used only following discussion with a senior member of the surgical team.
Appropriate splints should be applied as follows:

- Foot / ankle / tibia – Above knee back-slab including foot
- Femoral fracture – skin traction or pneumatic splint
- Upper limb – back-slab

*On the whole, there is a very limited role for the use of external fixation with these fractures.*

**Imaging**

- Imaging including the joint above and below the fracture should be undertaken in all patients. CT angiography of both lower limbs should be included in their initial trauma CT scan whenever possible. Ideally, CT angiography should be performed before surgical debridement, although it must not delay surgery.

- For patients initially managed in a trauma unit, radiographs should be transferred to the Southmead PACS as soon as the decision for transfer is made.

**Surgical Care of Open Fractures**

A combined plan for the management of both the soft tissues and bone is formulated by the plastic and orthopaedic surgical teams and should be clearly documented in the patient records.

- **The 6 hour rule does not apply**. Patients are better served by a planned consultant led Orthoplastic debridement and excision within working hours, unless significant contamination (Farmyard, Sewage, Aquatic) or vascular injury.

- Vascular impairment requires immediate surgery and restoration of the circulation using shunts, ideally within 3-4 hours, with a maximum acceptable delay of 6 hours of warm ischaemia. This should occur before before skeletal stabilisation and definitive vascular reconstruction

- Compartment syndrome also requires immediate surgery, with 4 compartment decompression via 2 incisions (see separate guideline)
• The primary surgical treatment (wound excision, debridement and fracture stabilisation) of severe open tibial fractures only takes place in a non-specialist centre if the patient cannot be transferred safely

• If definitive skeletal and soft tissue reconstruction is not to be undertaken in a single stage, then vacuum foam dressing or an antibiotic bead pouch is applied until definitive surgery.

• Definitive skeletal stabilisation and wound cover are achieved within 72 hours and should not exceed 7 days.

• Vacuum foam dressings are not used for definitive wound management in open fractures.

### Limb Salvage

**Perform emergency amputation when:**

- A limb is the source of uncontrollable life-threatening bleeding, **OR**
- A limb is salvageable but attempted preservation would pose an unacceptable risk to the person's life **OR**
- A limb is deemed unsalvageable after dual consultant assessment.

Include the person and their family members or carers (as appropriate) in a full discussion of the options if this is possible.

Multidisciplinary assessment involving an orthopaedic surgeon, a plastic surgeon, a rehabilitation specialist and the person and their family members or carers (as appropriate) is recommended to inform the decision whether to perform limb salvage or delayed primary amputation

### Transfer of Patients from Trauma Unit to Major Trauma Centre

Centres that cannot provide combined plastic and orthopaedic surgical care for severe open tibial fractures must transfer care of the patient to the major trauma centre as early as possible following injury.

**All** open lower limb fractures should be transferred to Southmead MTC via the major trauma pathway from ED to ED.

**Isolated** open upper limb fractures should be admitted to their presenting hospital T&O department. If there are concerns regarding safe primary wound closure, then onward referral to Southmead should be at consultant to consultant level
Transfer Arrangements:
Transfer to the Major Trauma Centre is arranged from the Trauma Unit ED to Southmead ED and is co-ordinated by the Trauma Team Leaders at those units.
Southmead Trauma Team Leader: 07703 886400

Documentation:
In patients requiring transfer, documentation of the wound characteristics (photographic where possible), wound toilet, dressings, antibiotics given, and splintage should be undertaken in the Emergency Department.

Exceptional Cases

BOAST 4 guidelines emphasise that open fractures are best managed by timely specialist surgery rather than emergency surgery.

Exceptions to this include:
1. Wounds heavily contaminated by marine agriculture or sewage matter
2. Open fractures with vascular compromise
3. Patients requiring emergency surgery for reasons other than their open fracture.

In these cases, appropriate management comprises:

- **Wound excision**: Removal of contaminated and dysvascular edges
- **Debridement**: Extensions proximally and distally to fully expose the zone of injury and thorough lavage with excision of contaminated or devitalised soft tissue.
- **Stabilisation**: This can be achieved with a cast, a temporary plate or an external fixator at the discretion of the operating surgeon
- **Dressings**: As per local preference

Queries: We are happy to discuss any aspects of the management of patients with open fractures within the Severn Trauma Network. Please contact Mike Kelly or Umraz Khan (via NBT switchboard 0117 3235999) or the orthopaedic consultant on-call.
Referral Guidelines to Specialist Peripheral Nerve Injury Unit

Key Points

1. The following guideline outlines the conditions that would particularly benefit from early assessment at a peripheral nerve injury unit (Royal National Orthopaedic Hospital, Stanmore, Middlesex)

2. In indicated cases, prompt referral of patients with early intervention is associated with improved outcomes

3. Contact Benita Patel PNI Unit Co-ordinator on 0208 909 5803 or the on-call PNI Unit Registrar via main switchboard on 0208 954 2300.

4. Provide a full statement of condition of the patient and associated injuries together with relevant medical history.

5. If urgent transfer for emergency intervention at the PNI Unit is planned, get an anaesthetic review prior to transfer to ensure fitness to travel and for subsequent surgery.

Indications for Referral to Royal National Orthopaedic Hospital, Stanmore Middlesex

Brachial Plexus Injury

- MRI proven cervical nerve root avulsion (pseudomeningocele visible) – urgent transfer indicated when patient fit to travel.
- Clinical deficit associated with blunt trauma to neck or shoulder.
- Clinical deficit associated with penetrating injury.
- Clinical deficit associated with subclavian or axillary artery disruption – urgent transfer indicated following vascular repair and patient being fit to travel.
- Clinical deficit (particularly of axillary nerve) following shoulder dislocation with associated tuberosity fracture – urgent assessment indicated following treatment of shoulder dislocation (local management of tuberosity lesion preferable when trauma work load allows, otherwise this can be performed at RNOH).
- Ongoing clinical deficit following shoulder dislocation.
- Ongoing pain and clinical deficit following definitive fixation of clavicular fracture.
In cases of low energy transfer injury and no ongoing pain it is reasonable to observe patients for a period to assess for signs of recovery. If no recovery is noted by 6 weeks then referral should be considered. If no recovery is noted by 3 months referral is strongly recommended.

**Supracondylar Fracture**

- Deficit of ulnar, median or radial nerves with ongoing pain pre or post reduction of fracture and / or pain in named median nerve distribution.

**Radial Nerve**

- Radial nerve deficit post fixation of humeral fracture.
- Ongoing pain and loss of function with associated humeral fracture.

In cases of deficit following fracture either with or without fixation where pain is not a feature it is reasonable to observe for 3 months. If no recovery of function is noted by 3 months referral should be strongly considered.

**Lumbosacral Plexus Injury**

- Flail lower limb following pelvic fractures – urgent referral once stabilisation of bony injuries is achieved and patient stable for transfer.

**Visualised Disruption of Major Nerves**

Including brachial plexus, median, ulnar and radial with very proximal division, sciatic, peroneal and tibial nerves.
- Urgent referral once patient fit for transfer
Please contact Benita Patel PNI Unit Co-ordinator on 0208 909 5803 or the on call PNI Unit Registrar via main switchboard on 0208 954 2300.

Please provide a full statement of condition of the patient and associated injuries together with relevant medical history. An assessment of the nerve injury and extent of lesion together with a full description of the mechanism of injury is essential. If urgent transfer for emergency intervention at the PNI Unit is planned, please get an anaesthetic review prior to transfer to ensure fitness to travel and for subsequent surgery.

References

British Orthopaedic Association and Bristol Association of Plastic, Reconstructive and Aesthetic Surgeons. Standards for Trauma: BOAST 5: Peripheral Nerve Injury
HEAD & SPINE
1. Head injury has around a 5% mortality. Early neuroprotective measures can significantly improve outcomes.

2. Early CT brain & skull are indicated in the majority of patients with GCS <14.

3. For a rapid overview of head injury management, please see the separate key points document “Care of Head Injured Patients”

4. Levetiracetam (Keppra) is now the first line anticonvulsant for patients with significant head injury.

5. Patients already taking anticonvulsants who sustain a head injury should have their anticonvulsant therapy discussed with a neurosurgeon.

Head injury is the commonest cause of death and disability in people aged 1–40 years in the UK. Most patients recover without specific or specialist intervention, but others experience long-term disability or even die from the effects of complications that could potentially be minimised or avoided with early detection and appropriate treatment.

The incidence of death from head injury is low, with as few as 0.2% of all patients attending emergency departments with a head injury dying as a result of this injury. The majority of fatal outcomes are in the moderate (GCS 9–12) or severe (GCS 8 or less) head injury groups, which account for 5% of attenders.

Appropriate guidance can enable early detection and treatment of life-threatening brain injury, where present.
This guideline is based on NICE CG176: Head Injury.

Initial Assessment and Management

As with all major trauma, patients with a head injury should be managed according to standard trauma primary survey principles.

Neurological assessment:
The patient should be assessed and monitored using the Glasgow Coma Scale. The individual components of the GCS and the overall score should be described in all communications and documentation.
In patients with a GCS of 8 or less, ensure there is early involvement of an anaesthetist or critical care physician to provide appropriate airway management and assist with resuscitation.

**Patients considered high risk for clinically important brain injury and/or cervical spine injury:**
Conduct a full clinical examination to establish the need to request CT imaging of head, cervical spine and other body areas.

**Patients considered low risk for clinically important brain injury and/or cervical spine injury following initial assessment:**
An emergency department clinician should re-examine the patient within an hour. The need to request CT imaging of the head and/or cervical spine should be established at this time.

### Airway

**Intubate and ventilate the patient immediately in the following circumstances:**
- GCS ≤8
- Loss of protective laryngeal reflexes
- Ventilatory insufficiency as judged by blood gases: hypoxaemia (PaO₂ <13 kPa on oxygen) or hypercapnia (PaCO₂ >6kPa)
- Spontaneous hyperventilation causing PaCO₂ <4kPa
- Irregular respirations

**If transferring from a trauma unit to major trauma centre, intubation and ventilation prior to the start of the journey is indicated in the following circumstances:**
- Significantly deteriorating conscious level (1 or more points on the motor score), even if GCS not ≤8.
- Unstable fractures of the facial skeleton
- Copious bleeding into the mouth (for example, from skull base fracture)
- Seizures

**Ventilate an intubated patient with muscle relaxation and appropriate short-acting sedation and analgesia. Aim for:**
- PaO₂ >13 kPa
- PaCO₂ 4.5 – 5.0, unless there is clinical or radiological evidence of raised intracranial pressure, in which case more aggressive hyperventilation is justified. If hyperventilation is used, increase the oxygen concentration.
- Maintain the mean arterial pressure at ≥80mmHg by infusion of fluid and vasopressors as indicated.
**Analgesia**

Pain can lead to an increase in intracranial pressure and should be managed effectively. Treat significant pain with small doses of intravenous opioids titrated against clinical response and baseline cardiorespiratory measurements. All patients with head injury should receive paracetamol (IV or PO) if not contraindicated.

**Imaging**

The current primary investigation of choice for the detection of acute clinically important brain injuries is CT imaging of the head. Do not perform MRI scanning as the primary investigation for clinically important brain injury. However, additional information of importance to the patient’s prognosis can sometimes be detected using MRI. Do not use plain X-rays of the skull to diagnose significant brain injury without prior discussion with a neuroscience unit.

**Perform a CT Head Scan Within One Hour:**

- GCS less than 13 on initial assessment in the Emergency Department
- GCS less than 15 at 2 hours after the injury on assessment in the Emergency Department
- Suspected open or depressed skull fracture
- Any sign of basal skull fracture (haemotympanum, ‘panda’ eyes, cerebrospinal fluid leaking from the ear or nose, Battle’s sign
- Post-traumatic seizure
- Focal neurological deficit
- More than 1 episode of vomiting

*A provisional written radiology report should be made available within 1 hour of the scan being performed.*

**Perform a CT Head Scan Within Eight Hours in Patients who:**

- Experienced some loss of consciousness or amnesia since the injury

**AND any of the following**

- Age ≥65
- Any history of bleeding or clotting disorder
- Dangerous mechanism of injury e.g pedestrian vs. motor vehicle, cyclist vs. motor vehicle, occupant ejected from a motor vehicle or fall from a height >1 meter / 5 stairs.
- More than 30 minutes of retrograde amnesia of events immediately before the head injury

*A provisional written radiology report should be made available within 1 hour of the scan being performed.*
Patients on warfarin:
For patients who have sustained a head injury with no other indications for a CT head scan and who have been receiving warfarin treatment, perform a CT head scan within 8 hours of the injury. A provisional written radiology report should be made available within 1 hour of the scan being performed.

Patients with any neurosurgical shunt for CSF diversion in situ:
For patients who have sustained a head injury with no other indications for a CT head scan and who have any neurosurgical shunt for CSF diversion in situ should undergo CT scan within 8 hours of minor head injury. This patient group lies outside of NICE guidance but are at significant risk of major intracranial haemorrhage and must be imaged within this timeframe.

Neurosurgical Involvement

Neurosurgical involvement is indicated if any of the following are present:
• Surgically significant abnormalities on imaging
• Persisting coma (GCS ≤8) after initial resuscitation
• Unexplained confusion which persists for more than 4 hours
• Deterioration in GCS score after admission (greater attention should be paid to motor response deterioration)
• Progressive focal neurological signs
• A seizure without full recovery
• Definite or suspected penetrating head injury
• A cerebrospinal fluid leak
• Neurosurgical shunt for CSF diversion

Discuss with a neurosurgeon the care of all patients with new, significant abnormality on imaging.

Transfer

All patients requiring neurosurgical involvement should be discussed with Southmead Hospital. Transfer would benefit all patients with serious head injuries (GCS of 8 or less) irrespective of the need for neurosurgery. If transfer of these patients is not possible, ongoing liaison with Southmead Hospital over clinical management is essential.

Initial resuscitation and stabilisation of the patient must be completed prior to transfer. Do not transport a patient with persistent hypotension despite resuscitation, until the cause of the hypotension has been identified and the patient stabilised.

See page 174 for guidance on when intubation and ventilation is indicated prior to a patient with head injury being transferred.
The following criteria should be used for admitting patients to hospital following a head injury:

- New, clinically significant abnormalities on imaging
- GCS has not returned to 15 after imaging, regardless of the imaging results
- CT scan is indicated, but cannot be done within the appropriate period
- Continuing worrying signs (e.g. persistent vomiting, severe headache) of concern to the clinician
- Other sources of concern to the clinician (e.g. drug or alcohol intoxication, other injuries, shock, suspected non-accidental injury, meningism, cerebrospinal fluid leak)

Admit patients with multiple injuries under the care of the team that is trained to deal with their most severe and urgent problem.

**Observation of Admitted Patients**

For all patients admitted for observation following head injury, the following neurological observations must be documented as a minimum:

- GCS (assess every 30 minutes until GCS equal to 15 has been achieved)
- Pupil size and reactivity
- Limb movements
- Respiratory rate
- Heart rate
- Blood pressure
- Temperature
- SpO₂

The minimum frequency of observations for patients with GCS equal to 15 should be as followed, starting after the initial assessment in the emergency department:

- Half-hourly for 2 hours
- 1 hourly for 4 hours
- 2 hourly thereafter

Should the patient with GCS = 15 deteriorate at any time after the initial 2 hour period, observations should revert to half-hourly and follow the original frequency schedule.

The must be prompt urgent reappraisal by the supervising doctor if any of the following examples of neurological deterioration occur:

- Development of agitation or abnormal behaviour
- A sustained (for at least 30 minutes) drop of 1 point in GCS score (greater weight should be given to a drop of 1 point in the motor response score of the GCS).
• Any drop of 3 or more points in the eye-opening or verbal response scores of the GCS, or 2 or more points in the motor response score.
• Development of severe or increasing headache or persistent vomiting
• New or evolving neurological symptoms or signs such as pupil inequality or asymmetry of limb or facial movement.

A second member of staff competent to perform observation should confirm deterioration before involving the supervising doctor. Where a confirmation cannot be performed immediately, the supervising doctor should be contacted without the confirmation being performed.

If neurological deterioration as listed above is confirmed, an immediate CT scan should be considered, and the patient’s clinical condition re-assessed and managed appropriately. In the case of a patient who has had a normal CT scan, but who has not achieved GCS equal to 15 after 24 hours’ observation, a further CT scan or MRI scanning should be considered and discussed with the radiology department.

References

1. NICE Clinical Guideline (CG176) Head Injury: Assessment and Early Management
   https://www.nice.org.uk/guidance/cg176

2. NICE Quality Standard (QS74) Head Injury
   https://www.nice.org.uk/guidance/qs74
### Patients Not Taking Anticonvulsants Prior to Injury

In patients who were not taking anticonvulsants prior to injury, where no witnessed seizure has occurred since injury:

- Start levetiracetam 1g twice daily
  - No loading dose needed
  - Initial dose intravenously
  - Give subsequent doses via NG/PO if absorbing feed, otherwise continue IV
- Continue treatment for 7 days THEN STOP
  - May need longer duration and/or increased doses if clinical or EEG evidence of seizures during treatment
  - Maximum doses 1.5g twice daily

In patients who were not taking anticonvulsants prior to injury, where a witnessed seizure *has occurred since the injury*:

- Give loading dose levetiracetam 20mg/kg
- Start levetiracetam 1g twice daily
  - Initial dose 12 hours after loading
  - Give via NG/PO route if absorbing feed, otherwise continue IV
  - Treatment duration on a case-by-case basis in discussion with the admitting neurosurgical team

*Levetiracetam is now the first-line anticonvulsant for TBI, replacing phenytoin. Phenytoin is the second line agent where levetiracetam is contraindicated or unavailable.*

### Patients Taking Anticonvulsants Prior to Injury

Patients who were taking anticonvulsants prior to a head injury should be discussed with the neurosurgical team regarding their need for additional anticonvulsant agents.
Care of Head Injured Patients

1. Effective analgesia is critical for all major trauma patients. All patients with significant pain should receive IV paracetamol if not otherwise contraindicated. Avoidance of sedating narcotics may have significant potential advantages in head injured patients and should be used with caution and titrated to effect.

2. Sedation (for any reason) makes accurate assessment of the GCS impossible and should be used only in order to gain control of an agitated patient in the pre-oxygenation phase of rapid sequence induction of anaesthesia.

3. RSI technique in head injury maintain oxygen saturations >94%, mitigate and pharyngeal and laryngeal stimulation and avoid unplanned hyperventilation all of which risk worse outcomes.

4. Following RSI, ventilation, volume management and packaging must be carefully considered but rapidly initiated with specific attention to optimisation of cerebral perfusion pressure.

5. Emergency control of clinically suspected raised ICP or impeding herniation can be attempted with boluses of 3ml/kg of 5% saline.

Background

The principles of head injury management are the provision of adequate oxygenation and cerebral perfusion, treatment of other significant injuries and rapid transfer to a neurosurgical service. Many patients with head injury do not require urgent neurosurgery but, if they do, taking them directly to a neurosurgical centre cuts the time dramatically. Even when surgical intervention is not required, patients with head injury do better when managed in neurosurgical centres.

Indications for emergency anaesthesia in patients with head injury are straightforward:

- Unconsciousness
- Airway compromise
- Ventilatory compromise

We also anaesthetise a number of patients with head injury and a relatively high GCS (9 – 14). Most of these patients have cerebral agitation and we know that patients who have cerebral agitation have a high incidence of intracranial pathology. Anaesthesia in this patient group makes them more manageable and may reduce the severity of secondary injury.
Use of Analgesia and Sedation

Sedation in head injured patients is a high risk procedure and should be performed only in the presence of those with significant experience and/or expertise.

Effective multimodal analgesia is associated with better outcomes in head injured patients. All patients without contraindications should receive paracetamol (IV) and consideration of non-steroidal and opioid analgesia in the usual fashion.

Oral codeine, where appropriate may achieve significant analgesia with minimal sedation, facilitating more accurate assessment of GCS and clinical condition.

If patients are in severe pain from a head injury alone then this could signify intracranial pathology until proved otherwise. However pain primarily from systemic injury may push patients into the 'agitated' category; thus if effective analgesia cannot be achieved without the use of potentially sedating narcotic analgesia, small doses of fentanyl, morphine or oxycodone should be titrated to effect.

