SEVERN TRAUMA ADULT GUIDELINE MANUAL

SEVERN MAJOR TRAUMA NETWORK

SEVERN
TRAUMA ADULT
GUIDELINE
MANUAL

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THE MAJOR TRAUMA NETWORK

Major trauma describes serious and often multiple injuries. It is a common cause of mortality and morbidity and remains the most common cause of death in the population under the age of 40.

The development of integrated trauma networks has aimed to organise regional major trauma care in a way that provides coordinated multidisciplinary care at a time and place that benefit the patient the most.

Each region has developed a network of hospitals based upon available facilities and transfer times. This has led to the designation of three tiers of hospital providing trauma care: Major Trauma Centres, Trauma Units, and Local Emergency Hospitals.

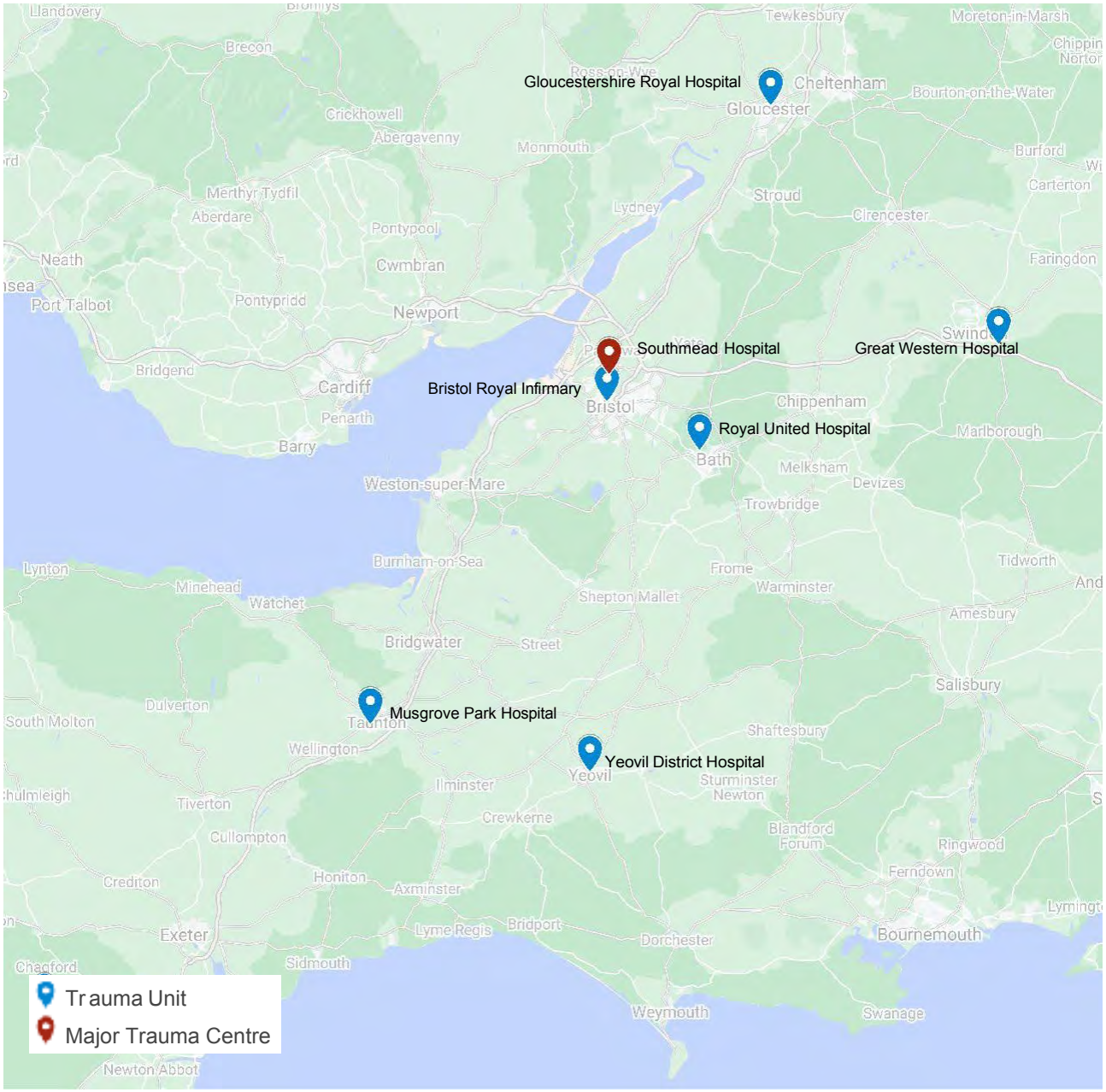
There are 26 Major Trauma Networks in England, each with a Major Trauma Centre. Major Trauma Centres are designated to deliver high quality speciality care and have all the facilities to provide resuscitation, emergency surgery, and interventional radiology with consultant-led trauma teams 24/7. Pre-hospital teams now use major trauma triage tools to identify patients who may have suffered severe injuries and require direct transfer to the Major Trauma Centre.

Southmead Hospital is one of two designated Major Trauma Centres in South West England, servicing the Severn region.

The Major Trauma Centre is supported by six acute trusts as designated trauma units:

- Bristol Royal Infirmary
- Gloucestershire Royal Hospital, Gloucester
- Royal United Hospital, Bath
- Great Western Hospital, Swindon
- Musgrove Park Hospital, Taunton
- Yeovil District Hospital

SEVERN MAJOR TRAUMA NETWORK



The Severn Trauma Network serves an adult population of around 2.3 million.

The South West has a greater proportion of inhabitants of pensionable age than any other English region (19.6%) and this is reflected in network data. The average age of major trauma patients treated in the network is 65.

The majority of major trauma patients across the network are treated as the result of a fall from less than 2m. Road traffic collisions are the second most common cause of injury, followed by falls more than 2m.

MAJOR TRAUMA AUTOMATIC ACCEPTANCE POLICY

KEY POINTS

- This policy will relate to patients from Trauma Units and Local Emergency Hospitals within the Severn Major Trauma Network area following major trauma
- The Severn Major Trauma Network must accept all severely injured patients in a timely manner
- This policy applies seven days a week, 24 hours a day
- Capacity constraints cannot be used over clinical priority to turn-down or delay patients
- The final responsibility for the implementation of this policy lies with the on-call Major Trauma Consultant (Trauma Team Leader).
- The Retrieve Adult Critical Care Transfer Service provides triage and co-ordination of all adult critical care transfer referrals 24/7 and should be contacted whenever a critical care transfer is required.

INTRODUCTION AND PURPOSE OF THE POLICY

Following the introduction of Regional Major Trauma Networks, Major Trauma Centres are required to have an automatic acceptance policy for 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 improve the patient pathway and quality of care. To do this it will:

- Ensure the automatic acceptance of major trauma patients after consultant to Trauma Team Leader (TTL) referral 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 a major trauma injury.

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 the Emergency Department, 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 (TTL) who accepts the patient. The trauma team leader can be contacted on **07703 886400**.

Departure from the policy would have to be justified to the Executive On call manager with clear and compelling reasons. Any departure from the policy must be documented in the patient notes and flagged through the major trauma governance process – **MTGovernance@nbt.nhs.uk**

PRINCIPLES

This policy applies 7 days a week, 24 hours a day

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

The Retrieve Adult Critical Care Transfer Service provides triage and coordination of all adult critical care transfer referrals 24/7 and should be contacted whenever a critical care transfer is required. All adult critical care transfer referrals should be made to Retrieve via their single point of contact telephone number (**0300 030 2222**)

In certain circumstances (at night and when the Retrieve team are committed elsewhere), the referring Trauma Unit will be required to undertake the transfer, providing appropriately trained and experienced clinical escorts and using a 999 ambulance (accessed via Retrieve).

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 Major Trauma Network repatriation policy
- SWASFT Major Trauma Triage Tool
- Inter-Hospital Transfer of Critically Ill Adult Major Trauma Patients
- Major Incident Policy

AUTOMATIC ACCEPTANCE PROCESS FOR EMERGENCY TRANSFERS

In the case of an emergency transfer the referring hospital must contact the on-duty Major Trauma Consultant (TTL - **07703 886400**) with details of the patient.

The referring hospital must also inform the Ambulance Service Coordination desk of the transfer and details of the patient. Retrieve should be contacted for any critical care transfers.

The transfer procedure must be carried out at TTL level

Full patient details including name of referring TTL and time of referral to be recorded in the Major Trauma booklet

Patient notes including their Major Trauma booklet should be transferred to the receiving hospital with the patient.

On arrival, the patient is met by the major trauma team and trauma call procedures initiated

CAPACITY AND 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.

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 TTL 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.**

In the unlikely event that a patient at a Severn Trauma Unit required a Major Trauma Centre Bed and the patient cannot be accepted at NBT because of capacity (such as during a major incident) it is the responsibility of the NBT TTL to ensure that 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 TTL.

If no other Major Trauma Centre within clinically acceptable transfer time can accept the patient then North Bristol NHS Trust must accept the patient.

SINGLE CALL ACCESS NUMBERS

NBT Trauma Team Leader (Consultant): 07703 886 400
SWASFT Ambulance Co-ordination Desk: 0845 1206342
Retrieve: 0300 030 2222

MASS CASUALTY AND MAJOR INCIDENT

The North Bristol Trust Major Incident Plan includes mass casualty response. In addition to this, there are Emergency Department, ICU, and Theatre Major Incident Plans detailing department response. The Emergency Department plans include a clear role of the trauma team and team leader with additional and supporting roles.

Responders should familiarise themselves with their local guidelines for the management of major incidents. NBT guidelines can be viewed on the Trust intranet and include:

- Major Incident Plan
- Major Incident Action Cards
- Major Incidence Guideline for Anaesthetists
- ED15 - Managing a Major Incident
- Major Incident Plan for Theatres - initial response

METHANE REPORT

The Trust is notified of a major incident by the Ambulance Service via an automated system to the Emergency Department. Information regarding the incident is communicated using the METHANE mnemonic which provides key information needed to inform the Trust's response:

1. **M**ajor Incident Standby / Declared
2. **E**xact Location
3. **T**ype of Incident
4. **H**azards—both present and potential
5. **A**ccess and egress to the incident
6. **N**umber of casualties and a breakdown of types
    i. Priority 1 (P1), life threatening injuries, resus
    ii. Priority 2 (P2), urgent, non life threatening, majors
    iii. Priority 3 (P3), delayed, minors
    iv. Number of children, burns etc
7. **E**mergency Services already at scene or involved in responding to the incident

On receipt of the Major Incident Notification, the Emergency Department documents the METHANE and initiates the appropriate response as outlined in the Major Incident Plan.

INITIAL MASS CASUALTY DISTRIBUTION PLAN

Principles Influencing Triage:

- Number and type of casualties
- Location of the incident within the network
- Neurosurgery only at NBT, cardiothoracic services at UHBW (one thoracic surgeon will receive patients at NBT). Specialised children's services at BCH.

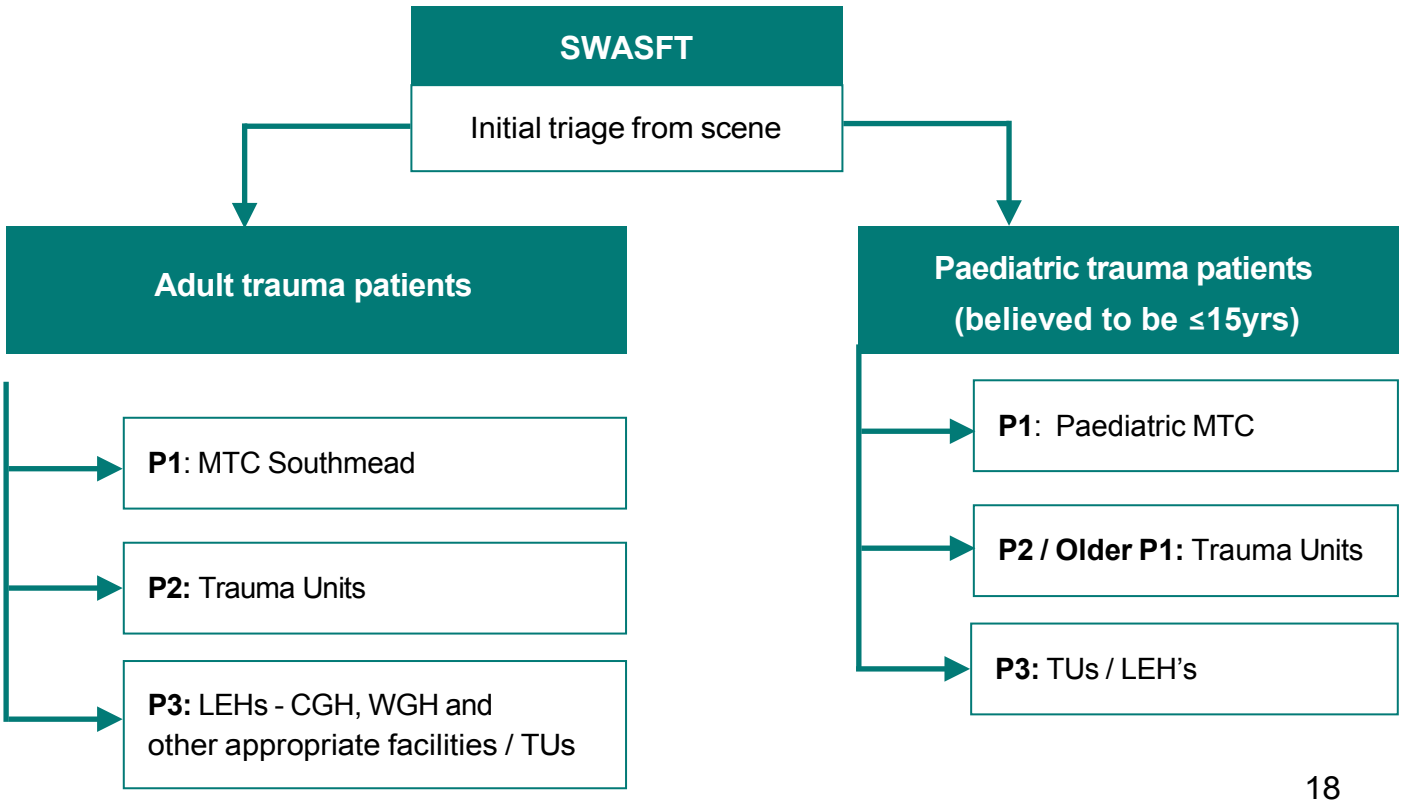
Severn Casualty Capability Chart: Pre-determined capacity for the first 2 hours

	Over 12 Years						Under 12 Years
P1 Capacity	Southmead Hospital 20			Bristol Royal Infirmary 10 (likely cardiothoracics)			Bristol Royal Hospital for Children 10
P2 Capacity	Bath RUH 20	Bristol BRI 20	Gloucester GRH 20	Swindon GWH 20	Taunton MPH 20	Yeovil YDH 20	Bristol Royal Hospital for Children 10
P3 Capacity (Adults & paeds)	Southmead Hospital Self-presenting		Weston General Hospital 30		Cheltenham General 20		

Total capacity for Severn (200). Ideally:

- Priority 1s to MTC
- Priority 2s to trauma units (but TUs may also have to take priority 1s)
- Priority 3s to TU's, LEH's and other appropriate facilitates.

These figures relate to the first 2 hours and should be viewed in the context of incidents producing mass casualties: within small incidents the figures for each unit will be lower.



MASS CASUALTY MANAGEMENT CONSIDERATIONS

All receiving hospitals should ensure they enact plans to enable them to free up 20% of their total bed base, 10% of which should be in the first six hours, and a further 10% within 12 hours of the incident declaration, allowing patients from the incident scene to be rapidly placed and ensure patient flow.
In addition to this, hospitals with level 3 Intensive Care capability should prepare to surge to double their normal level 3 ventilated bed capacity and maintain this for a minimum period of 96 hours.

Trauma Units should be prepared to manage patients who they would usually treat and transfer for extended periods, along with preparing to receive additional repatriations from the MTC. During a mass casualty incident, it may be necessary for receiving hospitals to expand their emergency capacity into space not usually occupied by the emergency pathway. This will require the activation of business continuity measures.

Organisations will need to consider activation of their lockdown arrangements to support site security and the need to protect access to health care facilities to those in need of treatment. In the event of being in a scene cordon the hospital may be asked to act as a temporary rest centre or reception centre.