Sedation (for any reason) makes accurate assessment of the GCS impossible and should be used only in order to gain control of an agitated patient in the pre-oxygenation phase of rapid sequence induction of anaesthesia.

Ketamine: Concerns relating to its use in un-intubated patients with head injury (due to the possibility that ketamine raises ICP when CO₂ is not controlled) are largely unfounded. Ketamine has the advantage of not impairing respiratory drive and of being haemodynamically stable; its use is increasing in all traumatically injured patient groups.

If being used for induction of anaesthesia, then common practice is to use 10-20% of the intended induction dose as a sedative premedication to facilitate patient positioning and preoxygenation. The subsequent induction dose of ketamine should be reduced.

Midazolam: If the patient is agitated or combative, sedate with 1-2mg aliquots of midazolam until control is achieved and then proceed to rapid sequence induction. This also enables effective pre-oxygenation.

Propofol: This should be used in caution due to significant risk of apnoea, hypoventilation and loss of systemic vascular resistance. Its only use would be in the context of achieving preoxygenation prior to RSI where propofol is being used as the induction agent (usually, isolated head injury with significant hypertension).
Rapid Sequence Induction

RSI technique in head injury should minimise CO₂ increases and pharyngeal and laryngeal stimulation in an attempt to minimise ICP rises. Meticulous attention to oxygenation is also important as is prevention of hyper and hypoventilation (which has been associated with poor outcomes).

This may be achieved by:

Adequate induction agent
- Use of adequate dose of Fentanyl and Ketamine where allowed by the patient’s cardiovascular status.

Adequate paralysis:
- Use 1mg/kg of Rocuronium
- Reparalyse frequently

Gentle and minimal laryngoscopy:
- Avoid touching the posterior pharyngeal wall during intubation

Minimal tube movement. Hold the tube when the patient is moved.

Ventilation

Ventilate to low normocapnia (end-tidal CO₂ of 30 mmHg/4.0KPa). This equates to a PaCO₂ of approximately 4.5KPa in normal individuals. This minimises the risk of cerebral vasodilation (high PaCO₂) and cerebral vasoconstriction (low PaCO₂).

High levels of PEEP can increase ICP. Use of more than 5 cmH₂O of PEEP without well founded clinical reason should be avoided.

Use of IV Fluids

After significant head trauma, the brain may lose the ability to autoregulate cerebral blood flow. A fall in mean arterial pressure may therefore result in a reduction in cerebral oxygen delivery even if the ICP is normal.

When effective splinting of limbs / pelvis has been maximised, then fluids should be administered to achieve a systolic blood pressure of 100mmHg. This can be increased to 120mmHg in isolated head injury.
Compression of the jugular veins will reduce venous return from the head and neck. This can increase ICP. The cervical collar, if used, should therefore be left slightly loose. Cervical spine immobilisation will be maintained with head blocks and tape on the scoop stretcher. The neck veins can also be constricted by a tight tracheal tube tie – this should be checked and loosened. Tube tapes are a sensible alternative. The patient should be managed in a 20-30 degree head up position to maximise venous drainage. Tilt the whole trolley to achieve this, in adequately resuscitated patients.

**Control of ICP / Impending Herniation**

**Hypertonic Saline (HTS):**
HTS has been shown to lower ICP in severe head injuries and may have other beneficial effects such as increasing circulating volume, minimal alteration to coagulation and anti-inflammatory properties. It is used extensively in ICU to lower refractory ICPs. North Bristol uses sodium chloride 5%. There is no evidence that one formulation of hypertonic saline offers advantages over another. It is available as a 250ml or 500ml infusion bag.

**Administration Policy:**
3ml / kg (to a maximum of 200ml) of 5% hypertonic saline should be delivered by well secured large bore peripheral (>18 gauge) cannula over 10 minutes in patients with signs of actual or impending herniation resultant from severe head injury:
- Unilateral or bilateral pupil dilation / GCS < 8 (usually 3)
- Progressive hypertensive (SBP over 160mmHg) and bradycardia (pulse below 60) / GCS <8 (usually 3).

This dose is given once and given regardless of blood pressure.
In patients with blunt trauma, hypotension and head injury a bolus of HTS as above will help restore circulating volume and may protect against cerebral hypoperfusion and reduce oedema.
NICE CG 44: Management of Head Injury
1. Thorough examination of the spinal column should always be methodically performed; inadequate immobilisation and unprotected movement of the spine may lead to additional neural injury and may worsen the outcome.

2. In all patients, cervical collars should be removed as soon as practically possible. Blocks & tape for immobilisation of the c-spine should still be applied until injury can be ruled out.

3. In the conscious, co-operative patient, the cervical spine can be safely cleared using the Canadian Cervical Spine rules. “Clearing” the cervical spine should involve further clinical assessment of the patient as well as discussion of the patient with a clinician experienced in the management of neck injuries where appropriate.

4. In the obtunded patient, imaging will usually be required. CT is the imaging modality of choice; there is no role for plain x-rays of the spine in the unconscious trauma patient.

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**Spinal Clearance**

C-spine injuries occur in 2.0-6.6% of blunt trauma patients. Co-existing head injury increases the incidence of C-spine injury to 10%. Injury to the cervical spinal cord in the absence of fracture occurs in 0.07-0.7% of trauma admissions.

Thorough examination of the spinal column should always be methodically performed; inadequate immobilisation or unnecessary movement of the spine may lead to additional neural injury and worsen the outcome.

CT imaging is largely replacing plain x-rays in the assessment of spinal injuries, but clinical clearance remains standard in awake, alert patients with no neurologic deficit, distracting injury, neck pain or tenderness.
In the conscious, co-operative patient: the Canada C-spine rule can be used to exclude the need for imaging. High index of suspicion should be maintained where imaging not used until clinical examination + discussion with a clinician experienced in the management of neck injuries have occurred and fracture has been excluded.

Removal of Cervical Spine Collars

In all patients, cervical collars should be removed as soon as practically possible (Grade III evidence). Early removal is associated with decreased collar related pressure ulcers, lower intracranial pressure, fewer ventilator days, fewer ICU and hospital days, decreased incidence of delirium and pneumonia.

In the conscious, co-operative patient, cervical spine collars do not need to be applied prior to imaging if they have not been applied pre-hospital.
**Obtunded Patient**

If collar is removed in the obtunded / sedated / unconscious patient, blocks and tape should remain in place until CT of the neck +/- spinal column have occurred. Clear verbal and written handover must occur between all staff caring for the patient stating that:

- The cervical spine and spinal column have not been clinically cleared of injury
- The patient should be nursed in a neutral position with head and neck maintained in the midline if possible while obtunded / unconscious / sedated.
- Consideration of and assessment for spinal injury must be undertaken once the patient regains an adequate level of consciousness.
- Individual clinical judgement must be used to determine the level of cervical and thoracolumbar spinal protection required as the patient regains consciousness.

**Imaging**

Patients with a GCS<13 following trauma: CT imaging of the cervical spine should be performed in all cases.

Unconscious patient following multi-system trauma: The whole of the spine should be imaged.

Acute fracture found anywhere in spinal column: The rest of the spinal column should be imaged

Patient presenting with neurology: CT imaging of the spine should be undertaken, followed by MRI – CT has a higher sensitivity for bony injury than MRI

If the patient complained of neurology MRI is required to clear the spine.

Patient not presenting with neurology: Isolated unstable ligamentous injury is uncommon, but where it does occur is a common reason for missed instability. However, ongoing spinal immobilisation of an unconscious patient is not a benign procedure. Therefore, in patients without (self) reported neurological symptoms prior to anaesthesia (whether pre- or in-hospital), the spine can safely be considered cleared following CT of the whole spine reported as "normal" by a consultant radiologist or clinician with advanced training in interpretation of neuraxial imaging modalities.

In the presence of a mechanism of injury that could cause instability e.g. flexion / extension, rotation of head or spinal column, consideration should be given to use of MRI for exclusion of unstable non-bony injury.

On emergence from anaesthesia or sedation, consideration of occult injury should occur and assessment for signs and symptoms of occult spinal injury should be undertaken where clinical suspicion or concern remains.

Flexion / Extension View: Should NOT be undertaken in unconscious patients at all. They have a questionable role in the conscious patient, except in the context of planning for operative intervention after trauma (interventions that are unlikely to be undertaken in the acute phase).

Plain radiographs: Have NO role in the assessment of the unconscious trauma patient.
Exclusion of a fracture on imaging should be based on report from or approved by a consultant radiologist. Discussion with and assessment by a spinal or neurosurgeons a clinician with experience of managing spinal injury should occur in any patient with suspected injury to the spinal column.

### Spinal Fracture Present

**If a significant fracture is noted in the spine:** The region of the spine with the injury should be assumed to be unstable until reviewed by an orthopaedic or neurosurgical consultant with training in spinal injury management.

**Stable cervical spine fracture for conservative management:**
- Miami or Philadelphia collar will be applied in Emergency Department.
- A named spinal consultant will be responsible for the ongoing management of the spinal injury.

**‘Insignificant’ cervical spine injuries:**
These include:
- Spinous-process fracture
- Simple wedge-compression fracture without loss of 25 percent or more of vertebral body height
- Isolated avulsion without associated ligamentous injury
- Type I (Anderson–D'Alonzo) odontoid fracture
- End-plate fracture
- Osteophyte fracture, not including corner fracture or teardrop fracture
- Injury to trabecular bone
- Transverse-process fracture

These injuries do not need specialist involvement at the major trauma centre unless the patient complains of neurological symptoms or has additional significant traumatic injuries.
Traumatic Spinal Cord Injury

**ASIA Score:** Patients with traumatic spinal cord injury must have ASIA score performed, ideally within 1st four hours, if patient is clinically assessable.

**Surgery:** Patients with traumatic spinal cord injury requiring surgery should have surgery within 4 hours of injury in MTC.

**Actions on Confirmation of Spinal Cord Injury**

**At Trauma Unit:** The trauma team leader should contact the specialist Neurosurgical or Spinal Surgeon on call at North Bristol NHS Trust.

**At Major Trauma Centre:** The trauma team leader should contact the specialist neurosurgical or spinal surgeon on call.

**Specialist Neurosurgical / Spinal Surgeon:** Should contact the on call consultant or registrar at the Duke of Cornwall Spinal Treatment Centre, Salisbury District Hospital (also colloquially known as "Odstock") ideally within 4 hours of diagnosis to establish a partnership of care. Salisbury switchboard can be reached on 01722 336262.

The appropriate location for best medical management and the immediate management plan for SCI must be agreed, taking into account other injuries and pre-existing medical conditions. Odstock will be responsible for providing ongoing advice, guidance and appropriate support via its outreach system until such time as the patient is transferred. All patients with SCI should normally be transferred from the MTC to Odstock once a bed becomes available, unless it has been agreed that the interests of the individual patient would be best served by planning a different model of care.
IniMal	Assessment	and	Management	of	Spinal	Cord	Injury

Initial resuscitation should be according to standard trauma principles. The management of a spinal cord injury should be agreed between spinal surgeons and the spinal cord injury centre. See page 193 for further information on contacting the spinal cord injury centre.

Airway and Cervical Spine Control

As soon as possible, the patient should be placed into the neutral supine position. Protect the cervical spine with manual in-line spinal immobilisation or blocks and tape. Avoid moving the remainder of the spine. Any turning must be through use of a coordinated "log-roll" using a minimum of 4 clinicians familiar with the principles of coordinated controlled movement of spinal cord injured patients.

Breathing

In high spinal cord injury, innervation to the intercostal muscles and diaphragm may be affected leading to hypoventilation. Many patients with spinal cord injury also have reduced or absent ability to cough. They are therefore at significant risk of impaired respiratory function.

Management:

- Continuous monitoring of \( \text{SaO}_2 \) - maintain at ≥85%
- Regular monitoring of respiratory rate, blood gases and vital capacity (by spirometry)
- If the vital capacity is reduced to <1 litre, secure the airway via endotracheal intubation and careful intermittent positive pressure ventilation
- Turn the patient 2 hourly to optimise V/Q match
- Early, regular and frequent physiotherapy, including assisted cough techniques, are the mainstay of treatment
Neurogenic Shock:
Patients with a spinal cord injury at the level of T6 or above are at risk of neurogenic shock. Impairment of the descending sympathetic pathways results in loss of vasomotor tone and sympathetic innervation to the heart. Vasodilatation of the lower-extremity and visceral blood vessels causes significant hypotension, whilst unopposed effects of the vagus nerve on the heart results in bradycardia. The blood pressure is often unresponsive to fluid resuscitation and vasopressors may be required. This is of particular importance in the acute phase, when impaired perfusion to the spinal cord may extend the spinal cord lesion and worsen neurological deficits.

Management of Hypotension:
- Patients with acute spinal cord injury must be nursed flat
- Maintain a systolic BP of 90-100mmHg and MAP of >70mmHg. Discuss on referral to Odstock.
- Maintain a urine output of ≥0.5mls/kg/hour.
- Prescribe IV crystalloid to maintain blood pressure and urine output targets.
- Monitoring of fluid balance is essential, especially in older patients and those with pre-existing cardiac and/or renal disease.
- In rare instances, inotropes may be required to maintain a stable BP.
- Prior to trial of patient sitting out for the first time, ephedrine (30-60mg orally/via nasogastric tube, once/day) may be given to prevent postural drop.

Management of Bradycardia:
An abnormal vaso-vagal response can occur through stimulation such as rapid changes in body positioning e.g. log rolling and procedures such as tracheal suctioning and NG tube insertion. This can result in significant bradycardia, hypoxia and in severe cases cardiac syncope.
- ECG monitoring is required
- If heart rate persistently ≤40 BPM and the patient is cardiovascularly unwell or unstable, administer Atropine 0.3-0.6mg as an IV bolus
- In patients with thoracic injuries, consider the possibility of cardiac contusion and potential resulting arrhythmias.

Assessment of Pain and Analgesia
Assess pain regularly. In the acute phase of injury, use an IV opioid as the first-line analgesic and adjust the dose as needed to achieve adequate pain relief. If intravenous access has not been established, consider the intranasal route with diamorphine or ketamine. Consider ketamine in analgesic doses as a second-line agent.
Neurological Assessment of Spinal Cord Injury

**Neurological Observations:** Initial observations should be recorded every two hours.

**Neurological Examination:** The standardised American Spinal Injuries Association neurological examination recording chart (ASIA Chart, Appendix V, page 283), should be completed:
- Within 4 hours of admission
- After 24 & 72 hours of admission
- Following any further neurological changes
- Pre- and post-operatively if surgery is undertaken

Test pin prick sensation on the anterior surface of the body and the perineum – patients alteration in pin prick easier to report than light touch.

Perianal sensation, deep anal pressure, tone and voluntary contraction should be examined. These can be significant for bowel and bladder management.

Mark the sensory level on the patient to more easily identify changes when conducting later examinations.

There should also be an assessment of the patient's vital capacity and ability to cough.

Careful documentation of findings is important as the neurological level may change in the days following the injury.

Worsening neurological features may indicate extension of the spinal cord injury secondary to inadequate oxygenation, hypoperfusion or complications such as epidural haematoma. Neurological examination allows early identification and may prevent avoidable deterioration of neurological deficit.

**Spinal Shock:** This refers to flaccidity and areflexia and occurs in the acute phase of spinal cord injury. The injured cord may appear completely non-functional, although spinal cord injury is not necessarily complete. The duration of spinal shock is variable, but typically around 48 hours.

In the period of spinal shock, formal classification of the injury is not possible.

The end of spinal shock is defined by the onset of spasticity below the level of the spinal cord injury. No recovery by this time suggests complete cord injury and poor prognosis.
Spinal Cord Injury Centre

Contacting the Spinal Cord Injury Centre

The Severn Trauma Network is linked with Duke of Cornwall Spinal Treatment Centre, Salisbury District Hospital, Odstock, Salisbury
Tel: 01722 336 262

Referral to the Spinal Cord Injury Centre

The Neurosurgical / Spinal Surgeon is responsible for contacting Odstock within 4 hours of initial assessment.
- The appropriate location for medical management (including surgery) should be discussed.
- Immediate management plan should be discussed and documented
- Complete the referral paperwork (Appendix X Part 1 and 2, page 287)
- Following the telephone referral process, online registration should be completed by the person making the referral.
  - www.spinalcordinjury.nhs.uk
  - Print the confirmation email
  - Sign the SCI pathway documentation (Appendix W)
- Ensure additional required assessments are completed, including anaesthetic assessments

The SCIC outreach team should be contacted for all ongoing care management enquiries.
The patient should be reviewed by a member of the SCIC outreach team within 5 days if appropriate.

Transfer to the Spinal Cord Injury Centre

When the patient is appropriate for transfer to the SCIC the referral is prioritised and bed availability notified. Weekly updates will be sent to relevant NBT team members.
Decisions to transfer and planning for it should take place between senior staff in the transferring and receiving units. Transfer to the SCIC or local hospital repatriation should be organised using the major trauma network guidelines.
For transfer checklist, see Appendix Y
### References

#### Spinal Cord Injury Pathway


8. NICE Guidance 41: Spinal Injury: assessment and initial management
   https://www.nice.org.uk/guidance/ng41
IMAGING
HEMS Direct to CT Pathway

1. HEMS teams familiar with Severn MTC may choose to accompany major trauma patients requiring a full trauma scan as per of their arrival procedure.

2. The pathway must be followed to minimise delays between patient arrival, imaging and handover

3. HEMS should identify any patients for the direct to CT pathway and contact the Trauma Team Leader / EM Red Phone

4. The patient remains under the clinical care of the HEMS team until formal handover in the resuscitation bay following imaging.

**Direct to CT applies to the following emergency attendances:**

- FAST positive patients through the Stroke Thrombolysis Protocol (not covered further in this document)
- Isolated CT Head for non-trauma patients (HEMS accompanied)
- Full trauma scan in stable major trauma patient (HEMS accompanied)

The ‘Direct to CT’ pathway is a series of steps that should be followed to ensure seamless patient arrival, imaging and handover and to minimise delays.

### Before Patient Arrives at Emergency Department

**HEMS should identify any patients where direct access to CT is appropriate**

**HEMS must contact the Trauma Team Leader (TTL) or ED Red Phone and inform of need for direct access to CT**

- HEMS should confirm that the patient is stable for scan
- Patient name and DOB, accurate ETA and route of transfer must be provided

**The doctor who receives the HEMS pre-alert must:**

- Inform reception staff to book-in patient and order required imaging
- Inform CT radiographer and on-call Radiology Registrar that the direct to CT pathway is in place
HEMS crew/paramedics will proceed direct to CT through the ‘far door’.

HEMS crew can acknowledge the receiving clinician (normally the TTL), but no handover is to occur in pit stop. Wristbands will be applied, but no other interventions should be undertaken by the ED trauma team at this time.

HEMS staff will transfer patient off stretcher to CT scan (weight limit 200kg)

The patient remains under the clinical care of the HEMS team before, during and immediately after the scan until the formal handover occurs in the ED Trauma resus bay. The receiving clinician (TTL) may observe the CT to enable contact of further staff if required.

The handover process should not begin until patient in Resus bay; interference must be avoided. No members of the trauma team except the TTL and any trauma team members specifically invited by the TTL should attend CT.

HEMS staff will load the patient from scanner to ED stretcher following completion of CT imaging.

A porter is to be available to drive trolley from CT to Resus bay and leave through the ‘front door’ and proceed to expected patient resuscitation bay.

HEMS will formally handover (ATMIST) the patient to the receiving clinician/TTL in ED Resuscitation bay.
Whole Body CT Imaging Protocols

1. Whole body multidetector CT (MDCT) is the gold standard for radiological assessment of the severely injured patient.

2. When the decision to proceed with MDCT has been made, transfer to the CT suite must not be delayed by inferior imaging modalities such as digital radiography or ultrasound (FAST).

3. North Bristol NHS Trust has a default MDCT whole body protocol for imaging of the head and neck and imaging of the thorax, abdomen and pelvis.

4. For trauma units not familiar with multiphasic whole body trauma imaging example protocols of alternative MDCT whole body protocols are suggested.

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**Background**

Whole body multidetector CT (MDCT) is the imaging modality of choice and the gold standard for radiological assessment of the severely injured patient (SIP).

Integration of MDCT in early trauma care significantly increases the probability of survival in multi-trauma patients. When a decision to proceed with MDCT has been made by the trauma team, transfer to the CT suite must not be delayed by inferior imaging modalities such as digital radiography or ultrasound.

MDCT protocols in trauma imaging have moved away from segmental body component imaging towards single pass and multiphase contrast injection scanning to shorten examination time and improve vascular and parenchymal enhancement and imaging.
The default MDCT whole body protocol in adult trauma at North Bristol NHS trust is a modified version of the camp Bastion ‘military’ protocol.

**Head and Neck – Ideally imaged with arms down**
- Brain - Unenhanced acquisition (0.625/1.25mm) with bony and soft tissue recons with the 3mm soft tissue recons made immediately available for review.

- C-Spine - Unenhanced spiral acquisition (0.625/1.25mm) from base of skull to T4 with 2mm axial, coronal and sagittal bony recons.

**Thorax, abdomen and pelvis – ideally imaged with arms up**
- Lung apices to symphysis pubis (bone and soft tissue algorithms)

- 150mls iodinated contrast, biphasic contrast injection
  - initially 85mls @ 2mls/sec
  - followed by 65mls @ 4mls/sec

- Image acquisition at 60 secs post initiation of contrast injection.
  - If there is high clinical suspicion of significant intracerebral or cervical vascular injury in the SIP then the post-contrast scan volume should start at the level of the circle of Willis. This should be agreed at the time of the scan by the supervising radiologist and TTL.
  - Additional scan to include the facial bones should be undertaken as part of the C-Spine acquisition in cases where significant facial injury is suspected by the TTL.
  - Additional delayed phase imaging in the presence of suspected high grade renal, collecting system or bladder imaging should be discussed by the supervising radiologist and trauma team leader (TTL) at the time of scan.
  - High clinical suspicion of a significant lower limb arterial injury merits extending the scan volume to cover the area of concern.

- Some patients will inevitably be unable to comply with body imaging with arms above their head. Alternative approaches to positioning and protocols for imaging these patients is given as a traffic light aide memoir in Appendix AA (page 293).
Alternative Whole Body Protocol for Trauma Units

Alternative MDCT whole body protocols for trauma units not familiar with multiphasic whole body trauma imaging should include as a minimum, non-contrast imaging of the head and neck supplemented by arterial phase imaging of the chest, abdomen and pelvis and portal venous phase imaging of the abdomen and pelvis.

An example protocol is given below:

**Head and Neck**
- Unenhanced acquisition (0.625/1.25mm) brain (bony and soft tissue recons) with 3mm soft tissue recons immediately available for review
- Unenhanced spiral acquisition (0.625/1.25mm) from base of skull to T4 with 2mm axial, coronal and sagittal bony recons

**Lung apices to symphysis pubis (bone and soft tissue algorithms)**
- 100mls iodinated contrast @ 3.5mls/sec.
- Arterial phase: Commence scan @ 25 seconds post injection – Lung apices to symphysis pubis.
- Portal venous phase: Commence scan at 65 seconds post injection from dome of liver to symphysis pubis.
- Consider delayed scan if suspicion of significant renal collecting system or bladder injury.

An immediate (within 5 minutes) primary radiological survey should be given to the trauma team leader following image review on PACS. An example proforma for communicating significant life threatening injuries is given below.

**Detailed radiological secondary survey should be completed within 1 hour.**

A consultant-verified report should be made available at the earliest opportunity, definitely within 24 hours and ideally within 1 hour of image acquisition.
## Interventional Radiology

1. The on-call Interventional Radiologist is contactable via switchboard

2. If contrast extravasation / active bleeding is seen on CT the on-call Interventional Radiologist should be contacted

3. Essentially any arterial bleeding can be treated by embolisation

4. Patients who are candidates for intervention will return to the Emergency Department for on-going management whilst awaiting the Interventional Radiologist team.

### Guidance for Discussion With On-Call Interventional Radiologist

If contrast extravasation/ active bleeding is seen on CT by the radiology registrar or general radiologist, **or if they are uncertain** the case should be discussed with the on-call Interventional Radiologist – contactable by switchboard.

Essentially any arterial bleeding can be treated by embolisation.

- Renal, splenic trauma and abdominal wall bleeding respond very well
- Pelvic bleeding (either fracture related or gynaecological) responds well but often needs more diffuse embolisation. In general, embolisation is not considered the first line for bleeding secondary to pelvic injury: all cases must be discussed with the on call consultant for pelvic surgery before embolisation is considered.
- Liver trauma is more difficult as 70% of blood supply is portal venous, but is worth attempting if there is arterial bleeding seen on CTA.

Upper and lower GI bleeding can also be treated with embolisation but is less commonly trauma related and usually has endoscopy as first line.

Patients who are candidates for intervention will return to the Emergency Department for ongoing management while awaiting the attendance/ mobilisation of the Interventional Radiology team.
The Emergency Department has a large radiology suite embedded within its design. The suite consists of:

- 4 plain film imaging rooms
- 2 CT scanners, one within the suite and one within the Resuscitation area
- Ultrasound room

**Plain Film:**
The plain film imaging rooms contain digital radiography equipment providing rapid imaging for all patients.

**CT:**
Both scanners are accessible 24/7, with all major trauma patients receiving their CT scans in the resus scanner. There is an onsite CT radiographer 24/7 and an on-call radiographer located within 30 minutes of the hospital.

**MRI:**
The MRI unit is located on Level 2. These facilities are accessible 24/7. An on-call radiographer is available outside of normal hours and within 30mins.

- Monday to Thursday 0730 – 2130
- Friday 0730-2000
- Saturday and Sunday 0730-1500

**Interventional Radiology**
Located on Level 2. The Interventional Radiology department has staffing available for 5 labs between 0900-1700, a hybrid theatre and 2 fluoroscopy rooms from 0900-1700 every day. In addition there is cover from 0800 in one lab and between 1700-2000 there is cover for one lab plus another radiographer for run overs.

From 2000-0800 there is on-call cover from home. At weekends on-call cover from 2000 Friday through until 0800 on Monday morning is available from home. A radiographer is always available within 30 minutes.


5. The Royal College of Radiologists: Standards for Providing a 24-hour interventional radiology service https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr171_24hr_ir.pdf

6. NICE: Major Trauma: Assessment and Initial Management – Interventional Radiology (Section 1.5.40 – 1.5.43) http://www.nice.org.uk/guidance/ng39/chapter/Recommendations#interventional-radiology
REHABILITATION
1. It is a requirement that all Major Trauma Networks maintain an up-to-date Directory of Rehabilitation Services.

2. The Directory should be easily available to all clinicians working in the Severn Major Trauma Network (SMTN).

3. There needs to be robust and straightforward processes in place to ensure that services can be added or removed from the Directory in a timely manner.

4. There needs to be robust and straightforward processes in place to ensure that the data maintained in the Directory is accurate.

Background

The Major Trauma Services Quality Indicators (T16-1C-112) stipulate that each Major Trauma Network should maintain a Directory of Rehabilitation Services. This requirement is not further qualified but it is presumed that the intent is to facilitate clinicians in obtaining the rehabilitation services required to meet any need that has been identified and assist in the handover of patients from one team to another.

It is recognised that with approximately 40% of patients admitted to the Major Trauma Centre (MTC) being either repatriated to their local Trauma Unit (TU) or the patient’s local community services that such information is valuable to ensure that all patients receive the rehabilitation care they require.

A smaller number of patients, principally those with Traumatic Brain Injury, Spinal Cord Injury or complex amputations, may require onward referral to specialist units some of which may lie outside of the SMTN. The relevant contact information and a brief outline of the services they provide needs to be readily available.
Nature of the Rehabilitation Directory

The Directory of Rehabilitation Services will be maintained as a protected Excel Spreadsheet. The Directory will include:

- A brief description of rehabilitation services relevant to the SMTN along with contact details to facilitate referrals - SMTN Rehabilitation Teams
- Network Rehabilitation Contacts
- List of National Major Trauma Centre coordinators and rehabilitation coordinators.

Who the Directory is Aimed At

The Directory is aimed at all clinicians and support staff working within the SMTN. It is not intended as a patient or public accessible document as it contains personal contact information.

How the Directory is Accessed

The Directory will be made available through the SMTN Website https://www.nbt.nhs.uk/severn-major-trauma/smtn-information

Who is Responsible for Maintaining the Directory

The responsibility for ensuring the Directory is maintained and any significant changes communicated to the SMTN will reside with the Network Manager Victoria.Legrys@nbt.nhs.uk and Network Director of Rehabilitation (interim) Stephen.Novak@nbt.nhs.uk

How Information can be Added or Removed from the Directory

Any changes such as addition and removal of contacts or services should be communicated to the Major Trauma Team at Southmead Hospital via email MajorTrauma@nbt.nhs.uk
**Tertiary Survey**

1. Tertiary survey (TS) is a mandatory aspect of trauma management at North Bristol NHS Trust.

2. It should be conducted by a member of the specialist team looking after the patients inpatient care of at least registrar or more senior.

3. It should be conducted at 24 hours and once the patient is as fully alert, responsive and able to communicate as possible – at day 14 or at least 72 hours prior to discharge if less than 14 days.

4. The tertiary survey consists of 4 elements: clinical record review, laboratory review, radiological review and full top-to-toe examination.

5. Results of the tertiary survey should be documented on the specific proforma (see Appendix BB, page 294).

**Background**

The tertiary survey (TS) is a patient evaluation that identifies and catalogues all injuries after the initial resuscitation and any subsequent emergent operative interventions. It is a comprehensive review of the medical record with emphasis on the mechanism of injury and pertinent co-morbid factors. The TS includes the repetition of the primary and secondary surveys, a review of all laboratory data, and a review of all related radiographic studies. Any new physical findings require further studies to rule out missed injuries.

Systematic re-evaluation of the multiply-injured trauma patient with the tertiary trauma survey reveals missed injuries that have the potential to be clinically significant factor and affect patient morbidity and mortality.

The evidence base suggests that that to understand the aetiology of missed injuries and to appreciate the significance of early detection improves morbidity and mortality in major trauma patients.

The incidence of missed injuries ranges from 9% to 65% of admitted blunt trauma patients following standard primary and secondary survey, though most studies reporting this data were conducted before routine use of CT as an adjunct to initial assessment in ED.
The tertiary survey should typically be conducted at around 24 hours in all patients. If the patient is not fully awake at this time, the tertiary survey should still be performed, but is repeated once again when the patient has extubated, is alert and responsive and able to communicate any complaints, or has achieved their best expected GCS, at 14 days following admission or at least 72 hours prior to discharge from the MTC.

For patients transferred into the MTC as tertiary referrals, the tertiary survey should be completed as soon as possible after admission.

The clinician accountable for ensuring correct completion of the tertiary survey will be the named consultant for the patient’s inpatient specialty. This will likely be orthopaedics, neurosurgery, general surgery or plastic surgery.

The trauma team leader (TTL) for the patient’s admission or a major trauma practitioner may also request that a clinician undertakes the tertiary survey or confirm it has been completed.

Compliance with the tertiary survey will be monitored via regular audit presented to the major trauma management committee.

Tertiary survey consists of several stages:

- Review of all documentation to understand mechanism and kinetics of injury and treatment interventions to date as well as relevant baseline clinical findings from earlier patient assessments.
- Review of all laboratory investigations
- Review of all radiologic investigation images and reports. (Recognising that occasionally, reports may not identify minor radiological abnormalities indicative of injury). The name and grade of the radiologist completing the report and certifying the report should be noted.
- Head to toe clinical examination of the alert patient.
- A further TS will be required once the results of any additional investigations are available.
- The results of the tertiary survey can be documented on the TS record, a copy of which is found in the appendix BB (page 294).
1. Feeding should be started early (oral, enteral or parenteral nutrition)

2. Use validated predictive equations to accurately calculate nutritional requirements

3. There should be regular monitoring of biochemistry and timely appropriate supplementation when required

**Early Nutrition (Within 12 Hours of Admission to ICU)**

Place NG tube (avoid Ryles)
Refer to ICU protocol to start appropriate feed and rate until Dietetic review at earliest opportunity
**Policy:** Enteral Nutrition Policy

**Requirements**

**Calculated by Dieticians**
Ventilated patients: Penn State equation
Non-ventilated patients: Condition specific predictive equation

**Micronutrients**

Additional vitamin, mineral and trace element supplementation is required should deficiencies present. If feeds prescribed are not nutritionally complete, a multivitamin prescription is required.
Long stay patients may require additional blood tests for specific vitamin, mineral or trace elements.
**Policy:** Enteral Nutrition Policy, Refeeding Guidelines
Overcoming Delayed Gastric Emptying

If gastric residual volumes <250mls or a large vomit: Start metoclopramide 10mg IV TDS (24 hours)
If ongoing large aspirates: Place NJ feeding tube OR start erythromycin 250mg QDS IV
Policy: Enteral Nutrition Policy

TPN

Should be considered in those who have confirmed ileus or where no enteral access is obtainable.
Out of hours TPN available on ICU only on Trust Intranet
During weekdays – Dietitian to prescribe
Policy: Parental Nutrition Policy
1. All patients with traumatic amputations should be referred to the Bristol Centre for Enablement.

2. All patients need a referral form signed by their consultant or registrar (electronic form in the J drive).

3. If unsure whether a referral form has been sent, contact the prosthetic secretaries – Joanne Sargent ext 04610 / Helen Ford ext 04609.

4. Advice and support from the counselling service is available for inpatients.

5. The centre provides advice and treatment options for post amputation phantom pain.

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**Referral Pathway**

All traumatic amputees (i.e. amputations resulting from a traumatic cause including delayed primary amputation) should be referred to the Bristol Centre for Enablement (previously called the Disablement Service Centre (DSC)) for their multidisciplinary service.

This is regardless of whether you think they will be able / fit enough to use a prosthesis; patients will benefit from counselling and support as a minimum.

**Bristol Centre for Enablement General Number:** 0300 3000110

Patients in England now have the option to choose any limb centre they wish in England e.g. there is Bristol and Exeter. However, it is still worth referring to Bristol centre and they will pass on the details to the appropriate when patient is moved/repatriated etc.

**All patients need a referral form signed by their consultant or registrar.**

J:\Major Trauma Centre Designation\Rehab\Amputees

The form can be completed by anyone – MT clinical team, or therapists or nurses on the ward, but does need to be signed by the consultant or registrar. They will aim to do their initial MDT assessment.

The referral can be faxed to **0117 340 4654**
If you are unsure whether the DSC referral has been sent, you can contact the prosthetic secretaries Joanne Sargent ext 04610 / Helen Ford ext 04609.

You can also pre-warn them of a complex patient by this number/email them or Helen Harvey. (NBT email addresses).

The patient will then be seen in an MDT clinic as an outpatient.

If you think the patient may benefit from the counselling service or specialist expertise as inpatient, contact Helen Harvey or the secretaries listed above.

You can also contact the counsellor (Senna Cook senna.cook@nbt.nhs.uk ) or amputee specialist nurse (Kirsty Steventon, Kirsty.Steventon@nbt.nhs.uk ext 04618).
Stump shrinkers are encouraged to be applied as soon as possible, but once bulky dressings have been removed. Please contact Kirsty for advice, and she will try to come over and see the patient to measure etc.

They will send us a copy of their clinic letter for our information if requested.

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**Psychological Support**

| Counsellor: Senna Cook: Senna.Cook@nbt.nhs.uk |
| OT Specialist: Karen Cook: Karen.Cook@nbt.nhs.uk |
| Specialist Physio: Katharine Atkin: Katharine.Atkin@nbt.nhs.uk |

Post amputation phantom pain Bristol Centre for Enablement offer advice and other treatments options at our centre, all of which are discussed with the patients when they come for their primary assessment.

**The guidelines we follow for phantom pain includes:**

- Discussing appropriate analgesia and nerve pain medication such as gabapentin, pregabalin and amitriptyline etc
- Offering relax socks for phantom pain
- Offering acupuncture, provided by our physio
- Hypnotherapy, mirror therapy, as alternative management provided by Senna our counsellor.
Major Trauma Networks (MTN) are required to identify all patients that have ongoing rehabilitation needs.

1. MTN are required to have clear and agreed pathways established to ensure the needs of patients requiring ongoing rehabilitation and / or support with return to work are met.

2. MTN are required to collect information in accordance with the requirements of the British Society of Rehabilitation Medicine (BSRM) and the Clinical Reference Group for Trauma and where appropriate record this information on the TARN database.

3. This Policy will consider separately the Referral Pathways for patients with Specialist Rehabilitation needs (Category A and B) and those patients requiring the support of their local non specialist rehabilitation teams (Category C/D)

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**Background**

The Trauma Audit and Research Network database provides us with a breakdown of the rehabilitation needs of all Trauma patients (ISS <8) admitted through the Severn Major Trauma Network (SMTN).

The Department of Health Specialist Services National Definition Set (SSNDS) 3rd edition published in 2009 defined four categories of patient need (A,B,C,D) and three levels of specialist service (1, 2 and 3). These form a useful framework for planning and commissioning of specialist rehabilitation services.

The most recent figures from the SMTN suggest 2.8%, or on average 36 patients per year, will have Category A, the most complex, rehabilitation needs, at the time of their discharge or transfer out of the Major Trauma Centre (MTC). A further 4.1% or 52 patient will have Category B needs.

Thus a total of 88 patients on average will be judged to have Specialist Rehabilitation needs at the time of their discharge or transfer from the MTC. These patients will come from all over the SMTN. The majority will have suffered, in addition to other injuries, a traumatic brain injury, a smaller number a spinal cord injury and the remainder will have complex musculoskeletal injuries or multiple limb amputations. Such patients will generally all have an ISS >15
A further 54% of patients (or about 675) per annum will be judged to have Category C/D needs. These patients who generally have musculoskeletal injuries will require support from their local Recovery, Rehabilitation and Re-enablement (RR+R) services. These services, which may be delivered in community hospital beds, in the patient’s own home or in outpatients are usually collectively referred to as Level 3 services. The variety of these services, across the SMTN, both in terms of locality and structure make it difficult to formulate a common referral policy.

Whilst an individual’s complexity of rehabilitation is categorised as A, B or C/D, Specialist Rehabilitation Services are defined as Level 1, 2 or 3. The ‘Level’ of a service is defined principally on the case mix it caters for as determined by the patient’s categorisation at the time of transfer. There are standards laid down by the British Society of Rehabilitation Medicine as to the expected staffing and services offered by different levels of Specialist Rehabilitation unit. Level 1 services are defined as having >85% patients with Category A needs at transfer. Level 1 services, because they cater for relatively small group of the most complex patients, are generally commissioned on a regional basis. Level 2 units are defined as taking between 50-80% (Level 2a) or 30-50% (Level 2b) patients with Category A needs.

From these definitions it can be seen that there is no restriction on a Level 2 unit taking Category A patients, indeed that is expect, so long as they have the skills and resources to manage this degree of complexity.

Commissioning of rehabilitation service within the SMTN is that NHS England commissions Level 1 services, but not on an individual patient basis, whereas level 2 and 3 services are commissioned by local Clinical Commissioning Groups (CCGs) using a variety of mechanisms including spot purchasing on an individual patient basis.

This Policy will principally be concerned with the onward referral of those patients with the most complex rehabilitation needs (Categories A and B). It will however attempt to address and provide solutions to the problems that arise when Category C/D patients fail to recover as anticipate and suggest possible routes of referral.

With the establishment of MTCs in 2012 it was anticipated that in many areas or networks adequate provision for Specialist rehabilitation would be lacking. This was one of the principal drivers behind the requirement that all major trauma patients would receive a Rehabilitation Prescription (RP) identifying those needs. This issue has been further addressed by the setting up of the National Clinical Audit of Specialist Rehabilitation following Major Injury (NCASRI). This audit, to which the SMTN was a contributor, was funded by the Health Quality Improvement Partnership.
Once analysed the NCASRI audit will determine the scope, provision, quality and efficacy of Specialist Rehabilitation services across England with the intent of improving the quality of care for adults with complex needs (Category A and B) following Major Trauma. A key component of the audit is to link, via the NHS number, the information held on TARN with the UK Rehabilitation Outcomes Collaborative (UKROC). It will be possible to track a MT patient from admission to discharge following rehabilitation.