HOSPITAL REPORTING

Trusts should be prepared to provide the information required on the NHS England National Incident Situation Report Template, or specific incident template issued during the incident to the appropriate time scales.

MORTUARY SERVICES

National arrangements for the identification of victims are likely to be invoked. These may include the activation of National Emergency Mortuary Arrangements (NEMA) or the designation of a Designated Disaster Mortuary (DDM) which may be on NHS premises but operated by the local authority.
It may be the case that the mortuary space in NHS hospitals has to be managed carefully, and coordinated with the appropriate HM Coroner's Office, HM Police and Local Authority to maintain capacity. This will be important where deceased are to be held for a period of time, and there will be delays in taking hospital mortuary bodies to the designated disaster mortuaries.

CLINICAL CELL (CRG)

NHS England will form a Clinical Cell with the Duty Clinical Director along with representatives of the NHS England EPRR Clinical Reference Group, with additional specialist representation as required.
This cell will act to ensure that the NHS England Incident Management Team (National) has the appropriate access to clinical advice to inform the response.
NHS England may make use of Medical Directors from Regional Offices and DCO teams to support the clinical cell in a protracted incident or where they have specialist subject advice required of the response. In addition to this, NHS England may contact individual experts to offer advice based on available known staff in organisations.

Clinical Impact Assessment Call
Within the first twenty-four hours of an incident, the Lead National Medical Director will establish a clinical call with responding centres to ascertain the likely impact to services and patient management across all services. An agenda for this is provided in Annex 6: Clinical Impact Assessment Call Agenda
Where possible this call will be held on the secure teleconferencing facilities accessible through the NHS England EPRR Duty Officer (NHS05).

Ethical Decisions
It may become necessary to enact decisions relating to the ceilings of care during a mass casualty incident to ensure the greatest number of survivors possible.
This may include the decision by the Clinical Cell to invoke the expectant triage category at the scene. This decision will be time limited, continually under review and only used at a time when NHS resources are overwhelmed

Patient Placement
The Clinical Cell will advise on the placement of patients who need to be transferred out of the incident response areas to ensure they receive the most appropriate definitive care.

Clinical Debrief
The Clinical Cell will establish a clinical debrief for the incident, the hot debrief will be held within two weeks of the incident, with a structured clinical debrief within one month.

Recovery Cell
Nationally a Recovery Cell will be established to coordinate with the response and ensure work is undertaken to manage the recovery of NHS England and the NHS in England. This group will look at the recovery support required and ensure liaison between recovery groups at all levels of the organisation and out to those groups established as part of SCG response.

RECOVERY CONSIDERATIONS

- Decision making for return to normal working ultimately rests with Incident Director (National). This may be delegated as the incident response evolves and recovery commences to regional leads; however, the option to refer to the designated national lead should remain in the case of local/regional dispute or unacceptable variation in recovery actions occurs.
- Financial implications must be transparent, and principles applied consistently across the system by providers and commissioners
- Recovery should be led by a senior Regional Recovery Lead and coordinated nationally across the health economy to ensure continued application of mutual aid principles, effective use of resources and to facilitate repatriations
- National, regional and local recovery leads should liaise at an early stage and throughout the process with ODNs. The ODNs will provide local intelligence and advise on actions to be taken at system level (local/regional/national)
- Return to organisational business as usual may take considerably longer than normal.
- Trauma cases may require multiple and prolonged returns to surgery and/or stays in critical care.
- Specialist services may need to be commissioned or expanded to deal with additional demand on a medium to long term basis
- Patients may need to be repatriated into their own health economy a long way from the incident location and may require medium to long term care and rehabilitation. Commissioners will need to agree the provision of additional resources.
- National support will be required to recover costs from overseas patients and national arrangements should be set out in advance. Costs may be for short, medium or long term care and treatment and could include; emergency and/or specialist treatment and care, rehabilitation services and repatriation.
- Discussions around the reduction, alteration, suspension or cancellation of services by organisations supporting the incident that impact on their national standards should be conducted between regulators at a national level.
- Proactive capture of points to inform learning from response and facilitate recovery should be achieved.

DEBRIEFING

All NHS organisations involved in the response will be expected to undertake a debrief as per the requirements of the NHS England EPRR Framework and Core Standards. Trusts may be invited to multiple debriefs by many agencies and should attend these where possible.

PSYCHOSOCIAL SUPPORT

Psychosocial support should be offered to patients and staff as needed they should also be made aware of those symptoms that are normal during the initial period following a traumatic event, An NHS England post incident leaflet is available 'Access to post incident mental health services leaflet'.

BACKGROUND INFORMATION

Risk factors and likely injury types

National planning assumptions state the likely split across triage categories will be 25% Priority 1 (casualties needing immediate intervention), 25% Priority 2 (casualties needing early treatment but delay acceptable), 50% Priority 3 (casualties needing treatment but a longer delay is acceptable).

The cause of the incident is likely to dictate the type of injury from a Mass Casualty event however there is likely to be:

- Severe Blunt Force or Ballistic Trauma (especially in firearms and bomb related incidents) across specialties.
- Burns
- Acoustic Injuries (where blasts have occurred)

Environmental

Local conditions can impact on the ease to get to medical facilities and the ease of access to patients requiring a greater response from the hospital. Weather conditions can impact on the number of casualties in an incident and the type of treatment and staff required to respond, extremes of temperature can increase the risk of shock, and bring about exposure related illness.

Water Supplies

Water supplies could be the cause of a mass casualty incident or impacted upon by an incident. The Trust has in place utility disruption plans to allow services to continue in the event of a disruption or contamination to supplies. Advice should be sought from Public Health England during any incident of this nature.

Lack of water supplies may require a change in the way patients are cared for and effect immediate treatment.

VIP Visits

It is likely during and/or following a mass casualty incident there will be significant interest from VIPs to visit hospitals and those affected. This may need to be coordinated nationally to ensure that appropriate arrangements are in place.

Visits from VIPs can require extensive resourcing and organisations need to carefully consider these against the need to deliver ongoing patient care.

NETWORK REPATRIATION POLICY

INTRODUCTION AND PURPOSE OF THE POLICY

The repatriation of major trauma patients to their local hospitals has the potential to be challenging for the patient, carers and organisations involved. Unnecessary delays are unhelpful in a number of ways:

- They can impede care packages for patients
- They can be inconvenient or distressing for both patients and relatives
- They are a source of frustration in relationships between hospitals
- They can prevent acutely ill patients being admitted into designated beds
- Can affect patient flow and operational running of the Major Trauma Centre (MTC)

The purpose of this policy is to provide direction and guidance for actions from key individuals and organisations to reduce the challenge and improve the patient pathway and quality of care for major trauma patients. It also aims to replicate the automatic acceptance principle that ensures acceptance of patients from the Trauma Units (TU) to MTC during the early phase of care. It will provide the MTC with an effective means of returning patients to their original or local Trust following their initial acute treatment and therefore ensure capacity is available in the MTC for any further patients requiring major trauma care.

SCOPE

The policy will be formally agreed and accepted amongst all organisations within the Severn Trauma Operational Delivery Network (ODN) and relate to those patients admitted to North Bristol NHS Trust (MTC) following major trauma.

This policy applies only to TARN inclusion criteria major trauma patients. For operational purposes, major trauma patients are those that have been received following triage according to the Major Trauma Triage Tool (Page 45). It does not apply to patients other than those deemed to have major trauma injuries at time of transfer.

SUMMARY OF THE POLICY

The policy will ensure that all patients are repatriated to their local health care provider when they are medically fit or have completed specific treatment at the MTC.

It will ensure that all relevant parties are aware of their specific roles and responsibilities and prevents delay to patient transfer.

It will provide clear guidance for action when patient pathways become blocked.