### Key Standards

All Major Trauma Networks are required to comply with and are audited against the standards agreed with NHS England and need to comply with the NHS England Standard Contract for Major Trauma Services.

All Specialist rehabilitation services are expected to comply with the standards laid down by the British Society of Rehabilitation Medicine and are audit against these standards by reference to their returns to the UK Rehabilitation Outcomes Collaborative (UKROC). They also need to comply with the NHS England Standard Contract for Specialised Rehabilitation for Patients with Highly Complex Needs (all ages).

- All Major Trauma Networks (MTNs) should have an operational policy describing agreed guidelines for access to rehabilitation services. T16-1C-113 (T16-2D-108)
- Each MTU/MTC should have a rehabilitation coordinator (may be combined with Trauma Coordinator) responsible for coordinating and communicating a patient’s current and future rehabilitation needs as well as having oversight of the rehabilitation prescription (RP). – T16-2D-103
- Each MTU/MTC should have referral pathways for patients requiring specialist rehabilitation and vocational rehabilitation. –T16-2D-104
- All patients should have a rehabilitation assessment including consideration of barriers for return to work with a RP being initiated within 48 hours of admission and completed by 96 hours. Thereafter it needs to be updated every week until the patient is transferred to a designated rehabilitation service or alternative service provider. Patients identified as having likely category A or B needs should have a ‘Specialist’ RP completed by a consultant in RM or their designated deputy. –T16-2D-106
- There should be a rehabilitation program for patients with a traumatic amputation which includes a linked prosthetic centre and a pain management service. –T16-2D-107
- The trauma rehabilitation service, if it does not include a clinical psychologist, should have details on how they access advice from a clinical psychologist. –T16-2D-109.
Overview

The most frequent need for specialist rehabilitation arises from persons who have suffered a traumatic brain injury. NHS England currently has a block contract with the Frenchay Brain Injury Rehabilitation Centre to provide 28 level 1 beds for Category A patients for the entire West Country.

It will be seen from the following that a number of the Trauma Units within the SMTN have locally CCG commissioned services for patients with Category B and in some cases Category A needs; specifically the Royal United Hospital in Bath, the Gloucester Royal Hospital and Musgrove Park / Yeovil District Hospitals.

The Bristol Royal Infirmary, Great Western Hospital in Swindon and Western General Hospital do not currently have identified specialist rehabilitation services for all acquired brain injury (although all three provide stroke services).

The role of the Major Trauma Centre is not to make good commissioning shortfalls in other localities. All hospitals are expected to comply with the NICE guidance and standards in respect of traumatic brain injury. All hospitals should have in place the means to assess the inpatient rehabilitation needs of people with new cognitive, communicative, emotional, behavioural or physical difficulties continuing 72 hours after a traumatic brain injury. All hospitals should have in place the means to safely manage such patients until an appropriate rehabilitation service is identified. Concerns that a hospital may not be able to meet the needs of a brain injured patient is not a justification for delaying repatriation; rather it is a concern to be raised with the hospital, the Network Director and, if necessary, the CQC.

Where a Trauma Unit (TU) has clear arrangements in place to meet the needs of a brain injured patient the appropriate teams should routinely be notified that a patient is to be repatriated. The team should be provided with up-to-date information on the patient’s cognitive and physical status as well as all other referrals that have been made.
For all patients with a Traumatic Brain Injury:-

- They should be identified as having likely category A or B needs by reference to the assessment carried out by the Major Trauma Practitioners and the Rehabilitation prescription which should have been initiated by 48 hours post admission.
- Patients should be assessed by a Consultant in RM or their deputy and their needs categorised by reference to the Patient Categorisation Tool (PCAT).
- All patients judged to have category A needs should be referred to Frenchay Brain Injury Rehabilitation Centre (BIRU) as below.
- Whilst such patients are still medically or surgically unstable a clear hyper-acute rehabilitation plan should be documented for their stay in NBT/MTC.
- When sufficiently stable to be transferred patients should be referred to their local services (if they come from outside the MTC catchment) and arrangement made for repatriation.
- Throughout their stay in the MTC and TU's it should be expected that patients will continue to improve and their rehabilitation needs reduce. Therefore reassessment of a patient’s categorisation should be carried out regularly when there is a perceived change in their condition. If a patient previously assessed to have category A needs is later assessed to have category B or C needs, BIRU should be so informed and appropriate alternative arrangements made.
- All patients and / or their families should be offered information or referral to Headway. Headway, a national charity with local affiliate branches, is able to provide advice and support through their website and helpline (freephone helpline 0808 800 2244, helpline@headway.org.uk) as well as through the Headway Acute Trauma Support (HATS) nurses.
- All patients and / or their families should be offered referral to Stewart’s Law, a pro-bono legal service, which can help with benefits advice, access to bank accounts, applying for court of protection and possible compensation.

The Frenchay Brain Injury Rehabilitation Centre

The Frenchay Brain Injury Rehabilitation Centre
Frenchay Park Road,
Bristol BS16 1UU
Tel: 0117 956 2697

Known locally as BIRU, it specialises in the treatment of patients, from 16 years and upwards, who have severe physical and/ or cognitive problems resulting from a brain injury. It is a private facility managed by the Huntercombe Group. It historically has a close connection with North Bristol NHS Trust. It operates on a non-acute site.
The service comprises 29 Level 1 beds commissioned by NHS England to serve the West Country. It also provides 24 Level 2 service beds which are funded by local CCGs on an individual patient basis. It is registered with UKROC as a Level 1b service. Medical staff includes not only consultants in Rehabilitation Medicine (RM) but also Neuropsychiatry. The service is able to manage patients held under Deprivation of Liberty Safeguards (DOLS) and the Mental Health Act (MHA). It can provide 1:1 supervision of patients as well as catering for up to 2 patients with stable tracheostomies.

The agreed referral pathway is as follows:-

- For those patients judged to have Category A needs a referral should be made in writing, including all relevant medical and social information, to BIRU.referrals@nhs.net. (Patients may be referred when still acutely unwell but not so early as to make assessment / prognostication unrealistic i.e. still intubated with an intention to wean, still with intracerebral drain or monitor in place.)
- The PCAT score and date of referral should be clearly recorded in the notes.
- A consultant from BIRU will assess within 10 days of referral (often much sooner).
- If accepted will be placed on the BIRU waiting list.
- For patients assessed as having Cat B needs from the Bristol, North Somerset and South Gloucester (BNSSG) CCGs an application for assessment and possible funding should be made to Jo Kapp (KAPP, Jo (NHS BRISTOL CCG) (jo.kapp@nhs.net). The process is still under development. One potential option is for the BNSSG CCG is to agree funding on an individual patient basis for a Level 2 bed at BIRU.
- The repatriation of a patient to their local TU should not be delayed whilst awaiting a BIRU assessment. The BIRU consultants are quite happy to follow up patients wherever they may be in the SMTN.

Royal United Hospital Helena Ward

Royal United Hospital Helena Ward
Royal United Hospitals Bath NHS Foundation Trust
Combe Park
Bath BA1 3NG

The RUH Helena Ward currently provides Level 1 and Level 2 rehabilitation for patients from the Bath and North East Somerset area and West Wiltshire. It is registered with UKROC as a Level 2a service.

It provides a dedicated team of clinical psychology, physiotherapy, occupational therapy and rehabilitation support workers hosted on a general neurology ward. Currently medical input comes from consultant neurologists.
It operates on an acute site and is able to manage potentially medically unstable patients and those with tracheostomies.

The service has a limited number of beds and, whilst able to manage patients with Cat A and Cat B needs, may subsequently transfer a Cat A patient to BIRU if a longer period of rehabilitation is required.

The agreed referral pathways are as follows.

For patients with Cat A needs:-
- Patients should be referred to BIRU for assessment.
- When medically / surgically sufficiently stable for repatriation patients should be referred to the on call neurologist.
- Simultaneously a referral should be made to, Peter BISHOP (ROYAL UNITED HOSPITALS BATH NHS FOUNDATION TRUST) <peterbishop@nhs.net> and, Gina SARGEANT (ROYAL UNITED HOSPITALS BATH NHS FOUNDATION TRUST) <gina.sargeant@nhs.net>
- For patients with persisting Cat A needs the team will make the decision as to whether or not an onward transfer of a patient to a BIRU bed is ultimately required.

For patients with Cat B needs:-
- When medically / surgically sufficiently stable for repatriation patients should be referred to the on call neurologist.
- Simultaneously a referral should be made to, Peter BISHOP (ROYAL UNITED HOSPITALS BATH NHS FOUNDATION TRUST) <peterbishop@nhs.net> and, Gina SARGEANT (ROYAL UNITED HOSPITALS BATH NHS FOUNDATION TRUST) <gina.sargeant@nhs.net>
- The RUH Helena team will liaise with their local CCG if additional support to meet the needs of this patient cohort is required.

Somerset Neurological Rehabilitation Unit (SNRU)

Somerset Neurological Rehabilitation Unit (SNRU)
Dene Barton Community Hospital
Lydeard Ward
Dene Road
Cotford St Lukes
Tauton TA4 1DD
Telephone 01823 431953

The Somerset Neurological Rehabilitation Unit is registered with UKROC as a Level 2b service. It is a 10 bedded service with the potential to expand to 20 beds. It provides neurological rehabilitation for patients from Somerset
It has a dedicated team of clinical psychology, physiotherapy, occupational therapy and rehabilitation support workers. The service is medically supported by a consultant in Rehabilitation medicine and a junior doctor. Staff are employed by Taunton and Somerset NHS Foundation Trust.

The service operates from a community hospital (managed by Somerset Partnership NHS Trust.) It shares this modern purpose built building with a number of community services including the Early Supported Discharge Team. It is a non-acute site with limited out of hours cover meaning patients have to be medically stable before transfer.

Currently all patients are first admitted or repatriated to the Neurology ward (Conservators Ward) at Musgrove Park Hospital. Conservators Ward has 12 acute neurological rehabilitation beds and 12 general neurology beds. The patients will then be assessed as to their suitability prior to transfer to the SNRU.

The agreed referral pathways are as follows

**For patients with Cat A needs.**

- Patients should be referred to BIRU for assessment.
- When medically / surgically sufficiently stable for repatriation patients should be referred to the on call neurologist.
- Simultaneously a referral should be made to, Dr Mohammed Inan Hai, Consultant in Neurological Rehabilitation.
- For patients with persisting Cat A needs the team will make the decision as to whether or not an onward transfer of a patient to a BIRU bed is ultimately required.

**For patients with Cat B needs:-**

- When medically / surgically sufficiently stable for repatriation patients should be referred to the on call neurologist.
- Simultaneously a referral should be made to Dr Mohammed Inan Hai, Consultant in Neurological Rehabilitation.
- When judged to be sufficiently stable the patient will be transferred to the SNRU if further inpatient rehabilitation is required.

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**Gloucester Brain Injury Team**

Gloucester Brain Injury Team  
Gloucester Royal Hospital  
Ground Floor Beacon House  
Great Western Road  
Gloucester GL1 3NN  
Telephone 0300 4225139
Although Gloucester has no specialist rehabilitation services recognised by UKROC it nevertheless has a long established team based at the Royal Gloucester Hospital. The team provides a number of services which naturally fall under the umbrella of level 2 and level 3 services. The team comprises clinical psychologists, physiotherapists, occupational therapists, speech and language therapists and therapy technicians.

For patients with Cat A or B needs the team provides a peripatetic rehabilitation service to the neurology ward 6a. Medical support comes from Consultants in Neurology.

For patients with Cat B needs requiring inpatient care beyond the point at which they are considered to be medically stable the Gloucester Brain Injury Team, as part of their early supported discharge program, will negotiate with local CCG for funding of on-going inpatient care at the Dean Neurological Centre (this is a private institution managed by Ramsay Health Care at the Winfield Hospital approximately 2 miles from the Royal Gloucester Hospital.) The team will inreach into the Dean to provide a peripatetic rehabilitation service.

For patients with persisting Cat A needs the team will continue to provide support until a bed becomes available at the Frenchay Brain Injury Unit.

The agree referral pathways are as follows.

**For patients with Cat A needs**:-
- Patients should be referred to BIRU for assessment.
- When medically / surgically sufficiently stable for repatriation patients should be referred to the on call neurologist.
- Simultaneously a referral should be made to, brain.injury@glos.nhs.uk

**For patients with Cat B needs**:-
- When medically / surgically sufficiently stable for repatriation patients should be referred to the on call neurologist.
- Simultaneously a referral should be made to, brain.injury@glos.nhs.uk

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**The Dean Neurological Centre**

The Dean Neurological Centre  
Winfield Hospital  
Tewkesbury Rd  
Longford  
Gloucester GL2 9EE  
Telephone 01452 420200
The Dean is a purpose built unit with 60 beds managed by Ramsay Health Care. Currently it has no contract with local CCGs or NHSE. Nevertheless the majority of its patients are CCG funded as continuing health care placements. The centre primarily cares for patients who have long term or lifelong care needs. It particularly specialises in patients in low awareness states or with tracheostomies. The unit has a small dedicated team of therapists and a larger team of trained rehabilitation support workers. It is medically supported by a local GP practice with monthly visits from a very experienced Professor of Neurological Rehabilitation. It is not registered with UKROC. There is no mechanism for direct referral of patients from the SMTN. A small number of beds have historically been funded by Gloucester CCG to provide inpatient care for Cat B patients with input from the Gloucester Brain Injury Team as part of their early supported discharge initiative.

Where no other suitable beds are available funding can be sought for Cat A patients in liaison with the NHS England Complex Patient advisors Rosie Yarnall (Rosie.yarnall@nhs.net) and Sally Plumb (splumb1@nhs.net)

Glenside Manor Healthcare Services Limited
Glenside Manor Healthcare Services Limited
Warminster Road
South Newton
Salisbury
Wiltshire SP2 0QD
Telephone 01722742066
Glenside is an independent provider for the rehabilitation of adults with neurological injury and conditions, including people with challenging behaviours. Glenside operates a pathway of inpatient care from acute care and intensive rehabilitation within the Hospital, to slow stream rehabilitation within eight homes and ten simulated supported living bungalows.

It is registered with UKROC as a level 2a unit providing 28 beds for neurological rehabilitation led by a RM consultant and 14 beds for patients with challenging behaviour led by a consultant in Neuropsychiatry. It can manage tracheostomies.

Although it lies just outside of the SMTN it is well positioned for patients coming from the east of the region. It has no formal contracts with CCGs in the SMTN but if no suitable beds are available for Cat A patients funding can be sought in liaison with the NHS England (South) Case managers – Complex Rehabilitation Rosie Yarnall (Rosie.yarnall@nhs.net) and Sally Plumb (SPlumb1@nhs.net)
Overview
Services for patients with a spinal cord injury are commissioned by NHS England 10. Guidance on initial management as well as the Acute Secondary Admission Pathway is described in detail on the National Spinal Cord Injury Strategy Board website (www.nscisb.nhs.uk). Irrespective of the mechanism of injury or severity this is considered a Specialist Rehabilitation service. The patient is to be managed whilst in either the MTC or TU in line with protocols agreed with Spinal Cord Injury Centre 11.

A perennial problem is the management of a SCI patient with a concurrent TBI. The SCIC will decide whether, by virtue of cognitive impairment, a patient is able to benefit from rehabilitation. Whilst there is some logic to this approach as rehabilitation is for the most part an iterative (learning by repetition) process there is clearly a gulf between what a brain injury unit will consider reasonable in terms of a patient’s ability to engage with or benefit from a rehabilitation environment and that of a SCIC.

The local SCIC is the Duke of Cornwall at Salisbury.

Salisbury Spinal Cord Injury Centre

Spinal Treatment Centre
Salisbury District Hospital
Salisbury
Wiltshire SP2 8BJ
United Kingdom
Telephone: 01722 336262

Referral pathway for all traumatic spinal cord injured patients.
Within the first 4 hours:

• Acute resuscitation, assessment of injuries and completion of first ‘ASIA’.
• Contact Duty Spinal Consultant on 01722336262
• Document agreed immediate management plan in patient’s notes.
• Register the patients referral to the SCIC on www.spinalreferrals.nhs.uk (note this website is only accessible from an NHS networked computer.)
• File registration confirmation email in patient’s notes.
• Commence SCIC management plan.

The referral will automatically trigger review by the SCIC outreach team. They will be available for telephone advice and will review the patient within 5 days, advise on management and consider patients suitability for inpatient rehabilitation at the SCIC.

The Acute Outreach Team can be contacted as below:-
Significant exclusion criteria for MT patients with SCI are:-

- Severe brain injury with significant cognitive deficits.
- Patients with significant mental health problems which might interfere with their engagement with a spinal rehabilitation program and/or held under the MHA.
- Patients with significant comorbidities which might affect their ability to undertake spinal rehabilitation.

To save delay it should be anticipated whether or not a patient is likely to be refused admission to the SCIC. In most instances such patients will be considered to have Cat A needs and should be referred to BIRU (see above). BIRU has experience in dealing with patients with TBI and SCI. The SCIC acute outreach team will in this event continue their involvement with the patient and provide ongoing support and advice.

---

**Services for patients who have had a traumatic amputation**

**Overview**

Only patients with multiple limb amputations are considered Cat A or B patients. The majority of amputees will undergo their rehabilitation in the community. For all patients an amputation is a life changing and psychologically challenging event.

All prosthetic services are funded through Specialist Commissioning (NHSE). A patient may choose to attend any prosthetic service. Patients will generally choose which ever is closest.

The SMTN is served by three Prosthetic services. Bristol serves Gloucester, Bristol, North Somerset and West Wiltshire. Exeter serves Somerset and Oxford serves patients living to the north of Swindon. However, only Oxford has access to inpatient rehabilitation beds.

Referral pathways for traumatic amputees or patients who are at risk of amputation:

All patients at the MTC should be referred, as soon as possible, in the first instance to the Bristol Centre for Enablement. The BCE will provide advice, counselling and support. The BCE or clinical team can arrange onward referral to a more local prosthetic service if this is required.

Contact:

Dr Swaroop Shanbhag, Consultant in Rehabilitation Medicine (swaroop.shanbhag@nbt.nhs.uk)

Senna Cook (Senna.Cook@nbt.nhs.uk) Counsellor
Bristol Centre for Enablement,
Highwood Pavilions,
Jupiter Road,
Patchway BS34 5SP
Telephone 0300 300 0110
Email: prosthetics@nbt.nhs.uk
Website www.nbt.nhs.uk/prosthetics

Those patients with multiple limb amputations who require inpatient rehabilitation should be offered referral to the Oxford Centre for Enablement.

**Prosthetics Referral**

Oxford Centre for Enablement
Nuffield Orthopaedic Centre
Windmill Road
Oxford OX3 7HE
Email: ouh.prosthetics@nhs.

Patients managed at the TUs should be referred as soon as possible to their local prosthetic service.

Exeter Mobility Centre
Lister Close
Off Wonford Road
Exeter EX2 4DU
Tel: 01392 403649/8
Fax: 01392 403667

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**Community Service / Level 3 Services for Patients with a TBI**

**Overview**
Currently services for patients with mild to moderate TBI, who are discharged directly to the community, are patchy across the SMTN. No services have yet been identified for the catchment area covered by the RUH or Great Western Hospital.