PRINCIPLES

- The process outlined in this policy applies twenty-four hours, seven days a week to all organisations within the Severn Trauma Network.
- The MTC is committed to automatically accepting major trauma patient transfers into the centre. As such to maintain flow it is critical that there is a robust and reliable process for repatriation to TU. A principle of automatic acceptance for repatriations needs to be approved by TU.
- MTC clinical teams will make contact with the receiving Trust clinical team and agree the transfer and acceptance of care using the Repatriation Notification Form (Page 26).
- The MTC and other hospitals should maintain communication throughout the patient's stay at MTC as appropriate.
- The MTC will provide as much notice as is reasonably possible of repatriation and endeavour that this is no less than 48 hours before repatriation is required.
- All relevant clinical and social information is to be provided to the receiving Trust upon referral.
- An escalation policy will be triggered if a bed is not allocated to a major trauma patient within 24 hours of them being ready for transfer.
- Transport will be organised by the MTC, providing necessary escort arrangements, together with all necessary documentation including a formal typed discharge summary to accompany the patient.
- If the patient has critical care needs, transport arrangements can be discussed with Retrieve – **0300 030 2222**.
- Lack of rehabilitation facilities within the receiving organisation should not affect the repatriation of patients.

- A patient must be accepted by a senior doctor (ST3 and above) doctor within the specialty required before the repatriation process can begin. Please note that for quadriplegic patients returning to hospitals within the Network an accepting consultant in the receiving specialty is required.

ESCALATION PROCEDURES

24 Hours
If repatriation has not occurred within 24 hours of patient being fit for transfer, then the Operations Manager at the MTC will be informed and will communicate with the Operational Lead at the receiving Trust. Out of hours this will be the site team lead or the manager on call.

48 Hours
If repatriation has not occurred within 48 hours of patient being fit for transfer, then the Deputy Director of Operations at the MTC is to be informed and communicate with their equivalent at the receiving Trust.

72 Hours
If following discussion between Directors of Operations, no agreement can be reached, a time for repatriation will be established by the MTC approximately 72 hours from patient being ready for transfer and this will be confirmed with the Trauma Unit, who must identify a receiving team and ward, the patient will then be transferred.

REVIEW

This policy will be monitored jointly by all Trauma Unit clinical and managerial leads and the Severn Major Trauma Operational Delivery Network Board. A formal review will be undertaken annually, and amendments will be made as necessary.

MAJOR TRAUMA REPATRIATION NOTIFICATION FORM

MAJOR TRAUMA REPATRIATION NOTIFICATION FORM

Major Trauma Centre Coordinators to Complete Top Section and Email to Receiving Trust nominated email address

Name		**DOB**	
Address		**Male / Female** *(delete as appropriate)*	
		Post Code	
NHS Number			
MRSA Status		**Swabbed Y / N** *(delete as appropriate)*	
COVID Status & last swab		**COVID Vaccination Status**	
CPE Status		**Swabbed Y / N** *(delete as appropriate)*	
MOI & Interventions			
Current care requirements			
Receiving hospital			
Time & Date of Referral		**Current Ward & contact number**	
Referring Clinician at MTC & specialty			
Accepting Clinician & Specialty		**Special considerations (i.e. 1 to 1 specialed)**	
Major Trauma office contact number	**0117 414 1540** **majortrauma@nbt.nhs.uk**		

……

Receiving Trust to contact the Southmead Operations Centre on 0117 414 0700 within 12 hours if there any concerns with the above information

CHAPTER 2

PRE-HOSPITAL

INTER-HOSPITAL TRANSFER OF MAJOR TRAUMA PATIENTS

PRE-HOSPITAL BLOOD

PRE-HOSPITAL HANDOVER

REGISTRATION OF PATIENTS WITH UNKNOWN DETAILS

INTER-HOSPITAL TRANSFER OF MAJOR TRAUMA PATIENTS

KEY POINTS

- Patients likely to require inter-hospital transfer should be identified early in their Emergency Department admission to facilitate time-efficient transfer
- In cases where uncertainty exists, early communication with the Trauma Team Leader (TTL) at North Bristol NHS Trust (NBT) is encouraged
- Resuscitation and stabilisation of the patient should occur in parallel with early referral to the Retrieve Adult Critical Care Transfer Service for critically ill patients, and South Western Ambulance Service NHS Foundation Trust (SWASFT) for all others
- Referral to the TTL at NBT should be made by the senior clinician caring for the patient
- In the event that Retrieve cannot transfer the patient, a dedicated team member should prepare and verify correct functioning of all transfer equipment & drugs
- Critically ill patients undergoing inter- and intra-hospital transfer should be accompanied by two trained, competent and experienced staff
- Ensure all radiology is electronically transferred to NBT so that it is available as the patient arrives at the MTC
- The default location for reception and handover will be the Emergency Department Resuscitation area at NBT
- A formal handover must occur between the transfer team and receiving team. Consideration should be given to using the SBAR or ATMIST structure
- Transfers must be documented by Retrieve or using South West Critical Care Network (SWCCN) transfer documentation, available in all hospitals.

Note:
This guideline applies to the transfer of critically ill (usually Level 2 and 3) major trauma patients. Other major trauma patients who require transfer (eg. isolated limb fracture requiring orthoplastics) should be transferred by SWASFT who can be contacted via 999 to undertake a time critical or urgent transfer.

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. Many of these patients are critically ill or at significant risk of deterioration and require critical care transfer.

The Retrieve Adult Critical Care Transfer Service provides triage and coordination of all adult critical care transfer referrals 24/7 and should be contacted whenever a critical care transfer is required. In certain circumstances (at night and when the Retrieve team are committed elsewhere), the referring Trauma Unit will be required to undertake the transfer, providing appropriately trained and experienced clinical escorts and using a 999 ambulance (accessed via Retrieve).

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 critical care transfers undertaken by referring hospitals 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 Retrieve 'Referring to Retrieve' SOP and 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 In Level 2 and Level 3 (as defined by the Intensive Care Society) 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 SWASFT 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.

REFERRING TO RETRIEVE

All adult critical care transfer referrals should be made to Retrieve via their single point of contact telephone number (**0300 030 2222**) and electronic referral platform.
For up-to-date information on this process and the information required, visit www.retrieve.nhs.uk/refer. Early contact with Retrieve is encouraged as they are often able to mobilise a team prior to the patient being ready for transfer and this can be beneficial in shortening the time between acceptance and arrival in the MTC.

Calls are triaged and coordinated by a Retrieve Duty Consultant who will either mobilise the dedicated Retrieve team or agree to arrange a SWASFT 999 ambulance for the Trauma Unit team to transfer the patient in with referring hospital clinical escorts.

Retrieve have a unique agreement with SWASFT whereby these vehicles are allocated and prioritised to provide a more timely response than by calling 999. They will be categorised according to the National Interfacility Transfer Framework (2019):

- Category 2 – time critical transfer (patient requiring life, limb, sight-saving procedure in the MTC within 60 minutes of arrival)
- Category 3 – urgent transfer (critically ill major trauma patients outside the above group – this is the majority)

PREPARATION FOR TRANSFER

See page 34 for additional information

1. Identify patient requiring transfer on admission or as soon as practicable

2. 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) if the transfer is being undertaken by Trauma Unit staff
   - Prepare SWCCN transfer documentation (available in every Emergency Department)

3. 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.

4. The senior clinician caring for the patient should contract Retrieve on **0300 030 2222**. In many cases the need to transfer can be identified very early in the patient's admission to the Trauma Unit Emergency Department. Early contact with Retrieve is encouraged, particularly during the daytime when the service has a dedicated transfer team, to shorten existing timelines. The person making the call will require the following information (further details in the 'Referring to Retrieve' SOP www.retrieve.nhs.uk/refer):
   - Type of transfer: Major Trauma Transfer
   - Urgency of response: time critical, urgent
   - Patient location [exact location within hospital]
   - Receiving hospital and department
   - If Retrieve are not undertaking the transfer:
     - Whether a critical care transfer trolley is being used. Most Level 2 and 3 transfers should be accompanied by 2 clinical escorts, in line with national guidelines.
     - Details of escort(s) being provided (for instance, doctor and nurse)
   - Patient's details:
     - Name
     - Date of birth
     - NHS number
   - Patient's current condition

5. Package patient on critical care transfer or 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

6. On departure update TTL with estimated time of arrival (SWASFT crew are able to estimate this). If Retrieve are transferring the patient, their clinical team will do this.

7. 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 and Retrieve 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 (FOR PATIENTS NOT TRANSFERRED BY RETRIEVE)

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).

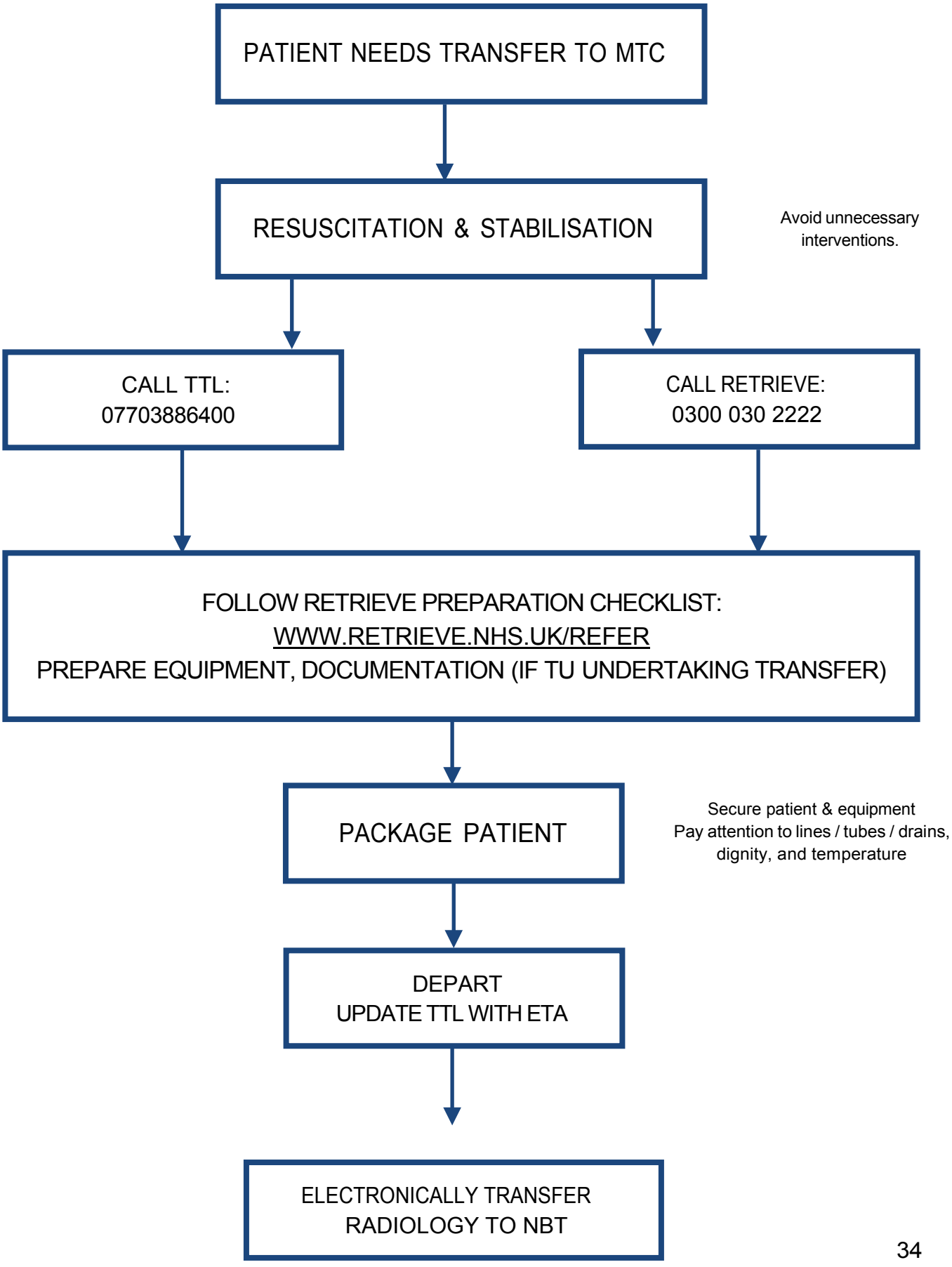
RECEPTION AND HANDOVER

The default location for reception and handover will be the 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.

The transferring team are not expected to escort the patient for additional imaging (eg. when time critical further imaging will determine location). In this situation, the patient may be directed to the CT scanner and met by the TTL and intensive care / anaesthesia team for onward escort through the hospital.

A formal handover must occur between the transfer team and receiving team led by the TTL. Handover should be structured and concise. Use of the ATMIST or SBAR format is encouraged. Written documentation must accompany a verbal handover.

EMERGENCY DEPARTMENT FLOWCHART FOR INTER HOSPITAL TRANSFER OF CRITICALLY ILL ADULT MAJOR TRAUMA PATIENTS



PRE-HOSPITAL BLOOD

KEY POINTS

- The majority of air ambulances within the Severn region now routinely carry packed red blood cells and/or fresh frozen plasma or Lyoplas.

- The majority of patients receiving a pre-hospital blood transfusion will need further blood and blood products on arrival in the Emergency Department. Shock Packs should be requested on the basis of the information provided in the pre-alert call.

- All patients who have received a pre-hospital blood transfusion will arrive wearing specific wristbands for traceability. If brought to Southmead MTC by Great Western Air Ambulance (GWAA), Wiltshire Air Ambulance (WAA) or Dorset & Somerset Air Ambulance (DSAA) the patient identifier should be used for all pathology and imaging requests (as they are generated by North Bristol Trust). Other air ambulance patients will need hospital specific wristbands on admission.

- The pre-hospital team may provide a pre-transfusion blood sample; this can be sent to the transfusion laboratory. 2 further crossmatch samples should be drawn and sent in the usual way.

PRE HOSPITAL BLOOD TRANSFUSION

The majority of air ambulances in the Severn region now routinely carry blood products and will perform pre-hospital blood transfusions when required.
Most air ambulances carry at least 2 units of packed red blood cells (RBC) with some carrying fresh frozen plasma (FFP) or Lyoplas.

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

- Prior to arrival, you should have received a pre-alert (ATMIST) call clearly stating that a pre-hospital blood transfusion has been given.

- The majority of patients who receive a prehospital blood product transfusion will require additional blood on arrival in the Emergency Department. Shock Packs should be requested on the basis of the information provided in the pre-alert call

- Any patient receiving pre-hospital blood will have a unique patient identifier (hospital number, name and date of birth) allocated to them in the pre-hospital phase. This will not be the patients actual name or date of birth. For patients conveyed to Southmead MTC by Great Western Air Ambulance (GWAA), Wiltshire Air Ambulance (WAA) or Dorset & Somerset Air Ambulance (DSAA) the unique identifier allocated in the pre-hospital setting should be used for all imaging and laboratory requests. This is because the unique identifier originates from North Bristol Trust. Patients brought in by other air ambulances will need hospital specific wristbands on admission

- The trauma team leader should confirm the unique pre-hospital identification number at the time of the pre-alert 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 pre-hospital patient identifiers and the actual patient details will be merged by the clerical team once the patient arrives at a location of definitive care and is stable (this may be 24-48 hours post admission). The pre-hospital team will provide blood transfusion specific accompanying documentation

- North Bristol Trust have recently introduced BloodTrack (an electronic blood tracking system). It is likely this will be rolled out to the pre-hospital teams in the future, however for the time being the paper based system remains

- On arrival, a pre-hospital Group & Save blood sample may be handed over. This should be sent to the transfusion laboratory as soon as possible (with or without other samples taken in the Emergency Department)

UNIQUE PRE HOSPITAL IDENTIFICATION (COMPATIBLE WITH NBT SYSTEMS)

This only applies to patients brought to Southmead MTC by Western Air Ambulance (GWAA), Wiltshire Air Ambulance (WAA) or Dorset & Somerset Air Ambulance (DSAA). Patients brought in by other air ambulances will need hospital specific identification on admission.

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

Hospital No: Unique 7 digit number – compatible with North Bristol Trust systems
Surname: Random word from phonetic alphabet.
First name: Random word from phonetic alphabet
Date of Birth: Random day and month from 1921

The above information should have been passed to the trauma team leader during the initial pre-alert call. All imaging and laboratory requests should be requested using these details.

Even when the patient details are known, the pre-hospital identifiers must continue to be used until the patient arrives at a location of definitive care (e.g. ICU) AND is stable. This may be 24-48 hours post admission. Once stable, the clerical team will merge the pre-hospital identifiers 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 pre-hospital team are responsible for ensuring it is correctly completed and copies lodged with the trauma team.