For patients living within the Bristol, North Somerset and South Gloucester catchment (BNSSG) there is the Head Injury Therapy Unit based at Frenchay. This service can provide assessment, treatment and advice to people recovering from or living with a TBI. The waiting time for first assessment is approximately 3 months. Referrals should be made to:-

Dr Emma Hale (Clinical Lead)
Head Injury Therapy Unit
Frenchay Beckspool Building
For patients living in the catchment areas of Gloucester Royal Hospital and Cheltenham there is the Gloucester Brain Injury Team (GBIT). Referrals should be made to:-

Gloucestershire Brain Injury Team,
Gloucestershire Royal Hospital
Tel: 0300 422 5139 (answerphone) Monday to Friday, 8:30am to 4:30pm
Email: brain.injury@glos.nhs.uk

For patients in Somerset there is a TBI clinic run by Dr Mohammad Hai, Consultant in Neurological Rehabilitation. Referrals should be made to:-

Dr Mohammad Hai, Consultant in Neurological Rehabilitation,
Musgrove Park Hospital,
Taunton TA1 5DA
Mohammad.Hai@tst.nhs.uk

Rehabilitation References

Tertiary Survey


2. NHS England Major Trauma Quality Measure T16-2C-107, 2016


APPENDICES
Appendix A - Major Trauma Triage Tool

Do serious injuries include ANY of the criteria below?

- Sustained RR less than 10 or more than 29
- Sustained systolic BP's less than 90mmHg or absent radial pulses
- GCS motor score of 4 or less (flexing to painful stimulus)

Give early ATMIST as soon as possible

For normal paediatric values, consult JRCALC

Consider early critical care or HEMS activation

Consideration of special patient groups to heighten suspicion of injury:
- Patients aged over 65
- Children aged 12 and under
- Pregnancy
- Anticoagulants
- Polypharmacy

Physiology

Extensive chest wall injury
- Neck or back injury with paralysis
- Suspected open, depressed or basal skull fracture
- Amputated limb
- More than 1 proximal long bone fracture
- Open long bone, midfoot or hindfoot fracture*
- Crushed, degloved or mangled limb*
- Suspected major pelvic fracture**

Anatomy

Does the clinician remain concerned?

Yes

Can airway and catastrophic haemorrhage be safely managed?

Yes

Can Major Trauma Centre be safely reached within 60 minutes?

Yes

Go to nearest Major Trauma Centre

No

Go to nearest Trauma Unit if closer than Major Trauma Centre

No

*Open fractures require treatment in a specialist orthoplastics centre within 6 hours of injury. If this is the only injury, consider contacting the MTC (or Salisbury ED if in Wessex Network area, RD&E in East Devon) for discussion of direct transport to orthoplastics.

**Suspected major pelvic fracture, where mechanism of injury is suggestive of a pelvic fracture AND is accompanied by any one or more of the following:
- Haemodynamic instability/signs of shock
- Deformity on examination
- Suspected open pelvic fracture due to bleeding PU, PV or PR (or scrotal haematoma)
### Appendix B - Major Trauma Phone Calls

<table>
<thead>
<tr>
<th>PRIMARY / SECONDARY</th>
<th>Date</th>
<th>Time</th>
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#### TRAUMA TRIAGE TOOL

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<thead>
<tr>
<th>Physiology</th>
<th>Location: ______________________</th>
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<tbody>
<tr>
<td>Sustained RR&lt;10 or &gt;29</td>
<td>(Prehospital / Hospital name)</td>
</tr>
<tr>
<td>Sustained SBP&lt;90mmHg / absent radial pulse</td>
<td>Name: __________________________</td>
</tr>
<tr>
<td>GCS Motor score&lt;=4</td>
<td>(HEMS Name if blood given)</td>
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</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Time of Incident: __________</th>
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<table>
<thead>
<tr>
<th>Mechanism</th>
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</thead>
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<table>
<thead>
<tr>
<th>Anatomy</th>
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</thead>
<tbody>
<tr>
<td>Extensive chest wall Injury</td>
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<tr>
<td>Neck or back Injury with Paralysis</td>
</tr>
<tr>
<td>Suspected open, depressed or basal skull fracture</td>
</tr>
<tr>
<td>Amputated limb</td>
</tr>
<tr>
<td>More than 1 proximal long bone fracture</td>
</tr>
<tr>
<td>Open long bone, midfoot or hindfoot fracture</td>
</tr>
<tr>
<td>Crushed, degloved or mangled limb</td>
</tr>
<tr>
<td>Suspected pelvic fracture with:</td>
</tr>
<tr>
<td>• Haemodynamic instability / signs of shock</td>
</tr>
<tr>
<td>• Deformity on examination</td>
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<tr>
<td>• Open fracture – PU. PV / PR Bleeding / scrotal haematoma</td>
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<td>Clinician Concern</td>
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<table>
<thead>
<tr>
<th>High risk groups</th>
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<tbody>
<tr>
<td>• Age &gt;65</td>
<td></td>
</tr>
<tr>
<td>• Pregnancy</td>
<td></td>
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<tr>
<td>• Anticoagulants</td>
<td></td>
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<tr>
<td>• Polypharmacy</td>
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<table>
<thead>
<tr>
<th>Injuries suspected / Confirmed</th>
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<table>
<thead>
<tr>
<th>Signs/Symptoms</th>
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<table>
<thead>
<tr>
<th>Treatment Given</th>
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<table>
<thead>
<tr>
<th>Team</th>
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<tbody>
<tr>
<td></td>
<td>(full/TTL/other)</td>
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</table>

<table>
<thead>
<tr>
<th>Call Taken By: __________________________</th>
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</thead>
</table>

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1. On activation of the trauma team, members should attend as soon as possible and ideally within 5 mins of the call being made.

2. This team should manage the initial assessment, resuscitation, imaging and co-ordination of disposal for trauma patients presenting to NBT

3. All members of the trauma team should inform their respective speciality team members of incoming trauma prior to attending ED

4. All trauma team members must remain with the patient until appropriate disposal is achieved

5. The reference cards below describe expected actions of each team member; laminated copies may be handed to trauma team members on arrival at the trauma call as an “aide-memoire”
**Trauma Team Leader - Reference Card**

**Pre-Arrival**

- Add alert call details to Trauma Board
- Ensure personal introductions by Team members and confirm roles.
- Brief Trauma Team
- Ensure team wear personal protective equipment
- Ensure scribe has relevant details required

**Patient Reception**

- Ensure resus clock and video recorder started
- Coordinate ATMIST handover from prehospital team
- Update details on Trauma Board – may delegate to scribe
- Co-ordinate transfer to Resus Trolley
- Make decisions in conjunction with team members and relevant specialists.
- Prioritise investigations and treatments
- Ensure imminent life threatening conditions are treated
- Ensure rapid transfer to CT or Theatre as required

*Promote an environment of open communication with review of ongoing management priorities and plans, ensuring involvement of all team members.*

- **Aim for CT within 15 minutes**
- **Consider CT in lieu of primary survey x-rays in some cases** see - “Imaging in Trauma Guidance”

**Patient Transfer**

- Remain with patient during transfer to and from CT & theatre.
- Hold the trauma mattress in fixed position on CT plinth during patient movements

**Adjuncts to Primary Resuscitation**

Antibiotics, urinary catheter, arterial lines, tetanus, pregnancy test need early consideration but can be delayed if transfer to theatre for emergency surgery is required.
**Communication**

**Handover**
Determines the Specialty to lead ongoing inpatient care.

**Blood Bank**
Ensure blood bank are aware of patient movement and ongoing requirements in the event of ongoing haemodynamic instability or transfusion requirements

**Speak to Relatives**

---

**Post Trauma Call**

**Documentation**
Review completed Trauma case note documentation

**Debrief team**
Complete Hot Debrief form

**Trauma Ward Rounds**
Follow up on known major trauma patients, ensuring documentation, assessment and ongoing care arrangements are appropriate to their clinical presentation
**Generic Trauma Team Role**

Collect specialty trauma bleep and receive handover + relevant specialty situational report.

**Start of Shift**

- Inform respective Specialty team members/ Consultant/ Theatres of incoming Trauma

**Trauma Call Activation**

- Attend Resus area of the Emergency Department as soon as possible on receipt of Trauma call.

The decision to activate the Trauma team is based on the expectation that the alerted team members will be present to receive the patient.

*There is no requirement for team members to ring the ED to discuss the case prior to the patient’s arrival.*

**On arrival to the Emergency Department:**

- Identify yourself to the Trauma Team Leader.
- Give name, specialty and grade to the scribe
- Fill in your identification sticker and place in a visible place
- Confirm expected role
- Review role aide-memoire as needed
- Ensure adequate personnel protective equipment

**Remain with the patient until appropriate disposal is achieved**

If you need to leave the Trauma Team environment – this **must** be discussed and be agreed by the Trauma Team Leader
Orthopaedic Registrar - Reference Card

Key Roles

- Catastrophic Haemorrhage control
- Cervical Spine and Pelvic stabilisation
- Venous access
- Perform Secondary Survey
- Determine imaging requirements (additional to trauma CT)

Haemorrhage Control

- Direct pressure haemorrhage control as required
- Consider tourniquet use for severe uncontrolled extremity bleeding
- Ensure pelvic splint in situ, correct size and placement
- Ensure legs aligned with internal rotation – bandage ankles to maintain position

Venous Access

- Venous access – shared role as directed by Team Leader
- Ensure or gain 2 x i.v./i.o access points
- **If possible, free cannula to be placed in the back of the left hand for the IV contrast.**
- Obtain 20mls blood for FBC, UE’s, LFT’s, Lipase, Clotting screen, X- match, venous blood gas and blood glucose
- Confirm i.v. access patency (flush with saline, observe for extravasation)
- Ensure samples labelled correctly and dispatched to appropriate departments

Neurological Assessment

- Perform baseline peripheral neurological examination, prior to anaesthesia if planned or just prior to logroll as directed by TTL
- Ensure c-spine collar in situ, correct size and placement if directed by TTL
### Orthopaedic Assessment

- Identify & splint long bone fractures
- Contribute to case discussion with the TTL, particularly where limb or lifesaving interventions are required

### Secondary Survey

Carry out secondary survey, when deemed appropriate and verbally report findings to TTL and scribe

- Document all wounds, grazes and degloving
- Evaluate each joint and long-bone for dislocation / stability / fracture
- Neurovascular examination of all limbs
- Record presence or absence of peripheral pulses
- Identify peripheral injuries that need to be included in trauma CT scan
- Splint fractures as needed
- Repeat neurovascular examination after splintage

### Determine Additional Imaging Requirements

- Determine imaging needs in addition to trauma CT series - discuss with TTL prior to making request
- Consider retrograde-urethrogram prior to insertion of urinary catheters in patients with anterior pelvic injuries

### Communication

- Discuss Orthopaedic plan / priorities with team leader
- Liaise with theatres, anaesthetic colleagues, bed manager and orthopaedic consultant for patients needing theatre and / or admission
- Assist with sending/ordering tests
- Liaise with specialists or undertake procedures as training and ability allow e.g. chest drains, urinary catheter.
Post Trauma Call

- Document all actions and findings with a clear plan in patient notes
- **Remain with the patient until appropriate disposal is achieved**
- If you need to leave the trauma team environment – this **must** be discussed and be agreed by the TTL
### Key Roles

- Assess Breathing and Circulation
- Perform logroll examination
- Determine need for immediate surgical intervention in theatres

### Breathing

- Identify significant chest pathology
- Assess tracheal position/chest expansion/percussion/air entry
- Report & discuss findings to Trauma Team Leader
- Institute appropriate interventions as needed

### Circulation

- Venous access – shared role as directed by Team Leader
- Ensure or gain 2 x i.v./i.o access points
- If possible, free cannula to be placed in the back of the left hand for the IV contrast.
- Obtain 20mls blood for FBC, UE’s, LFT’s, Lipase, Clotting screen, X-match, venous blood gas and blood glucose
- Confirm patency of i.v. access
- Ensure samples are labelled correctly and dispatched to the appropriate departments
Abdomen

• Complete abdominal examination

During Log-roll
• Assess occiput / cervical/thoracic / lumbar spine
• Examine posterior chest including auscultation
• Palpate flanks
• PR examination
• Perform rectal examination
• Assess posterior aspect of limbs

Communication

• Discuss surgical assessment / priorities with TTL
• Communicate with theatres – share communication with ICU
• Consider need for vascular +/- plastic specialist input - ensure relevant specialists contacted to attend
• Inform surgical consultant of expected case progression
• Complex injuries or ongoing haemodynamic instability may require attendance of the General Surgery consultant to ED or theatre
• Assist with sending/ordering tests
• Liaising with specialists and perform procedures as training / ability allows e.g. chest drains, urinary catheter

Post Trauma Call

• Document all actions and findings with a clear plan in patient notes
• **Remain with the patient until appropriate disposal is achieved**
• If you need to leave the trauma team environment – this **must** be discussed and be agreed by the Trauma Team Leader
**Key Roles**

- Confirm airway patency / confirm ETT position & patency
- Ensure patient oxygenated and ventilated
- Anaesthetise and intubate when appropriate - in discussion with TTL
- Ensure complete baseline neurological examination prior to emergency anaesthesia or sedation
- Control patient logroll
- Ensure safe patient transfer

**Airway**

**Intubated patients**
- Take physical handover of ETT or LMA from prehospital team
- Check ETT position (length at teeth)
- Confirm ETT placement with end tidal CO₂
- Assess effectiveness of ventilation with BMV / Mapleson C circuit in conjunction with surgical registrar assessment of chest
- Attach to ventilator as soon feasible
- Confirm of effective bilateral ventilation as soon as possible

**Non-Intubated patients – requiring intubation**
- Intubate when appropriate in discussion with TTL
- Ensure baseline neurological examination performed beforehand, orthopaedic registrar will assess peripheral limb response, anaesthetist to assess pupil response and formal GCS.
- Perform coordinated emergency anaesthesia with Airway Nurse
- Proceed as per intubated patient actions above

**Non-Intubated patients – NOT requiring intubation**
- Communicate airway patency and issues to team leader / scribe
- Assess respiratory rate and inform team leader / scribe
- Ongoing assessment of GCS and pupil size/reaction
- Take AMPLÉ history and inform TTL / scribe
- Explain what is happening and reassure patient
Exposure

- Control the log roll when directed by TTL
- Consider endogastric tube (nasal or oral)
- Avoid delays in transfer to CT or theatre: defer arterial line insertion unless exceptional circumstances

Communication

- Discuss fluid management, blood products and inotropic support with TTL
- Discuss implementation of massive transfusion protocol when needed
- Communicate patient needs requirements with theatres
- Liaise with additional anaesthetists as needed e.g. massive transfusion, complex cases, handover of care etc
- Manage massive transfusion once in theatre, communicate regularly with blood bank +/- haematologist
- N.B. In ED TTL + non-airway nurse will have primary responsibility for massive transfusion
- Inform ITU Consultant on call of likely case progression
- ICU consultant may need to attend the ED or theatre where appropriate – e.g. patient with complex injuries / ongoing haemodynamic instability / massive transfusion requirements.
- Assist with sending/ordering tests
- Liaise with specialists
- Performing procedures as training and ability allows e.g. chest drains, urinary catheter

Documentation

- Document all actions and findings with a clear plan in patient notes.
- **Remain with the patient until appropriate disposal is achieved.**
- If you need to leave the trauma team environment – this *must* be discussed and be agreed by the Trauma Team Leader.
Non Airway Nurse - Reference Card

Key Roles

- Liaise with TTL, Senior ED Nurse and other Trauma Team Nurse
- Review & prepare resus bays, ensure checklists completed / signed
- Set up Level 1 Infuser and / or chest drain kits when directed by TTL
- Ensure availability of equipment for IV / IO access and blood samples
- Confirm availability of O-ve blood
- Meet patient on helipad if required – coordinate with porters

Prior to Patient Arrival

- Support TTL as required
- Set up level one infuser run through when / as directed
- Prepare chest drain kit if requested
- Ensure scoop stretcher and pelvic binder to hand
- Ensure equipment for gaining large bore IV access and taking bloods is available
- Ensure availability of O-ve Blood
- Meet patient at helicopter if required – co-ordinate porters/ transfer equipment.
- Ensure clock +/- video recording started when patient arrives in Resus

Patient Arrival

- Assist in transfer to the Resus trolley
- Position to the patients left side
- Remove enough clothing initially to attach monitoring
- Rapidly obtain and clearly state first observations to TTL & scribe
- Remove all remaining clothing including underwear and store securely
- Check temperature
- Cover with Bair Hugger / blankets
- Assist with IV access and sending bloods f required
- Set up intraosseous kit (ez-IO) if no/difficult IV access
- Attach patient to level one infuser if required.
- Assist with log roll
- Draw up drugs / administer as prescribed
• Prepare for transfer to CT ASAP (within 10 minutes ideally) and/or theatre
• Help with procedures as identified e.g. catheter, chest drain, and arterial line Dressings and splints of open fractures / significant wounds
• Ensure patient kept warm
• Ensure you have documented all your interactions in the notes
• Ensure you have signed for any drugs
• Only leave the patient after liaising with the Trauma team leader
**Airway Nurse - Reference Card**

### Key Roles

- Liaise with TTL, Senior ED Nurse and other Trauma Team Nurse
- Review & prepare resus bays, ensure checklists completed / signed
- Particular focus on airway equipment and suction
- Assist with initial assessment & management of airway with anaesthetist
- Assist in preparation of drugs requested by anaesthetist
- Prepare arterial line kit if requested

### Prior to Patient Arrival

- Support TTL as required
- Check suction available and working
- Check all appropriate airway & ventilation equipment is available and working
- Assist in preparing any drugs requested by anaesthetist

### Patient Arrival

- Position yourself to patient’s right side
- Assist in transfer to resus trolley
- Reassure and establish a rapport with patient
- Assist anaesthetist airway and ventilation e.g. passing adjuncts as necessary
- Prepare any drugs needed by anaesthetist - check drugs with anaesthetist or non-airway nurse
- Assist during log roll
- Prepare arterial line equipment if requested

### Post Trauma Call

- Ensure you have documented any of your interactions
- Ensure you have signed for any drugs
- Only leave patient after liaising with the Trauma team leader
**Key Roles**

- Ensure reception aware of and available for patient registration
- Ensure all team members sign into the trauma call
- Ensure tabards/labels are available and worn
- Confirm all patient details are correct if/when available
- Ensure all NOK details correct if/when available
- Ensure wristbands to patient
- Prepare & record chronologically all assessments, interventions and events until discharge from ED

**Prior to Patient Arrival**

- Ensure Receptionist is on-hand for rapid patient registration
- Ensure paperwork is available for documentation
- Ensure bags/documentation available for patient property
- Ensure team sign onto white board on arrival
- Document team member’s presence on Trauma Board: including specialty, grade e.g. ST3 and supervising consultant
- Ensure tabards/role labels available – encourage members to place labels visibly in centre of chest

**Patient Arrival**

- Ensure clock has been started when patient arrives in the Resus Bay
- Obtain Patient Care Record (PCR) from prehospital team
- Ensure all patient details correct & NOK information is documented
- Document all prehospital interventions, drugs and fluids – times and amounts
- **Document all observations, assessment, events and interventions in chronological order e.g. time of cannulation, move to CT etc**
- **Ensure you are given all information you need: inform the TTL if not**
- Inform the team leader if key observations have not been taken e.g. Temp or GCS
- Inform the team leader every 15 mins that pass
- Document reasons for any delays in reaching CT/theatre
- Log running total of blood products transfused – this role may be done by a specified nurse responsible for the level one infuser
- In a massive transfusion after every 4-5 units prompt the TTL of need for adjuncts (such as calcium or insulin / dextrose)
<table>
<thead>
<tr>
<th>Post Trauma Call</th>
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</table>

- Ensure all documentation is complete
- Liaise with police if any property handed over for evidence
- Ensure all drugs/fluids signed for by appropriate person
- Only leave the patient after liaising with the trauma team leader
Radiographer (MSK) - Reference Card

Key Roles

- Obtain plain film x-rays as required during trauma call
- Place cassettes under the trolley to speed up initial x-rays
- Liaise with TTL or nurse in charge if team members are not wearing lead. Liaise with team leader if team members are obstructing your chance to x-ray to prioritise actions.

Radiologist - Reference Card

Key Roles

- Liaise with CT radiographer to clear the CT Scanner
- Communicate with Resus when CT is likely to be available
- Attend the trauma call whenever possible
- Review imaging and eFAST scans and provide expert interpretation as required
- Early recognition of interventional radiology requirements
- Planning of imaging (CT vs IR vs US)
- Ensure CT complete and initial report within 30 mins of arrival in ED
Appendix E - Emergency Department Flowchart for Inter-Hospital Transfers of Adult Major Trauma Patients

- Patient needs transfer to MTC
  - Resuscitation & stabilisation
    - Avoid unnecessary interventions
    - Some patients may remain unstable
  - Call TTL: 07703886400
  - Call 999 to book ambulance
  - Prepare transfer equipment & documentation
    - Pre-transfer checklist
    - Secure patient & equipment
    - Pay attention to lines/tubes/drains
    - Dignity & temperature
    - Ambulance crew can estimate journey time
  - Package patient
    - Pay attention to lines/tubes/drains
    - Dignity & temperature
  - Depart Update TTL on ETA
    - Electronically transfer radiology to NBT
# Appendix F - Details Required for 999 Call To SWAST

<table>
<thead>
<tr>
<th>Type of Transfer</th>
<th>Major Trauma Transfer</th>
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</thead>
</table>
| Urgency of response       | Time critical (8 minutes)  
                           | Immediate (30 minutes)   
                           | Urgent (1-4 hours)       |
| Patient location          |                       |
| Receiving hospital and department | Southmead Emergency Department |
| Paramedic required        | If your patient is being escorted by a doctor and a nurse (this is expected for level 2 and 3 patients) then a paramedic is not required |
| Details of escort(s) being provided | Doctor, nurse, etc |
| Patient’s current condition | Anaesthetised, ventilated, etc. |
| Medical devices being transported | Ventilator, monitor, syring pump(s), etc. |
The checklist should be completed as a challenge/response process. Ensure the patient has a tightly applied reservoir mask/BVM and that the reservoir is moving.

<table>
<thead>
<tr>
<th>Prepare Patient</th>
<th>Prepare Team</th>
<th>Prepare Equipment</th>
<th>Difficulty</th>
</tr>
</thead>
<tbody>
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- **Emergency Induction Checklist**
  - Are any specific equipment changes required?
  - Where is the relevant equipment found?
  - How will you maintain the patient's condition?
  - When equipment is checked and available?
  - Where is the patient's condition optimised?
  - Is the patient's position optimised?
  - Are preoxygenation procedures performed?
  - Is the patient's position optimised?
  - Who is the patient's condition optimised?
  - Where is the patient's position optimised?
  - Are all drugs, equipment, and supplies available?
  - How will anaesthetists be involved?
  - Before induction, can the patient's condition be optimised?
  - When does the team leader indicate?
  - Do you have all the drugs?
This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.

Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults


Management of unanticipated difficult tracheal intubation in adults

Stop and Think

1. Wake the patient up

2. Intubate the patient using the SAD

3. Proceed with intubating the trachea

4. Preoxygenate or consider ventilation

Think and act

Make the patient up

Post-operative care and follow up

Plan A: Facemask ventilation and tracheal intubation

Plan B: Maintenance of oxygenation and ventilation

Plan C: Focussed ventilation

Plan D: Emergency hand of neck access

Plan E: Choke

Drill / laryngoscopy (maximum 3 attempts)

Accurate neuromuscular block

Preoxygenate

Optimize head and neck position

Elevate tracheal intubation

Removal of blood pressure

Adjunctive Laryngoscopy

Immediate laryngeal mask intubation

Immediate intubation and anaesthesia

If in difficulty call for help
Failed intubation, failed oxygenation in the paralysed, anaesthetised patient

CALL FOR HELP

Continue 100% O₂
Declare CICO

Plan D: Emergency front of neck access

Continue to give oxygen via upper airway
Ensure neuromuscular blockade
Position patient to extend neck

Scalpel cricothyroidotomy

Equipment: 1. Scalpel (number 10 blade)
2. Bougie
3. Tube (cuffed 6.0mm ID)

Laryngeal handshake to identify cricothyroid membrane

Palpable cricothyroid membrane
- Transverse stab incision through cricothyroid membrane
- Turn blade through 90° (sharp edge caudally)
- Slide coude tip of bougie along blade into trachea
- Railroad lubricated 6.0mm cuffed tracheal tube into trachea
- Ventilate, inflate cuff and confirm position with capnography
- Secure tube

Impalpable cricothyroid membrane
- Make an 8-10cm vertical skin incision, caudad to cephalad
- Use blunt dissection with fingers of both hands to separate tissues
- Identify and stabilise the larynx
- Proceed with technique for palpable cricothyroid membrane as above

Post-operative care and follow up
- Postpone surgery unless immediately life threatening
- Urgent surgical review of cricothyroidotomy site
- Document and follow up as in main flow chart

This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.
Appendix I - Traumatic Cardiac Arrest

**Trauma patient**

Cardiac arrest / Periarrest situation?

Consider non-traumatic cause → LIKELY

Universal ALS algorithm

**Hypoxia**

**Tension pneumothorax**

**Tamponade**

**Hypovolaemia**

**Simultaneously address reversible causes**

1. Control external catastrophic haemorrhage
2. Control airway and maximise oxygenation
3. Bilateral chest decompression
4. Relieve cardiac tamponade
5. Surgery for haemorrhage control or proximal aortic compression
6. Massive transfusion protocol and fluids

Start / Continue ALS

**Elapsed time <10 min since arrest?**

**Expertise?**

**Equipment?**

**Environment?**

Consider immediate resuscitative thoracotomy

**Return of spontaneous circulation?**

**NO**

Consider termination of CPR

**YES**

Pre-hospital:
- Perform only life-saving interventions
- Immediate transport to appropriate hospital

In-hospital:
- Damage control resuscitation
- Definitive haemorrhage control
# Invasive Procedure Safety Checklist: CHEST DRAIN

## Before the Procedure

<table>
<thead>
<tr>
<th>Indication</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumothorax</td>
<td></td>
</tr>
<tr>
<td>Pleural effusion</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

- Patient identity checked as correct? **Yes** [ ] **No** [ ]
- Does the procedure need to be performed ASAP? **Yes** [ ] **No** [ ]
- Appropriate consent completed? **Yes** [ ] **No** [ ]
- Is suitable drain and equipment available? **Yes** [ ] **No** [ ]
- Confirm site of clinical abnormality **Yes** [ ] **No** [ ]
- Correlates clinical signs with CXR? **Yes** [ ] **No** [ ]
- Medicines and coagulation checked? **Yes** [ ] **No** [ ]
- Any Known Drug Allergies? **Yes** [ ] **No** [ ]
- Safe site of drain insertion identified? **Yes** [ ] **No** [ ]
- Are there any concerns about this procedure for the patient? **Yes** [ ] **No** [ ]

### Names/Registering body numbers of clinicians responsible for chest drain insertion

1)  
2)  
3)  

## Time Out

Verbal confirmation between team members before start of procedure:

- Is patient on adequate ventilator settings and 100% FiO2? **Yes** [ ] **No** [ ]
- Is patient adequately sedated and paralysed? **Yes** [ ] **No** [ ]
- Is position optimal? **Yes** [ ] **No** [ ]
- All team members identified and roles assigned? **Yes** [ ] **No** [ ]
- Any concerns about procedure? **Yes** [ ] **No** [ ]
- If you had any concerns about the procedure, how were those mitigated? ____________

## Sign Out

<table>
<thead>
<tr>
<th>Sutures, tubing and dressing secured? <strong>Yes</strong> [ ] <strong>No</strong> [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient advised about care and not elevating drain above the chest? <strong>Yes</strong> [ ] <strong>No</strong> [ ]</td>
</tr>
<tr>
<td>Analgesia prescribed? <strong>Yes</strong> [ ] <strong>No</strong> [ ]</td>
</tr>
<tr>
<td>In effusion, confirm no more than 500ml is drained in the first 1 hour or no more than 1500mls in the first 24 hours? <strong>Yes</strong> [ ] <strong>No</strong> [ ]</td>
</tr>
<tr>
<td>Request chest X-ray to confirm position? <strong>Yes</strong> [ ] <strong>No</strong> [ ]</td>
</tr>
<tr>
<td>Verbal handover to Nurse responsible for patient? <strong>Yes</strong> [ ] <strong>No</strong> [ ]</td>
</tr>
</tbody>
</table>

Signature of responsible clinician completing the form

<table>
<thead>
<tr>
<th>Procedure date: ____________</th>
<th>Time: ____________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator: ____________</td>
<td></td>
</tr>
<tr>
<td>Observer: ____________</td>
<td></td>
</tr>
<tr>
<td>Assistant: ____________</td>
<td></td>
</tr>
<tr>
<td>Level of supervision: Soft</td>
<td>Consultant</td>
</tr>
<tr>
<td>Equipment &amp; trolley prepared:</td>
<td>__________</td>
</tr>
</tbody>
</table>

**Patient Identity Sticker:**

---

Appendix J - Chest Drain Safety Checklist

The Faculty of Intensive Care Medicine

intensive care society
care when it matters
<table>
<thead>
<tr>
<th>During Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile Scrub/Gown and Gloves?</td>
</tr>
<tr>
<td>Chloraprep 2% to skin?</td>
</tr>
<tr>
<td>Local anaesthetic (if required)?</td>
</tr>
<tr>
<td>Large fenestrated drape Used?</td>
</tr>
</tbody>
</table>

**STOP if unable to aspirate Air/fluid while infiltrating LA with green needle**

<table>
<thead>
<tr>
<th>Side</th>
<th>L</th>
<th>R</th>
<th>Site</th>
<th>LA used</th>
</tr>
</thead>
</table>

Appearance of fluid
Chest drain type Size F
Method of insertion: Surgical / Seldinger

Samples sent for: Microbiology □ Histology □ MC&S □

Additional Comments/Adverse events Noted:

Guide to anatomical landmarks for ‘Safe Triangle’ for chest drain insertion

![Diagram of anatomical landmarks for chest drain insertion](image)
Appendix K - Major Haemorrhage Protocol

**PATIENT MEETS CRITERIA FOR MAJOR HAEMORRHAGE PROTOCOL**

**Organisation:** Most senior clinician to declare ‘Major Haemorrhage’
Member of staff responsible for communication activates Major Haemorrhage Protocol using x2222
Stating ‘Major Haemorrhage, location xxxx’
Member of staff responsible for communication also contacts transfusion laboratory to confirm they are aware, giving contact number and further details as needed
Dedicated porter is automatically activated by the switchboard cascade following the 2222 call.

**Resuscitation:** <C>ABCDE approach
Identify and arrest bleeding: direct pressure, tourniquets, surgery, embolisation
Damage Control Resuscitation (DCR): prevent, halt and reverse hypothermia, acidosis and coagulopathy

**MEDICAL INTERVENTIONS**
Tranexamic Acid
1 g over 10 mins then
Tranexamic Acid Infusion
1 g over 8 hrs (within 3 hrs of injury for trauma)
Early consideration of cell salvage

**HAEMATOLOGICAL GOALS**
- Hb 70-100 g/L
- INR < 1.5 → FFP 15 mL/kg
- Fibrinogen > 1.5 g/L → 2 pools cryoprecipitate
- Platelets > 75x10^9 /L → 1 adult unit platelets
- Ionised Ca\(^{2+}\) > 1 mmol/L → 10 mL 10% calcium chloride
- K\(^+\) < 5.5 mmol/L → 10 IU insulin in 50 mL 50% glucose

NBT Transfusion: x35630 (0800 - 2200)
bleep 9433 (all other times or when busy)

**LABORATORY SUPPORT**

- **Shock Pack 1:** 4 RBC & 4 FFP
- **Shock Pack 2:** 4 RBC, 4 FFP & 1 Plts

**TAKE BASELINE BLOOD SAMPLES**
- * FBC, U&E, Ca\(^{2+}\), clotting screen, fibrinogen
- ABG/VBG, ROTEM
- X-match: 2 samples, minimum 4U PRBC’s
- **Consider early platelets and fibrinogen**
- ***Ongoing shock pack requirements guided by ROTEM & clinical picture***
Consider 1:1:1 ratio (shock pack 2) if ROTEM unavailable and haemorrhage ongoing
Recheck all bloods and ROTEM at least hourly

**PHYSIOLOGICAL GOALS**
Permissive hypotension
SBP 90-100 mmHg OR SBP > 100 mmHg in TBI
1st hour only OR definitive haemorrhage control
Lactate < 2 mmol/L
Base excess > -4 mmol/L

Stand down protocol at earliest opportunity i.e as soon as massive transfusion no longer required
Debrief whole team
Complete audit form for by Specialty and Trust Transfusion Committee
Appendix L - Intra-Operative Cell Salvage

The use of intra-operative cell salvage provides an alternative to allogenic blood transfusion and avoids the morbidity associated with the immunological complications of their use. In addition to clinical benefit, its use may also represent a cost-saving alternative to allogenic blood products\textsuperscript{10,11}.

Indications for intra-operative cell salvage include\textsuperscript{10,11};

- Anticipated blood loss of > 20% of the patient’s estimated blood volume
- Patients with increased risk factors for bleeding or a pre-existing anaemia
- Patients who are difficult or cannot be cross-matched (e.g. rare blood types or multiple antibodies)
- Major haemorrhage
- Patients who do not accept allogenic blood transfusions but are accepting of cell-salvaged blood

Cell salvage should not be used where substances that are not licensed for intravenous use enter the surgical field. These include iodine, topical clotting agents and orthopaedic cement\textsuperscript{10}. Cell salvage may be resumed once these have been washed away\textsuperscript{21}.

When the use of cell salvage is proposed in surgery for malignancy or infection, an explanation should be given to the patient of the potential risks and benefits and specific consent should be obtained\textsuperscript{22}. NICE guidance recommends its use in radical prostatectomies and cystectomies. If used in these cases an infusion set with leucodepletion filter is recommended\textsuperscript{22}.

Cell salvage is not recommended for routine use during caesarean section. However, in the context of a blood management strategy in women where anticipated blood loss is very likely to be significantly higher than average, there may be a role for its use. Amniotic fluid should preferably not be aspirated into the collection reservoir, but should be removed by separate suction prior to starting cell salvage. This may require the use of two suction devices during caesarean section\textsuperscript{21}.

With regards to cell salvage in perforated bowel surgery, the European Society of Anaesthesia suggests its use is not contraindicated provided the surgical field is evacuated of soiled abdominal fluid, additional cell washing occurs and broad-spectrum antibiotics are used\textsuperscript{21}. The UK Cell Salvage Action group recommends bowel contents are not aspirated into the system as there is a potential for bacteraemia\textsuperscript{22}.

Current guidance from the Association of Anaesthetists of Great Britain and Ireland states that intra-operative cell salvage in the clinical situations described above should be made by the clinicians caring for the patient, taking into account the latest evidence and having considered the risks and benefits for each individual patient\textsuperscript{10}. 

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Appendix M - Idarucizumab (Praxbind®) reversal for dabigatran

Is patient on Dabigatran?

Yes

Is bleeding immediately life-threatening or intracranial?

No

Take blood for urgent coagulation screen

No

Take blood for urgent coagulation screen

Yes

Idarucizumab only effective in patients on Dabigatran

Is APPT prolonged?

Yes

Give Idarucizumab 5g (2 x 2.5g vials) as bolus injection or infusion over 5-10 minutes each

Repeat coagulation screen

Can be done immediately post infusion, use separate venepuncture site

Is APPT prolonged?

No

No further Idarucizumab

Yes

Is bleeding still life-threatening or uncontrolled or does patient require emergency surgery/intervention?

No

No further Idarucizumab

Yes

Discuss with on-call Haematologist:

Administration of a second 5g dose of Idarucizumab may be considered in the following situations:
- Recurrence of clinically relevant bleeding together with prolonged clotting times, or
- If potential rebleeding would be life-threatening and prolonged clotting times are observed, or
- Patient requires a second emergency surgery / urgent procedure and has prolonged clotting times

Jason Kendall on behalf of the Thrombosis Committee (February 2016 version 2)
### North Bristol NHS Trust ED Adult Major Haemorrhage Audit Form

Date:………………………………Consultant: ………………………………..

<table>
<thead>
<tr>
<th>Patient Name:</th>
<th>Hospital No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOB:</td>
<td></td>
</tr>
</tbody>
</table>

### Diagnosis / reason for bleed (circle or tick as appropriate)

<table>
<thead>
<tr>
<th>Major Trauma</th>
<th>Upper GI bleed</th>
<th>AAA</th>
</tr>
</thead>
</table>

Other:……………………………………………

### Comorbidities:

### Definitive Treatment Planned (circle or tick as appropriate)

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Angiographic Embolisation</th>
<th>Endoscopic Control</th>
</tr>
</thead>
</table>

ITU for ongoing resus

### Please identify interventions performed:

<table>
<thead>
<tr>
<th>Intervention</th>
<th>YES / NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correction of hypothermia</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Correction of acidosis</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Heparin reversal</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Warfarin reversal</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Use of tranexamic acid</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Blood Products</td>
<td>Clinical Area to Complete</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td></td>
<td>No. of Units Requested</td>
</tr>
<tr>
<td>Packed Red Cells</td>
<td></td>
</tr>
<tr>
<td>FFP</td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td></td>
</tr>
<tr>
<td>Cryoprecipitate</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

Please enter number even if 0

Results prior to and post transfusion:

<table>
<thead>
<tr>
<th></th>
<th>Prior to haemorrhage</th>
<th>Post haemorrhage (no further need for transfusion in immediate future)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT/APTT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibrinogen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please identify how you found communication with the Transfusion laboratory:

**GOOD / SATISFACTORY / POOR**

If poor please state problem(s)

Please list any other problems encountered in the implementation of this Guideline:
Corrective actions should be agreed and documented here prior to Transfusion Committee review:

Signed:…………………………………………………

Please leave this completed form in the MH Audit tray in R1, or on Simon Odum’s Desk in the Consultant Offices.

For review by relevant specialty then copy to Trust Transfusion Committee via Tim Wreford-Bush, Transfusion Laboratory Manager.

Please could Trauma Team Nurse document Outcome at 24 hours below
North Bristol NHS Trust Theatre Adult Major Haemorrhage Audit Form

Date:………………………………Location: ………………………………..

Consultant: ………………………………

<table>
<thead>
<tr>
<th>Patient Name:</th>
<th>DOB:</th>
<th>Hospital No.:</th>
</tr>
</thead>
</table>

Diagnosis / reason for bleed (circle or tick as appropriate)

<table>
<thead>
<tr>
<th>Major Trauma</th>
<th>Upper GI bleed</th>
<th>AAA</th>
<th>Other:</th>
</tr>
</thead>
<tbody>
<tr>
<td>……………………………………</td>
<td>……………………………………</td>
<td>……………………………………</td>
<td>……………………………………</td>
</tr>
</tbody>
</table>

Comorbidities:

Previous Treatment in ED / Ward (Packed Red Cells, FFP, Platelets, Cryoprecipitate, Other):

Please identify interventions performed:

<table>
<thead>
<tr>
<th>Surgery</th>
<th>YES / NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angiographic embolisation</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Endoscopic control</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Correction of hypothermia</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Correction of acidosis</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Heparin reversal</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Warfarin reversal</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Use of tranexamic acid</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Use of ROTEM</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>YES / NO</td>
</tr>
<tr>
<td>Blood Products</td>
<td>Units Transferred From Other Clinical Area</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Packed Red Cells</td>
<td></td>
</tr>
<tr>
<td>FFP</td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td></td>
</tr>
<tr>
<td>Cryoprecipitate</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Red Cell Salvage</td>
<td></td>
</tr>
</tbody>
</table>

Results prior to and post transfusion:

<table>
<thead>
<tr>
<th></th>
<th>Prior to haemorrhage</th>
<th>Post haemorrhage (no further need for transfusion in immediate future)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT/PTT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibrinogen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Outcome at 24 hours:

Please identify how you found communication with the Transfusion laboratory:

GOOD / SATISFACTORY / POOR

If poor, please state problem(s)
Please list any other problems encountered in the implementation of this Guideline:

Corrective actions should be agreed and documented here prior to Transfusion Committee review:

Signed:………………………………………………………

Please return completed form to Dr Amit Goswami, Consultant Anaesthetist

For review by relevant specialty then copy to Trust Transfusion Committee via Tim Wreford-Bush, Transfusion Laboratory Manager.
Appendix O - Damage Control Surgery Protocol

The protocol on the following pages should be used in trauma patients who are cardiovascularly unstable despite resuscitation or trauma patients who become unstable intraoperatively.