- Pre-hospital Blood Transfusion Record (prescription on front with traceability labels attached to back)
- Group & Save Request Form (with sample)
- SWASFT Patient Care Report (electronic Patient Care Record - ePCR)

PRE-HOSPITAL HANDOVER

ATMIST

The mnemonic ATMIST is a method of clinical handover between pre-hospital and hospital teams. It should be used to handover all trauma patients.

The Severn Major Trauma Network uses ATMIST for patient early alert, pre-alert, and handover. The introduction of this system in 2010 significantly improved communication between pre-hospital teams and Emergency Departments.
It offers a structured format for handover and is expected to take less than 60 seconds.

AGE (AND PATIENT NAME IF KNOWN)

TIME OF INCIDENT

MECHANISM OF INJURY

INJURIES

VITAL SIGNS

TREATMENT SO FAR

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

Pre-Alerts

The ATMIST pre-alert is required in the following circumstances:

- Any patient triaged as major trauma by the Major Trauma Triage Tool (Page 45)
- Any patient where a trauma team is required outside of the Major Trauma Triage Tool criteria e.g. specific clinical concerns

The proforma on Page 46 should be used to record the pre-alert for all major trauma patients.

Patient Handovers

It is also advisable to apply the ATMIST approach when providing a clinical patient handover in the Emergency Department.

Special Circumstances

If the patient has received a pre-hospital blood transfusion this should be clearly stated during an ATMIST pre-alert. The TTL should confirm the unique pre-hospital identification number at the time of the pre-alert call so that the correct number can be used for requesting investigations.

REGISTRATION OF PATIENTS WITH UNCERTAIN DETAILS

KEY POINTS

- Patient identifiers including MRN for ‘unknown’ patients are issued to conform with NHS EPRR Guidance.
- Patient identifiers including MRN are issued using a specific format which creates a unique patient identity which should not be similar to other ‘unknown’ patients in the circumstances of multiple simultaneous ‘unknown’ patient registrations.
- ‘Unknown’ patients who receive blood products during their care by certain pre-hospital providers will already have a pre-generated series of identifiers prior to their initial Emergency Department attendance.
- 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 and is stable.
- Deviation from this process could lead to significant patient harm

PATIENTS WHO RECEIVE PRE HOSPITAL BLOOD PRODUCTS FROM GREATER WESTERN AIR AMBULANCE OR WILTSHIRE AIR AMBULANCE

1. Patients who receive pre-hospital blood products from Great Western Air Ambulance or Wiltshire Air Ambulance will be assigned a pre-generated series of identifiers by the pre-hospital team prior to their arrival in the Emergency Department. These identifiers are pre-generated by NBT and supplied for use by the above providers.

2. These identifiers consist of:
   - A randomly generated **phonetic alphabet surname, first name** combination (e.g. Foxtrot, Echo)
   - A **date of birth** consisting of a randomly generated day and month with the year 1921
   - A unique **MRN**
   - The Emergency Department reception team will register the patient with the above details. In addition they will change the sex of the patient to male or female once this information has been handed over by the pre-hospital team.
   - The patient must have their initial attendance registered with these details once blood products have been given irrespective of whether their true identity has been identified. It is imperative that the patient remains registered as an 'unknown' until such time as the patient moves to an area of definitive care and is stable.
   - The registration generated using the above details will allow all NBT systems to be used including ICE and PACS.

Example:
Name: Bravo, Delta
Date of Birth: 19/02/1921
MRN: Unique MRN
Sex: Male/Female

PATIENTS WHO DO NOT RECEIVE PRE HOSPITAL BLOOD PRODUCTS FROM GREATER WESTERN AIR AMBULANCE OR WILTSHIRE AIR AMBULANCE

1. Patients who do not receive pre-hospital blood products from the above pre-hospital teams including those who receive blood products from alternative pre-hospital providers will have an 'unknown' identity created upon registration in the Emergency Department

2. These identifiers consist of:
   - A randomly generated **phonetic alphabet surname, first name** combination (e.g. Foxtrot, Echo)
   - A **date or birth** using the day and month of attendance with a year based on the patients estimated age
   - A unique **MRN**
   - Sex of the patient

3. It is imperative that the patient remains registered as an 'unknown' until such time as the patient moves to an area of definitive care and is stable.

4. The registration generated using the above details will allow all NBT systems to be used including ICE and PACS.

Example:
(Patient arriving on the 6th June 2021, estimated age 30)
Name: Foxtrot, Hotel
Date of Birth: 06/06/1991
MRN: Unique MRN
Sex: Male/Female

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.

Major Trauma Triage Tool

Consider early critical care or HEMS activation

Consideration of special patient groups to heighten suspicion of injury:

- Children aged 12 and under
- Pregnancy
- Anticoagulants

Suspected Major Trauma?

↓

Do serious injuries include any of the criteria below?

↓

PHYSIOLOGY

- Sustained RR less than 10 or more than 29
- Sustained systolic BPs less than 90mmHg or absent radial pulses
- GCS motor score of 4 or less (flexing to painful stimulus)

OR

ANATOMY

- Extensive chest wall injury.
- Suspected open, depressed or basal skull fracture - only if GCS Motor score <4
- Amputated limb
- Bilateral femoral fracture
- Crushed, degloved or mangled limb
- Suspected major pelvic fracture**

↓ NO*

↓ YES

EXCLUSION CRITERIA
Patient is a Nursing Home resident
OR
Clinical Frailty (Rockwood) score of 5 or over

YES → **Go to nearest Trauma Unit**

The Trauma Advice Line can be contacted if required

↓ NO

Can Airway and Catastrophic Haemorrhage be safely managed?

NO → **Go to nearest Trauma Unit**

↓ YES

Can MTC be safely reached in <60 minutes?

NO → **Go to nearest Trauma Unit**

↓ YES

Contact Trauma Advice Line on 0300 369 0510 and provide them with an ATMIST and location. Trauma Advice line will then contact the MTC TTL to arrange admission. If approved proceed to MTC.

** 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)

*** DECISION SUPPORT**

MAJOR TRAUMA PHONE CALLS

PRIMARY / SECONDARY		Date:	Time:
		Location: (Pre-hospital / Hospital Name)	
PHYSIOLOGY	Sustained RR<10 or >29	Name: (HEMS name if blood given)	
	Sustained SBP <90 mmHg / absent radial pulse	**A**GE:	**T**IME OF INCIDENT:
	GCS Motor Score ≤4		
ANATOMY	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, mid foot or hindfoot fracture		
	Crushed, degloved or mangled limb		
	Suspected pelvic fracture with: • Haemodynamic instability / signs of shock • Deformity on examination • Open fracture - PU / PV / PR bleeding / scrotal haematoma		
Clinician Concern			
HIGH RISK GROUPS	Age >65 Pregnancy Anticoagulants Polypharmacy		
		Team Activation: (Full / TTL / Other)	
		Call Taken By:	

CHAPTER 3

THE EMERGENCY DEPARTMENT

THE TRAUMA TEAM

KEY POINTS

- Activation of the trauma team is based on anatomical and physiological parameters
- This team should manage the initial assessment, resuscitation, imaging and co-ordination of disposal for trauma patients presenting to NBT
- The decision to activate the trauma team is made by the senior doctors and Band 7 on duty following pre-alert from the ambulance service / patient arrival in the ED.
- The trauma team is activated by ringing '2222' and stating 'trauma call'
- The Trauma Team Leader (TTL) should be available within 5 minutes of notification
- All members of the trauma team should inform their respective specialty team members of incoming trauma and attend the resus area as soon as possible on receipt of the trauma call.
- All trauma team members must remain with the patient until appropriate disposal is achieved.

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 (Page 13). A copy of the South West Ambulance Service NHS Trust Major Trauma Triage Tool can be found on Page 45.

Indications for Trauma Team Activation

Anatomy:
Unsafe airway
Flail chest
Penetrating injury to head, neck or torso
Severe pelvic injury
Major crush injury to torso or upper thigh
Limb amputation
Two or more long bone fractures
Paralysis from spinal cord injury
Burns over 20% or potential airway burns

Abnormal Physiology:
Respiration <10 or >30 or other signs of respiratory compromise
Pulse <50 or >120
Systolic blood pressure <90 mmHg
Systemic signs of shock
Head injury with motor score ≤4

Special Circumstances
Multiple patients
Agreement between TTL and paramedics on scene
Agreement between the TTL and Specialist Paramedics on SWAST's Trauma Advice Line
HEMS requested
Secondary Transfer from Trauma Unit

TRAUMA TEAM

The ethos is that this team manage the initial assessment, resuscitation, imaging and co-ordination of disposal be it theatre, ITU or ward for major 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 10:00 and at 16:00

Call Activation

1. 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.

2. Ring x2222

3. State ‘trauma call’

4. The TTL and Senior Nurse will carry out a situational appraisal of the department with the Duty ED lead to allocate appropriate bays and resources.

5. On arrival of patient the TTL must identify themselves to the lead pre-hospital clinician and receive handover.

6. The salient points of this handover will be written on the Trauma Board to prevent repetition of information, using the ATMIST handover formula – see Page 39. A sticker for ATMIST handover should be available and completed by the scribe.

7. Each member of the trauma team should fulfil their roles unless the TTL dictates otherwise.

8. Members of the trauma team must not leave resuscitation without discussion with the TTL.

TRAUMA CALL ADULT TEAM

Contact numbers for the trauma team at **North Bristol Trust:**

TRAUMA TEAM MEMBERS	BLEEP
Trauma Team Leader	9745
Anaesthetist 3rd on Call	9033
ICU Registrar	9039
General Surgeon Reg on Call	9772 (Take) 9656 (Post-Take)
Orthopaedic Reg On Call *(SHO will hold bleep when SpR not on site)*	9750
Radiology Registrar	9746
Haematologist	9433
Radiographer	9704
Trauma Nurse Co-Ordinator	9747, 9748, 9749
ED Nurse 1	
ED Nurse 2	
ED Nurse 3 ERA	
Porter	9567
Matron ED	9744
Senior nurse ED	9743
Receptionist	9742
Other specialities may be called as clinically indicated	
Neurosurgery	Ext. 45726
Plastics	1311
Cardiothoracics	Via switchboard @ University Hospitals Bristol and Weston

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 TTL 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.
- Medical Photography

Pre-Arrival

- Add alert call details to Trauma Board and 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 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:
Emergency 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.

Arrival
On arrival of the patient into resus the TTL will make a brief assessment of the patient (a '5 second round') to ensure no immediate interventions are required

The pre-hospital team will move to the patient right side of the stretcher and liaise with the TTL to move the patient from the ambulance stretcher to the hospital trolley with a trauma mattress. The ambulance stretcher should then be removed from the cubicle. Patients arriving by air will be wheeled in directly on a hospital trolley and no movement of the patient is required.

The pre-hospital team will then give a verbal handover of the patient to the Trauma Team. This is an important handover of information; the whole hospital team should give this their full attention. No one should touch the patient during this process whilst the pre-hospital team continue to monitor the patient. This process should not be interrupted, unless critical, with questions held until the end, to prevent the loss of vital information.

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 TTL.

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 TTL 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 completed Trauma case note documentation
Complete Hot Debrief form

Debrief team

GENERIC TRAUMA TEAM ROLE

Start of Shift
Collect speciality trauma bleep and receive handover + relevant speciality situational report.

Trauma Team 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 ED 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 primary survey doctor, 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

ORTHOPAEDIC REGISTRAR

Key Roles

- Catastrophic haemorrhage control
- Cervical spine and pelvic stabilisation
- Venous access
- Perform secondary survey
- Determine imaging requirements (additional to trauma CT)

Patient Management

- Direct pressure haemorrhage control as required, in extreme conditions for extremity bleeds – consider tourniquet use.
- Ensure c-spine protection adequate
- 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 TTL
- Confirm patency of IV access
- Unless the patient has two patent IV access sites - Gain IV/IO access with 20mls blood samples for:- FBC, U&E's, LFT's, lipase, clotting screen, cross-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.

Neurological Assessment

- Perform baseline peripheral neurological examination, prior to anaesthesia if planned or just prior to logroll as directed by TTL
- Ensure c-spine protection in situ and placement correct 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

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 ED resus or to theatre as appropriate.

Secondary Survey

- Carry out secondary survey, when deemed appropriate and verbally report findings to TTL and scribe
- Document all wounds, grazes and degloving directly into the trauma booklet
- 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

Any additional imaging requirements in addition to a CT Trauma series should be discussed (review "Imaging in Trauma" Guidance). 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 TTL. 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
  – On occasion Primary Survey Breathing and Circulation assessment may be performed by a senior Emergency Medicine Doctor at the discretion of the TTL
- Perform logroll examination
- Determine need for immediate surgical intervention in theatres

Breathing

- Assess air entry, chest expansion, percussion and tracheal position to allow identification of significant chest pathology.
- Report findings to TTL, discuss, agree and institute appropriate interventions.

Circulation

- Venous access – shared role – as directed by TTL
- Confirm patency of IV access
- Unless the patient has two patent IV access sites - Gain IV/IO access with 20mls blood samples for:- FBC, UE's, LFT's, lipase, clotting screen, cross-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 IV access sites then gain 20mls blood for samples from a femoral arterial puncture
- Ensure samples are labelled correctly and dispatched to the appropriate departments.
- Complete abdominal examination
- Assess pelvis through visual examination and light palpation of bony prominences – work with orthopaedic registrar to ensure correct pelvic splintage
- Assess long bones as source of haemorrhage

Perform examination on logroll – 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. Logroll may be delayed until after CT and indeed be part of secondary or even tertiary surveys when patients are expedited to surgical/interventional radiological management.

Contribute to case discussion with the TTL. 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 multisystem injury, or is likely to need early surgery. This may require the attendance of the consultant to ED Resus or to theatre as appropriate.

Stay with the patient in Resus/CT until stood down by the TTL. 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 TTL 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 TTL – ensuring baseline neurological examination performed beforehand.
- Control patient logroll
- Ensure safe patient transfer

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 registrar's assessment of Breathing
- Attach to ventilator as soon as 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 registrar's assessment of Breathing
- Attach to ventilator as soon feasible – with confirmation of effective bilateral ventilation.

Non-Intubated patients

- Communicate airway patency and issues to TTL / scribe.
- Assess respiratory rate and inform TTL / 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 TTL/scribe
- Provide enhanced analgesia and sedation for patients that require procedures such as fracture/joint reduction/splintage and intercostal drain insertion

AMPLE History
Allergies
Medications
Past medical history
Last meal
Everything else relevant

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 transfusion 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 ED resus 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.

INTENSIVE CARE REGISTRAR

Key Roles

- Assist 3rd on Anaesthetist with RSI/intubation and line placement as appropriate
- Liaise with TTL to ensure prompt access to ICU beds
- Liaise with TTL and ICU Consultant when additional resuscitative support is required on arrival

Prior to Patient Arrival

Speak with TTL prior to arrival of the patient(s). The ICU Consultant must be informed of the likely case progression. This may require the attendance of the consultant to ED resus or to theatre as appropriate. The TTL may request an ICU Consultant to attend for the initial resuscitation.

Patient Arrival

Assist with interventions (such as RSI and lines) as training and experience dictates.

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. Make ICU nursing staff of the need for an ICU bed if required directly from ED or following theatre interventions.

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.