TURN TO FOLLOWING PAGES FOR PROTOCOL
Damage Control Surgery (DCS) Protocol

For use in trauma patients who are cardiovascularly unstable despite resuscitation

Date: ____________________________

Patient details:

____________________________________

____________________________________

____________________________________

____________________________________

____________________________________

____________________________________

____________________________________

July 2017
<table>
<thead>
<tr>
<th>Team Brief</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Trauma Team Leader to state:</strong></td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>-</td>
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<td>-</td>
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<tr>
<td>-</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td><strong>2. Abbreviated WHO checklist:</strong></td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td><strong>3. Surgeon to state:</strong></td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>-</td>
</tr>
</tbody>
</table>

| 4. Anaesthetist to state: |
| - | Cardiovascular stability |
| - | Lactate/base excess |
| - | Need for active warming/temp |
| - | Remaining blood products |

| **5. Scrub nurse to confirm:** |
| - | Major abdominal set |
| - | Major vascular set |
| - | Thoracotomy set |
| - | Cell salvage |
| - | AbTHERA VAC availability |

**6. STATE ALOUD: THIS IS A DAMAGE CONTROL LAPAROTOMY. THE INTENTION IS TO FINISH WITHIN 1 HOUR AND TRANSFER TO ITU FOR RESTORATION OF PHYSIOLOGY (THE AIM IS HAEMORRHAGE AND CONTAMINATION CONTROL).**

| **7. ODP to state:** |
| - | Clock started |
| - | Start time marked on board |
SITREPS: every 10 minutes

Tick box to confirm that each point has been discussed.

<table>
<thead>
<tr>
<th>Time since start of procedure</th>
<th>SITREP 1: 10 mins</th>
<th>SITREP 2: 20 mins</th>
<th>SITREP 3: 30 mins</th>
<th>SITREP 4: 40 mins</th>
<th>SITREP 5: 50 mins</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anaesthetist states:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Cardiovascular stability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Clotting (ROTEM +/- lab results)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. TOTAL blood products given</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ABG (every 20 mins)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surgeon states:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Surgical progress</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(vascular control, need for packing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Any new findings/problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Surgical plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
60 minute review

1. Anaesthetist to state
   - Has cardiovascular stability been achieved?
   - Total number of blood products given
   - Clotting
   - Lactate/base excess
   - Any inotrope requirement

2. Surgeon to state:
   - Extent of injuries
   - Has damage control been achieved?
   - Any further surgery necessary?
   - Plan for second look surgery at _____hrs

Has cardiovascular stability been achieved?

Yes:  Complete surgery and transfer to ITU
No:   Consider other options (interventional radiology)

Consider if surgery is futile: seek second opinion from ICU consultant and input from Trauma Team Leader

Plan/documentation of discussion with ICU consultant/second opinion:

IF TREATMENT IS WITHDRAWN, DEBRIEF:
Appendix Q - AAST Organ Injury Grades

Liver Injury Grading

Grade I – Haematoma: subcapsular <10 percent surface area. Laceration: capsular tear <1 cm parenchymal depth
Grade II – Haematoma: subcapsular 10 to 50 percent surface area, intraparenchymal <10 cm in diameter. Laceration: capsular tear 1 to 3 cm parenchymal depth, <10 cm in length
Grade III – Haematoma: subcapsular >50 percent of surface area or ruptured subcapsular or parenchymal haematoma; intraparenchymal haematoma >10 cm or expanding. Laceration >3 cm in depth
Grade IV – Laceration: parenchymal disruption involving 25 to 75 percent of a hepatic lobe or 1 to 3 Couinaud segments.
Grade V – Laceration: parenchymal disruption of >75 percent of a hepatic lobe, >3 Couinaud segments within a single lobe. Vascular: juxtahepatic venous injuries (retrohepatic vena cava, central major hepatic veins).
Grade VI – Hepatic avulsion

Splenic Injury Grading

Grade I – Haematoma: subcapsular, <10 percent of surface area. Laceration: capsular tear <1 cm in depth into the parenchyma.
Grade II – Haematoma: subcapsular, 10 to 50 percent of surface area. Laceration: capsular tear, 1 to 3 cm in depth, but not involving a trabecular vessel.
Grade III – Haematoma: subcapsular, >50 percent of surface area OR expanding, ruptured subcapsular or parenchymal haematoma OR intraparenchymal haematoma >5 cm or expanding. Laceration: >3 cm in depth or involving a trabecular vessel.
Grade IV – Laceration involving segmental or hilar vessels with major devascularisation (ie, >25 percent of spleen).
Grade V – Haematoma: shattered spleen. Laceration: hilar vascular injury which devascularises spleen
Gastrointestinal Tract Injury Grading

Stomach:
Grade I – Intramural hematoma <3 cm; partial-thickness laceration
Grade II – Intramural haematoma ≥3 cm; full-thickness laceration <3 cm
Grade III – Full-thickness laceration >3 cm
Grade IV – Full-thickness laceration involving vessels on greater and/or lesser curvature
Grade V – Extensive rupture >50 percent; devascularisation

Duodenum:
Grade I – Haematoma involving a single portion of duodenum or partial thickness laceration without perforation
Grade II – Haematoma involving more than one portion or disruption <50 percent circumference or major laceration without duct injury or tissue loss
Grade III – Laceration with disruption of 50 to 75 percent circumference of 2nd portion or disruption of 50 to 100 percent circumference of 1st, 3rd, 4th portion
Grade IV – Laceration with disruption >75 percent circumference of 2nd portion or involving ampulla or distal common bile duct
Grade V – Massive laceration with disruption of duodenopancreatic complex or devascularisation of duodenum

Small intestine:
Grade I – Contusion or haematoma without devascularisation; partial-thickness laceration
Grade II – Full-thickness laceration <50 percent of circumference
Grade III – Full-thickness laceration ≥50 percent of circumference
Grade IV – Transection
Grade V – Transection with segmental tissue loss; devascularised segment

Colon:
Grade I – Contusion or haematoma; partial-thickness laceration
Grade II – Full-thickness laceration <50 percent of circumference
Grade III – Full-thickness laceration ≥50 percent of circumference
Grade IV – Transection
Grade V – Transection with tissue loss; devascularised segment

Rectum and Rectosigmoid Colon:
Grade I – Contusion or haematoma; partial-thickness laceration
Grade II – Full-thickness laceration <50 percent of circumference
Grade III – Full-thickness laceration ≥50 percent of circumference
Grade IV – Full-thickness laceration with perineal extension
Grade V – Devascularised segment
### Pancreas Injury Grading

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Minor contusion without duct injury or superficial laceration without duct injury</td>
</tr>
<tr>
<td>II</td>
<td>Major contusion without duct injury or tissue loss, or major laceration without duct injury or tissue loss</td>
</tr>
<tr>
<td>III</td>
<td>Distal transection or parenchymal/duct injury</td>
</tr>
<tr>
<td>IV</td>
<td>Proximal transection or parenchymal injury involving ampulla</td>
</tr>
<tr>
<td>V</td>
<td>Massive disruption of the pancreatic head</td>
</tr>
</tbody>
</table>

### Kidney Injury Grading

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Subcapsular, non-expanding contusion/haematoma without parenchymal laceration</td>
</tr>
<tr>
<td>II</td>
<td>Non-expanding perirenal haematoma or cortical laceration &lt;1cm deep without urinary extravasation</td>
</tr>
<tr>
<td>III</td>
<td>Cortical laceration &gt;1cm without urinary extravasation</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Laceration</strong>: through corticomedullary junction into collecting system or <strong>Vascular</strong>: segmental renal artery or renal vein injury with contained haematoma or partial vessel laceration, or vessel thrombosis</td>
</tr>
<tr>
<td>V</td>
<td><strong>Laceration</strong>: shattered kidney or <strong>Vascular</strong>: renal pedicle or avulsion</td>
</tr>
</tbody>
</table>
Appendix R - Retrograde Urethrogram and Catheter Cystogram

The below instructions are from BOAST-14 guidelines and should be considered for any patient with suspected urological injury or significant pelvic fracture.

### Retrograde Urethrogram

Performed in Resus, usually following CT scan.

1. Place X-ray plate under pelvis.
2. 20 ml dilute IV contrast medium (10 ml contrast + 10 ml saline), 10 or 12Ch Foley catheter are required.
3. Insert the balloon of Foley catheter into penile meatus and gently inflate balloon with normal saline.
4. Catheter is held in place and contrast injected
5. AP Pelvis x-ray taken.
6. Additional lateral if possible

### Catheter Cystogram

Performed in Resus, usually following CT scan. Patient is catheterised using a standard Foley catheter of appropriate size using aseptic technique as per trust guidelines.

1. Place X-ray plate under pelvis.
2. 300ml dilute IV contrast medium (150 ml contrast + 150 ml saline) are required
3. Push the catheter into the genitals a further 2-3 cm. This ensures the balloon not blocking bladder neck.
4. Inject contrast down catheter with bladder syringe. Immediately clamp catheter.
5. AP Pelvis x-ray taken. Additional lateral if possible.
6. Evacuate contrast using bladder syringe and repeat AP Pelvis x-ray.
ALL POLYTRAUMA PATIENTS FOR URGENT TRANSFER NEED TO BE REFERRED TO THE TRAUMA TEAM LEADER VIA SOUTHMEAD SWITCHBOARD
PLEASE ENSURE RADIOLOGY IMAGES ARE TRANSFERRED TO NORTH BRISTOL PACS AT THE TIME OF REFERRAL

Please email completed form to pelvictrauma@nbt.nhs.uk and call the Pelvic Team secretary in-hours to confirm referral: 01174141623 / 01174141625
If urgent advice is required please contact Southmead switchboard and ask for the Pelvic Trauma Consultant on-call: Switchboard Tel: 01179 505050

PACS Tel: 01174 143508
Out-of-hours a ‘pushed’ image package will automatically be accepted by NBT.
Appendix T - Pelvic Fracture Checklist

**Date of planned procedure:**

*In addition to the the standard history, examination and recording of associated injuries, please ensure all the checklist points are documented in the notes as appropriate and indicated below.*

## Pre-Op

<table>
<thead>
<tr>
<th>Surname:</th>
<th>Ward:</th>
<th>Date:</th>
<th>Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Name:</td>
<td>Affix Patient Label Here</td>
<td>Date of Injury:</td>
<td>NBT Admission Date:</td>
</tr>
<tr>
<td>DoB:</td>
<td>Referring Hospital:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NHS Number:</td>
<td>Clinical Summary:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Name, Grade, Role &amp; Signature:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complete</th>
<th>Initial and Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurological Examination</td>
<td></td>
</tr>
<tr>
<td>Rectal / Vaginal / Perineal Examination</td>
<td></td>
</tr>
<tr>
<td>Genito-urinary injury (ascending urethrogram)</td>
<td></td>
</tr>
<tr>
<td>AP Pelvis Radiograph</td>
<td></td>
</tr>
<tr>
<td>*Acetabular fractures – pre-op Judet views</td>
<td></td>
</tr>
<tr>
<td>* Pelvic ring injury – inlet / outlet views</td>
<td></td>
</tr>
<tr>
<td>CT scan pelvis / acetabulum / lumbar spine</td>
<td></td>
</tr>
<tr>
<td>Blood tests: FBC, U&amp;E, clotting, group and save</td>
<td></td>
</tr>
<tr>
<td>4 units of RBC cross matched for theatre</td>
<td></td>
</tr>
<tr>
<td>Thromboprophylaxis and gastric protection</td>
<td></td>
</tr>
<tr>
<td>Antibiotic propylaxis (teicoplanin and gentamicin)</td>
<td></td>
</tr>
<tr>
<td>NSAIDs stopped</td>
<td></td>
</tr>
<tr>
<td>Duplex scans both legs if delay from injury &gt;3 days</td>
<td></td>
</tr>
<tr>
<td>MRSA swabs taken</td>
<td></td>
</tr>
<tr>
<td>Consent and marked</td>
<td>Signature</td>
</tr>
<tr>
<td>Neurovascular status of lower limbs</td>
<td>Complete</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>FBC, U&amp;E within 24hrs of operation</td>
<td></td>
</tr>
<tr>
<td>AP film within 24 hours</td>
<td></td>
</tr>
<tr>
<td>Fine cut CT scan within 3 days (excluding THR)</td>
<td></td>
</tr>
<tr>
<td>Duplex ultrasound both legs 7-10 days</td>
<td></td>
</tr>
<tr>
<td>Thromboprophylaxis</td>
<td></td>
</tr>
<tr>
<td>Heterotrophic ossification prophylaxis (Y/N)</td>
<td></td>
</tr>
<tr>
<td>Weight bearing instruction</td>
<td></td>
</tr>
<tr>
<td>Dictate discharge summary by surgeon</td>
<td></td>
</tr>
<tr>
<td>Physio plan in place</td>
<td></td>
</tr>
<tr>
<td>Transfer back agreed with base hospital</td>
<td></td>
</tr>
<tr>
<td>Follow-up arrange (6/52 pelvic clinic)</td>
<td></td>
</tr>
<tr>
<td>Planned treatment for associated injuries</td>
<td></td>
</tr>
<tr>
<td>Signature</td>
<td></td>
</tr>
</tbody>
</table>
Appendix U - Spinal Cord Injury Algorithm

**Inclusion Criteria**
Clinical diagnosis of spinal cord injury resulting in full or partial, para or tetraplegia as a result of trauma & non traumatic insult (tumour, complete and incomplete cauda equina, abscess and infection, haematoma).

**ASIA Score** within 24 hours and again at 72 hours. Helpful to do this prior to call if possible.

**Exclusion Criteria**
Injury to the vertebral spine without cord injury.

**Useful Contact Numbers**
- Neurosurgical Spinal ANP
  Bleep 1192 /1153
- Orthopaedic Spinal NP
  07796581139
- Trauma Network Team NP
  Bleep 1630/1623
- Neuro Physio Lead
  Bleep 1394

**Inclusion Criteria**
Clinical diagnosis of spinal cord injury resulting in full or partial, para or tetraplegia as a result of trauma & non traumatic insult (tumour, complete and incomplete cauda equina, abscess and infection, haematoma).

**ASIA Score** within 24 hours and again at 72 hours. Helpful to do this prior to call if possible.

**Exclusion Criteria**
Injury to the vertebral spine without cord injury.

**Useful Contact Numbers**
- Neurosurgical Spinal ANP
  Bleep 1192 /1153
- Orthopaedic Spinal NP
  07796581139
- Trauma Network Team NP
  Bleep 1630/1623
- Neuro Physio Lead
  Bleep 1394

**Admission to NBT**
Neurological assessment, triage/management of associated injuries, respiratory evaluation and neuro-protection therapy

**Initiate SCI Pathway**
Complete SCI documentation as well as specialty proforma/documentation.

**Contact SCI Centre: Tel: 01722 336262**
Traumatic call by 4 hours
Non-Traumatic call made on diagnosis

Verbal Doctor to Doctor referral process. Please ensure additional required assessments completed, including anaesthetic. Immediate medical needs prioritised and confirmation of isolated SCI level and sensory with significant associated injuries. Appropriate location for optimum medical management agreed (including surgery). Immediately agreed management plan for SCI documented in SCI pathway.

Online registration of SCI Centre referral to be made (following call) this can be actioned by either Dr. or ANP. www.scireferrals.nhs.uk . Print off confirmation email and sign SCI pathway.

**Follow SCIC management, admission and outreach advice plan.**

**Traumatic SCI Transfers**
Transfer to SCIC or local hospital repatriation to be organised by trauma team as per the trauma pathway guidelines

**Patient review by a member of SCIC outreach team within 5 days if appropriate**
Patient appropriate for SCI Centre admission
Referral prioritised & bed availability notified—weekly email updates to be sent to relevant NBT team members, Staff to contact SCIC outreach team for all ongoing care management queries..

**Non-Traumatic SCI Transfers**
Transfer to SCIC or local hospital repatriation to be organised by discharge liaison team for specialty as per local guidelines

**Patient medically fit for transfer**
Transfer to SCIC - transport to be booked by 10am so that admission is on or by 1pm. Transfer to local trauma units follow bed manager direction for that unit
### Muscle Function Grading

0 = total paralysis
1 = palpable or visible contraction
2 = active movement, full range of motion (ROM) with gravity eliminated
3 = active movement, full ROM against gravity
4 = active movement, full ROM against gravity and moderate resistance in a muscle specific position
5 = (normal) active movement, full ROM against gravity and sufficient resistance to be considered normal if identical
NT = not testable (i.e. due to immobilization, severe pain such that the patient cannot be graded, amputation of limb, or contracture of > 50% of the normal ROM)

### Sensory Grading

0 = Absent
1 = Altered, either decreased/impaired sensation or hyperesthesia
2 = Normal
NT = Not testable

### When to Test Non-Key Muscles:
In a patient with an apparent AIS B classification, non-key muscle functions more than 3 levels below the motor level on each side should be tested to most accurately classify the injury (differences between AIS B and C).

### ASIA Impairment Scale (AIS)

- **A** = Complete. No sensory or motor function is preserved in the sacral segments S4-S5.
- **B** = Sensory Incomplete. Sensory but no motor function is preserved below the neurological level and includes the sacral segments S4-S5 (light touch or pin prick at S5 or deep anal pressure) and no motor function is preserved more than three levels below the motor level on either side of the body.
- **C** = Motor Incomplete. Motor function is preserved at the most cauda equina segments for voluntary and contraction (VAC) or the patient meets the criteria for sensory incomplete status (sensory function preserved at the most caudal segments (S4-S5) by LT, PP or DAP, and has some sparing of motor function more than three levels below the ipsilateral motor level on either side of the body. (This includes key or non-key muscle functions to determine motor incomplete status.) For AIS C—less than half of key muscle functions below the single NLJ have a muscle grade ≥ 3.
- **D** = Motor Incomplete. Motor Incomplete status as defined above, with at least half (but not more) of key muscle functions below the single NLJ having a muscle grade ≥ 3.
- **E** = Normal. If sensation and motor function as tested with the SNCSOA are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

### Steps in Classification

1. Determine sensory levels for right and left sides. The sensory level is the most caudal intact dermatome for both pin prick and light touch sensation.

2. Determine motor levels for right and left sides. Defined by the lowest key muscle function that has a grade of at least 3 (on spine testing), providing the key muscle functions represented by segments above that level are judged to be intact (graded as a 3). Note: In regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level, if testable motor function above that level is also normal.

3. Determine the neurological level of injury (NLI). This refers to the most caudal segment of the cord with intact sensation and motor function (3 or more) muscle function strength, provided that there is normal (intact) sensory and motor function rostrally respectively.

   The NLI is the most cephalad of the sensory and motor levels determined in steps 1 and 2.

4. Determine whether the injury is Complete or Incomplete, (i.e. absence or presence of sacral sparing). If voluntary anal contraction = NO AND at S4-5 sensory scores = 0 AND deep and pressure = NO, then injury is Complete. Otherwise, injury is Incomplete.

5. Determine ASIA Impairment Scale (AIS) Grade:
   - **Is injury Complete?** If YES, AIS=A and can record ZPP (lowest dermatome or myotome on each side with some preservation)
     - **Are at least half (half or more) of the key muscles below the neurological level of injury graded 3 or better?**
       - **AIS=C**
       - **AIS=D**

   If sensation and motor function is normal in all segments, AIS=E

   Note: AIS E is used in follow-up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact, the ASIA Impairment Scale does not apply.
### Appendix W - Spinal Cord Injury Care Pathway

#### Part 1: Patient Information

<table>
<thead>
<tr>
<th>Patient Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Birth:</td>
<td></td>
</tr>
<tr>
<td>Hospital Number:</td>
<td></td>
</tr>
<tr>
<td>Address:</td>
<td></td>
</tr>
<tr>
<td>Consultant Neurosurgeon / Orthopaedic Surgeon / Other Responsible for SCI Care:</td>
<td></td>
</tr>
</tbody>
</table>

#### Part 2: Admission Details

<table>
<thead>
<tr>
<th>Date and Time of Injury</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanism of Injury</td>
<td>Traumatic SCI Non Traumatic SCI</td>
</tr>
<tr>
<td>Date</td>
<td>Provisional / Actual Spinal Cord Injury Diagnosis</td>
</tr>
</tbody>
</table>

#### Part 3: Spinal Injury Neurological Assessment Record:

*ASIA Score must be completed once diagnosis, within 24 hours, 72 hours and following any clinical changes. If spinal surgery is undertaken the ASIA Chart must be carefully completed both pre and post-operatively. NB: This is however less reliable in the presence of spinal shock.*

<table>
<thead>
<tr>
<th>1st</th>
<th>Within 4hrs of admission by assessing Dr</th>
<th>ASIA Completed</th>
<th>Date</th>
<th>Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd</td>
<td>Within 24hrs of admission</td>
<td>ASIA Completed</td>
<td>Date</td>
<td>Sign</td>
</tr>
<tr>
<td>3rd</td>
<td>Within 72hrs of admission</td>
<td>ASIA Completed</td>
<td>Date</td>
<td>Sign</td>
</tr>
<tr>
<td>4th</td>
<td>Further neurological changes</td>
<td>ASIA Completed</td>
<td>Date</td>
<td>Sign</td>
</tr>
<tr>
<td>5th</td>
<td>Further neurological changes</td>
<td>ASIA Completed</td>
<td>Date</td>
<td>Sign</td>
</tr>
<tr>
<td>6th</td>
<td>Further neurological changes</td>
<td>ASIA Completed</td>
<td>Date</td>
<td>Sign</td>
</tr>
<tr>
<td>7th</td>
<td>Further neurological changes</td>
<td>ASIA Completed</td>
<td>Date</td>
<td>Sign</td>
</tr>
<tr>
<td>Date</td>
<td>Logroll Y □ N □</td>
<td>Sit up Y □ N □</td>
<td>Full mobilisation Y □ N □</td>
<td>TLSO Y □ N □</td>
</tr>
<tr>
<td>------</td>
<td>-----------------</td>
<td>----------------</td>
<td>-----------------------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>Logroll Y □ N □</td>
<td>Sit up Y □ N □</td>
<td>Full mobilisation Y □ N □</td>
<td>TLSO Y □ N □</td>
</tr>
<tr>
<td></td>
<td>Logroll Y □ N □</td>
<td>Sit up Y □ N □</td>
<td>Full mobilisation Y □ N □</td>
<td>TLSO Y □ N □</td>
</tr>
<tr>
<td></td>
<td>Logroll Y □ N □</td>
<td>Sit up Y □ N □</td>
<td>Full mobilisation Y □ N □</td>
<td>TLSO Y □ N □</td>
</tr>
<tr>
<td></td>
<td>Logroll Y □ N □</td>
<td>Sit up Y □ N □</td>
<td>Full mobilisation Y □ N □</td>
<td>TLSO Y □ N □</td>
</tr>
<tr>
<td></td>
<td>Logroll Y □ N □</td>
<td>Sit up Y □ N □</td>
<td>Full mobilisation Y □ N □</td>
<td>TLSO Y □ N □</td>
</tr>
</tbody>
</table>
## Part 1: Referral to Spinal Cord Injury Centre

*Parts a and b are both mandatory*

### Spinal Cord Injury Centre

- □ Duke of Cornwall Spinal Treatment Centre, Salisbury District Hospital, Salisbury (01722 336262)
- □ Other:

### a) Verbal referral and management plan discussed with Consultant/SPR at SCIC

- □ Within 4 hours of injury/diagnosis
  - Discussion with Cons/SPR: …………………………
  - Call Made By
    - Name
    - Date
    - Time
    - Signature

- □ Within 24 hours of injury/diagnosis
  - Discussion with Cons/SPR: …………………………
  - Call Made By
    - Name
    - Date
    - Time
    - Signature

### b) Online referral form (after call)

- Form completed by:
  - Name
  - Date
  - Time
  - Signature

## Part 2: Please Record the Plan from SCIC

<table>
<thead>
<tr>
<th>Deviation from SCIC plan:</th>
<th>Ventilation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y □ No ☐</td>
</tr>
<tr>
<td>Circulation</td>
<td>MAP Target:</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Position:</td>
<td></td>
</tr>
<tr>
<td>DVT</td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td></td>
</tr>
<tr>
<td>Gastric Protection</td>
<td>☐ NBM/ ☐ NG Free drainage/ ☐ NG feed</td>
</tr>
<tr>
<td>Bladder</td>
<td>☐ Indwelling catheter/ ☐ Suprapubic catheter ☐ Self-Intermittent catheterisation</td>
</tr>
<tr>
<td>Bowel</td>
<td>Commence NBT neurogenic bowel pathway: ☐ Reflexic pathway / ☐ Areflexic pathway</td>
</tr>
<tr>
<td>Autonomic Dysreflexia</td>
<td>At risk of AD? Y ☐ (if SCI at or above T6) / N ☐</td>
</tr>
<tr>
<td>Mental Health</td>
<td>Mental health referral advised? Yes ☐ / No ☐</td>
</tr>
</tbody>
</table>
Document any deviation from SCIC plan and reasoning:

### Section 2. SCIC Outreach visits – visits by specialist spine practitioners

<table>
<thead>
<tr>
<th>Date</th>
<th>Advice given</th>
<th>Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix Y - Transfer to Spinal Cord Injury Centre Checklist

<table>
<thead>
<tr>
<th>Transfer to SCIC Checklist</th>
<th>Yes</th>
<th>No</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does this patient need a HDU or ITU bed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immobilisation of the spine is adequate and secure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long bone fracture immobilisation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airway is clear and can be maintained during transfer&lt;br&gt;Intubate if PaCO2 is &gt;5.5 kPa or if respiratory failure is likely to develop during a prolonged transfer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplemental O₂ is being administered and ventilation is adequate whether spontaneous or assisted.&lt;br&gt;Voluntary vital capacity should exceed &gt; 15 ml/kg: elective ventilation if incipient or frank respiratory failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest drainage if pneumothorax or haemothorax before&lt;br&gt;transfer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV is patent and infusing at desired rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naso-gastric tube is in situ, draining freely.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indwelling urinary catheter is in situ and draining freely</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin is protected from injury and apparatus or debris which may cause pressure ulcers is cleared away</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of Spinal Cord Injury is documented</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other injuries – thorax, abdomen, pelvis etc. are documented and stabilised</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any head injury documented and monitored</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copy of Medical records, drug charts and test results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-rays or radiology images have been transferred using:&lt;br&gt;Image Exchange Portal □ Decrypted CD □</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurse to Nurse handover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family/relatives aware of transfer</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Repatriation to another Hospital:**

<table>
<thead>
<tr>
<th>Repatriation to another Hospital</th>
<th>Yes</th>
<th>No</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copy of Medical records, drug charts and test results including SCI care documents.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurse to Nurse handover</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer letter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outpatients Appointment?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date____________________</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time____________________</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Planning for home**

- TTA completed and dispensed
- Family aware of discharge
- Transport Booked
- Package of Care set up
# Appendix Z - Radiological Primary Survey Checklist

<table>
<thead>
<tr>
<th>PATIENT NAME:</th>
<th>MRN:</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE:</td>
<td>Time on SCANNER:</td>
</tr>
<tr>
<td>RADIOLOGIST:</td>
<td>SPR 1 2 3 4 5 6 CONSULTANT</td>
</tr>
</tbody>
</table>

## AIRWAY

<table>
<thead>
<tr>
<th>ET Tube Placement</th>
<th>N/A</th>
<th>Incorrect</th>
<th>Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign Body</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Airway Obstruction</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Major Air Leak</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS:**

## BREATHING

<table>
<thead>
<tr>
<th>Drain Placement</th>
<th>N/A</th>
<th>Incorrect</th>
<th>Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumothorax</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Haemorrhax</td>
<td>Yes</td>
<td>No</td>
<td></td>
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</table>

**COMMENTS:**

## CIRCULATION

<table>
<thead>
<tr>
<th>CHEST</th>
<th>ABDOMEN</th>
<th>PELVIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast Extrusion</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Great Vessel Injury</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Mediastinal Haematoma</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Mediastinal Gas</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Pericardial Fluid</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

**COMMENTS:**

## DISABILITY

| Intracranial Bleed | Yes | No |
| Mass Effect | Yes | No |
| C Spine Fracture | Yes | No |
| T-L Spine Fracture | Yes | No |

**COMMENTS:**

## X-RAYS

| CXR: |
| Pelvis: |
| Other: |

This is an early (15 minute) provisional report and is purely to help facilitate the immediate management of the patient. Only gross and life threatening injuries are commented on in this report - please ensure the full report is checked when available.

**Clinicians Contacted**

Name / Specialty / Grade:

Time Complete:
Appendix AA - Whole Body CT Protocols

### Image Quality

**Stable**
- GCS 15
- Able to follow commands & raise arms above head
  - Non contrast head & C-spine in headrest
  - Patient moved from headrest
  - Biphasic lung apices to lesser trochanters
  - Patient arms up

**Stable**
- Ventilated
- Unable to raise arms above head
  - Non contrast head & C-spine in headrest
  - Patient remains in headrest
  - Biphasic lung apices to lesser trochanters
  - Patient arms across abdomen

**Unstable**
  - Non contrast head only on footrest
  - Patient remains on footrest
  - Biphasic base of skull to lesser trochanters
  - Patient arms across abdomen

### Patient Dose
The proforma on the following pages should be used for all major trauma patients, and be completed by at least a registrar level (ST3+) trainee or above. The aim is to ensure gold standard care as well as identify all injuries that may not have been identified during the initial management phase of patient care. It should be completed at 24 hours post admission, then repeated once the patient is alert, responsive and able to communicate pain and injury if not at 24 hours. Ideally it should be completed at least 72 hours prior to discharge, or on Day 14 if the patient has not yet discharged by this time.

All sections must be completed; the proforma will be audited as part of regular MTC governance processes.

If during the tertiary survey any new problems or issues are found, these should be discussed either with the patients named consultant or with the named TTL if the named consultant is unavailable.

When performing top-to-toe examination be diligent and thorough; don’t forget commonly missed areas; the occiput, axillae, back, perineum, popliteal fossae, toes and soles of feet. Document all injuries (old and new), no matter how trivial they appear, and consider the mechanism and kinetics of the patients injuries.

If possible, test active and passive movements (being aware at all times of spinal clearance), and ask the patient directly to indicate if they have any areas of pain, discomfort, deformity or stiffness that have not so far been discussed with them.
# Tertiary Survey Clinical Proforma

<table>
<thead>
<tr>
<th>Field</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surname:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>First Name:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>DoB:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>NHS Number:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Ward:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Date:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Time:</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Clinical Summary:**

**Name, Grade, Role & Signature:**

**Consultant:**

## Checklist

- Clinical records reviewed?
- Laboratory reports reviewed?
- Radiology images reviewed?
- Radiology reports reviewed?
- Top-to-Toe exam complete?
- Always examine pressure areas, vascular compartments, AND full neurological assessment
- Additional tests required?
- Tertiary Survey to be repeated?
- Date of next tertiary survey:

## Standards of Care Checklist

<table>
<thead>
<tr>
<th>Requirement</th>
<th>N</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate analgesia prescribed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antiemetics prescribed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VTE prophylaxis plan documented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycaemic control required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutritional plan documented</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Spinal Clearance

- Spine not cleared/confirmed unstable spine = LOGROLL
- Spine cleared on CT but not clinically: careful handling
- Spine fully cleared: no precautions

## Post Tertiary Survey Summary

**Clinical Summary & ongoing issues (after completion of tertiary survey):**

**Laboratory Summary:**

**Radiological Summary (after reviewing images):**

**Name, Grade, Role & Signature:**

**Consultant:**
<table>
<thead>
<tr>
<th>Site</th>
<th>Problem/Injury</th>
<th>Consultant</th>
<th>Plan (inc follow up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Face</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Neck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdomen</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Pelvis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Limbs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Limbs</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Compartments</td>
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<td></td>
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</tr>
<tr>
<td>Skin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(inc. pressure areas)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vascular</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(inc. periph. pulses)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CONTACT NUMBERS
NBT Trauma Team Leader (Consultant): 07703 886 400 | Bleep 9745
SWASFT Ambulance Co-ordination Desk: 0845 1206342
ED Red Phone Emergency Phone: 0117 9506862

Specialties:
Anaesthetist 3rd on call Bleep: 9034
General Surgeon Reg on call Bleep: 9772 & 9656
Orthopaedic Reg on call: 9750
Radiology Registrar Bleep: 9746
Haematologist Bleep: 9433
Radiographer Bleep: 9740
Neurosurgery – dial: 45726
Plastics – Bleep: 1311
Cardiothoracics – via switchboard
Maxillofacial - via switchboard
Trauma Nurse Co-ordinators Bleep: 9747, 9748 & 9749
In-patient Respiratory Physiotherapy Bleep: 1395, 9552
Acute Pain Service: Bleep 1509 or 9670 (07:30 to 17:30)

In the event of paediatric trauma / death contact:
Consultant community paediatrician (contacted via BRI switchboard - 76100)
Ann Fry (named nurse for child protection- 0117 323 2363)

Tissue Donation - 24 hour National Referral Centre: 0800 432 0559
SNOD: 07659 591 642
Organ Donation Register: 01179 757 580

Pelvic Team Secretary: 0117 4141623 / 0117 4141625
PACS: 01174 143508

Peripheral Nerve Injury Unit Co-ordinator: Benita Patel - 0208 909 5803
Spinal Cord Injury Centre - Duke of Cornwall Spinal Treatment Centre: 01722 336 262

Amputee Referral Pathway
Bristol Centre for Enablement, North Bristol NHS Trust: 0300 3000110
Referral Can be Fax ed To: 0117 340 4654

Amputation Referral Pathway - Prosthetic Secretaries:
Joanne Sargent ext 04610 | Helen Ford ext 04609.

Amputation Referral Pathway - Counsellor: Senna Cook: Senna.cook@nbt.nhs.uk
Amputee specialist nurse: Kirsty Steventon: ext 04618, Kirsty.Steventon@nbt.nhs.uk
Amputation Referral Pathway - OT Specialist: Karen Cook: Karen.Cook@nbt.nhs.uk
Amputation Referral Pathway - Specialist Physio: Katharine Atkin: Katharine.Atkin@nbt.nhs.uk
INDEX OF GUIDELINES
Patient Pre-alert

Major Trauma Centre Automatic Acceptance Policy
Version: January 2015
Review Date: January 2019
Author: Professor David Lockey

Pre-Hospital Blood Transfusion Alert
Version: May 2017
Review Date: May 2019
Author: Dr Timothy Hooper

ATMIST Handover
Version: August 2017
Review Date: August 2019
Author: Dr Richard Turck, Dr Jules Blackham

Inter-Hospital Transfer of Adult Major Trauma Patients
Version: May 2018
Review Date: June 2019
Reviewer: Dr Benjamin Walton, Dr James Blackburn
Author: Dr Scott Grier

Trauma Team Roles

Trauma Team Roles:
Version: May 2017
Review Date: May 2019
Author: Ms Sarah Lapham

Patient Reception

Unknown Patient Registration
Version: May 2017
Review Date: May 2019
Author: Dr Simon Odum

Operational Guidelines

ED & ICU Major Trauma Drug Bags
Version: September 2017
Review Date: November 2019
Author: Dr Rowena Johnson

Tranexamic Acid
Version: June 2017
Review Date: June 2019
Author: Dr Adam Brown

Death and Breaking Bad News in the ED following Major Trauma
Version: September 2017
Review Date: June 2019
Authors: Ms Victoria Stanley, Dr Ian Thomas
Airway & Anaesthesia

Emergency Anaesthesia in Major Trauma
Version: May 2017
Review Date: October 2018
Reviewers: Dr Patrick Morgan, Dr James Blackburn, Dr Benjamin Walton
Authors: Dr Patrick Morgan, Dr Katherine Livingstone

Emergency Surgical Airway
Version: March 2018
Review Date: March 2020
Reviewer: Dr James Blackburn, Dr Benjamin Walton
Author: Dr Benjamin Walton

Oral & Maxillofacial Injuries
Version: March 2015
Review Date: March 2019
Reviewer: Mr Alistair RM Cobb, Dr James Blackburn
Authors: Mr Alistair RM Cobb

Thoracic Trauma

Management of Chest Injuries in Major Trauma:
Version: Jan 2017
Review Date: June 2020
Author: Dr Richard Turck, Dr Benjamin Walton, Professor David Lockey

Circulation and Haemorrhage

Cardiac Injuries including Resuscitative Thoracotomy
Version: July 2018
Review Date: July 2020
Reviewers: Dr James Blackburn, Dr Benjamin Walton
Authors: Professor David Lockey, Dr Benjamin Walton

Traumatic Vascular Injury Management:
Version: September 2017
Review Date: September 2019
Reviewers: Dr James Blackburn, Dr Rowena Johnson, Mr William Neary, Dr Neil Collin
Authors: Mr William Neary, Dr Neil Collin

Major Haemorrhage Protocol:
Version: May 2018
Review Date: October 2019
Reviewers: Dr Benjamin Walton, Dr Timothy Hooper, Dr Amit Goswami, Dr Tim Wreford Bush, Dr Nirosha DeZoysa
Authors: Dr James Blackburn, Dr Benjamin Walton, Dr Tim Wreford Bush, Dr Rowena Johnson

Abdomen & Pelvis

Assessment and Management of Major Abdominal Trauma
Version: November 2017
Review Date: December 2019
Reviewers: Miss Anne Pullyblank, Dr James Blackburn, Dr Nicholas Howes, Dr Neil Collin, Dr Rowena Johnson
Authors: Mr David Sanders, Dr Christine Blane, Dr Katy Hill, Miss Anne Pullyblank, Dr Rowena Johnson
Pelvic and Acetabular Fractures Management and Referral
Version: June 2018
Review Date: June 2020
Reviewers: Dr James Blackburn, Dr Benjamin Walton, Mr Tim Chesser
Author: Dr James Blackburn, Mr Tim Chesser, Dr Benjamin Walton

Extremities

Compartment Syndrome
Version: January 2015
Review Date: July 2019
Reviewer: Mr Luke Harries, Mr Andrew Riddick
Author: Mr Andrew Riddick, Mr Luke Harries

Management of Open Fracture for Adults
Version: March 2015
Review Date: May 2019
Reviewer: Mr Luke Harries, Mr Andrew Riddick
Author: Ms Joanna Maggs, Mr Mike Kelly, Mr Umraz Khan, Mr Luke Harries

Referral Guidelines to the Specialist Peripheral Nerve Injury Unit
Version: January 2015
Review Date: January 2020
Reviewer: Dr James Blackburn
Author: Mr Anthony Macquillan

Head & Spine

Management of Severe Traumatic Brain Injury
Version: November 2017
Review Date: November 2019
Reviewer: Mr David Sandeman, Dr James Blackburn
Author: Mr Crispin Wigfield

Care of Head Injured Patients
Version: August 2017
Review Date: August 2019
Reviewer: Mr David Sandeman
Author: Dr James Blackburn, Dr Benjamin Walton

Spinal Cord Injury Pathway
Version: May 2017
Review Date: June 2019
Reviewer: Dr Rowena Johnson, Dr James Blackburn
Author: Ms Laura Crowle, Dr Jules Blackham, Dr Rowena Johnson

Imaging

Imaging in Major Trauma
Version: September 2017
Review Date: September 2019
Author: Dr Adam Brown, Dr Adrian Pollentine
Rehabilitation

Directory of Rehabilitation Services
Version: September 2017
Review Date: September 2019
Author: Dr Steven Novak

Tertiary Survey
Version: September 2017
Review Date: September 2019
Author: Dr James Blackburn
Reviewer: Ms Laura Crowle

Specialist Dietetic Management and Nutritional Support for Major Trauma Patients
Version: June 2017
Review Date: June 2019
Reviewer: Dr James Blackburn
Author: Ms Kaylee Allan

Amputee Referral Pathway
Version: February 2015
Review Date: February 2019
Reviewer: Dr James Blackburn
Authors: Ms Deborah Cleary, Ms Helen Harvey

Referral Guidelines to Rehabilitation Services
Version: May 2018
Review Date: September 2019
Author: Dr Steven Novak