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 emergency blood.
Co-ordinate porters / transfer equipment – porters will need to meet patient's transferred in by air at the helipad

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 TTL & scribe as soon as available.
- Then continue to remove all clothing including underwear and store securely.
- Check temperature
- Cover with Bair Hugger / blankets
- Help with getting IV access and sending bloods off if required, set up intraosseus 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, 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.
- Obtain an anaesthetic grab bag from the resus controlled drugs cupboard
- Assist in preparing any drugs requested by anaesthetist/TTL.
- 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

THEATRE CO ORDINATOR

Key Roles

- Liaise with Theatres, TTL and surgical teams to ensure ready availability of operating space
- Provide additional skilled support if asked to do so – e.g. management of the Rapid Infuser alongside ED Nursing Team

SCRIBE EMERGENCY NURSE ASSISTANT (ERA)

A complex job but vital. Ensure you are being given the information you require and inform the TTL if you are 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 into Trauma Booklet on arrival
- Document team member's presence in the Trauma Booklet: including speciality, grade e.g. ST3 and supervising consultant.
- Ensure 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.
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 pre-hospital drugs and fluids – times and amounts.
- Document initial vital signs and then every 5 mins in unstable patient 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
- Print out pre-hospital ePCR
- 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 TTL

RADIOGRAPHER CT

Key Roles

- Present to TTL, discuss plan for immediate CT imaging based on pre-hospital clinical information
- Work with trauma team to ensure CT performed within 15 minutes of patient arrival
- Ensure Radiologist available to review images as the patient is in the scanner

RADIOGRAPHER MSK

Key Roles

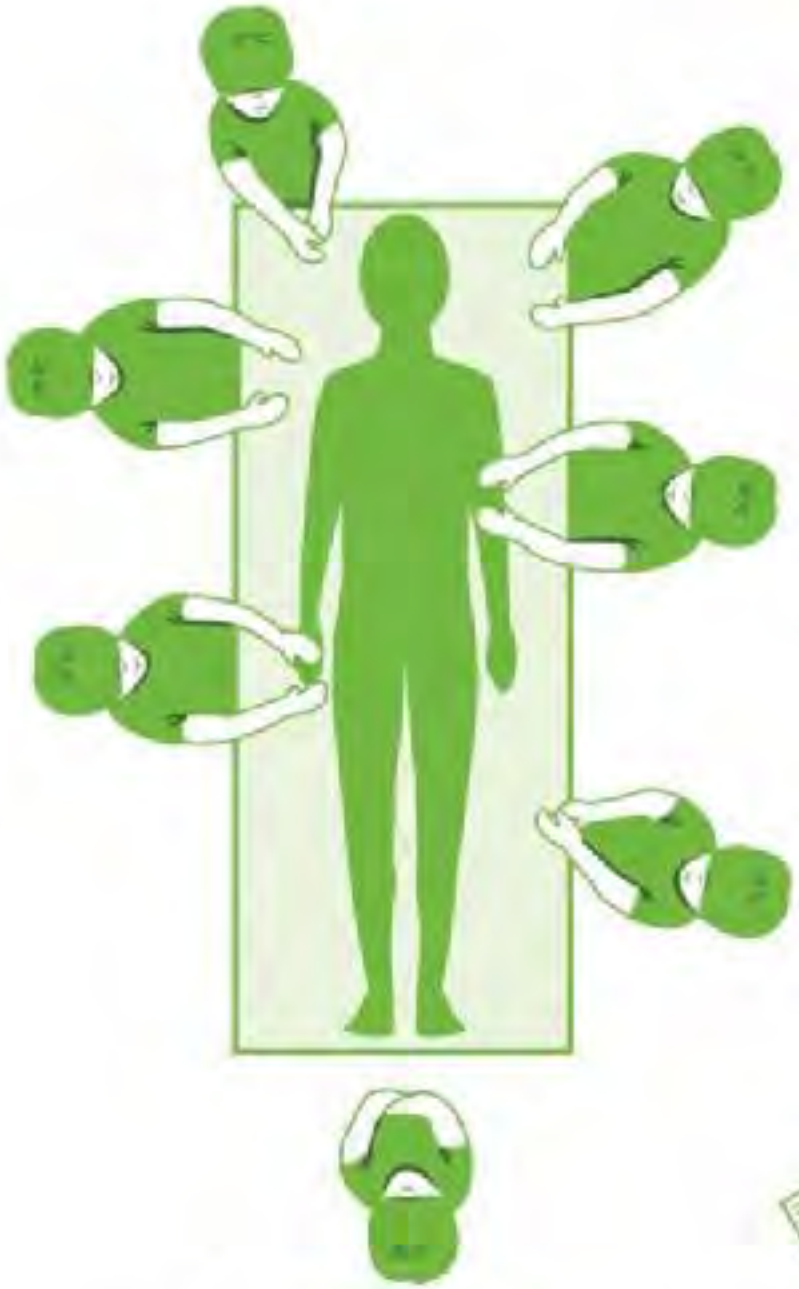
- Obtain plain film x-rays as required during trauma call
- Place cassettes under the trolley to speed up initial x-rays
- Liaise with TTL or nurse in charge if team members are not wearing lead. Liaise with TTL if team members are obstructing your chance to x-ray to prioritise actions.

RADIOLOGIST

Key Roles

- 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 to 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.

POSITIONS OF THE TRAUMA TEAM FOLLOWING HANDOVER



EMERGENCY DEPARTMENT AND CRITICAL CARE DRUG BAGS

KEY POINTS

- The drug bags should be kept in the locations identified in the following pages.
- The drug bags should be sealed with a tamper proof seal once restocked
- 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.
- 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.
- The drug bags should be available on activation of the trauma team in all major trauma calls, prior to arrival of the patient.
- 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

The Emergency Department drug bag should be stored in the locked controlled drug cupboard in resus.

Contents of the ED Major Trauma Drug Bag:

Drug	Strength	Quantity
Ketamine	200mg/20mL	1
Midazolam	5mg/5mL	1
Morphine	10mg/1mL	2
Fentanyl	500mcg/10mL	1
Propofol	200mg/20mL	1
Metaraminol	10mg/1mL	1
Rocuronium	50mg/5mL	2
Suxamethonium	50mg/1mL	2
Lorazepam	4mg/1mL	1
Tranexamic acid	500mg/5mL	2

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.

The Emergency Department have a separate SOP covering the management of controlled drugs within the drug bag in the Emergency Department. Clinicians should familiarise themselves with this.

THE INTENSIVE CARE UNIT EMERGENCY DRUG BAG

The Intensive Care Unit has two emergency drug bags in the Pod D Controlled Drug fridge. One of these bags should be taken to any in-hospital trauma.

Contents of the ICU Emergency Drug Bag:

Drug	Strength	Quantity
Propofol 1%	200mg/20mL	2
Propofol 2%	1000mg/50mL	1
Thiopentone	500mg	2
Suxamethonium	100mg/2mL	2
Rocuronium	50mg/5mL	2
Atracurium	50mg/5mL	2
Fentanyl	500mcg/10mL	1
Ketamine	200mg/20mL	1
Midazolam	5mg/5mL	1
Adenosine	6mg/2mL	3
Adrenaline 1:1,000	1mg/1mL	2
Adrenaline 1:10,000	1mg/10mL PFS	2
Amiodarone	300mg/10mL PFS	1
Atropine	600mcg/1mL	2
Calcium chloride 10%	10mmol/10mL PFS	1
Chlorphenamine	10mg/1mL	1
Ephedrine	30mg/10mL	1
Glucose 50%	25g/50mL	1
Ipratropium bromide	250mcg/1mL nebuliser	2
Magnesium sulfate 50%	5g/10mL	1
Metaraminol	10mg/1mL	1
Naloxone	400mcg/1mL	2
Salbutamol	2.5mg/2.5mL nebuliser	2
Sodium bicarbonate 8.4%	10mL	2
Sodium chloride 0.9%	10mL	4
Tranexamic acid	500mg/5mL	2
Water for injection	10mL	4

The Intensive Care Unit has a separate SOP covering the management of controlled drugs within the ICU Emergency Drug Bag. Clinicians working on the Intensive Care Unit should familiarise themselves with this.

DEATH AND BREAKING BAD NEWS IN THE EMERGENCY DEPARTMENT

KEY POINTS

- Effective & timely communication with patients and their relatives is a crucial element of effective trauma care.
- The most experienced clinician involved with the patient should convey information to relatives to avoid conflicting information and mixed messages being given.
- Information should be given in an open and honest manner with sensitivity taken towards the religious, cultural or spiritual needs of relatives where known.
- Use of a named nurse and a private space within which to hold conversations is best practice.
- NBT supports the principle of witnessed resuscitation and families should be offered this if appropriate
- Relatives, including children, should be encouraged to spend time with the patient prior to transfer to ICU or theatre.
- All patients with a perceived devastating brain injury should be considered for admission to ICU for a period of neuro-prognostication. **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 patient's admission to ICU.
- If a decision to withdraw life sustaining treatment in ED is being considered, two senior clinicians must agree that this is appropriate. If agreed, a SNOD **must** be contacted by the trauma team leader/senior member of staff prior to any family approach.
- Any discussion about organ donation should be undertaken as a collaborative approach involving the senior clinician, SNOD, and a named link nurse
- Tissue donation should be considered following the death of any patient in the ED.

SUDDEN TRAUMATIC DEATH

Communication with Relatives

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 and a telephone available
- The most experienced clinician involved with the patient should convey information to relatives to avoid conflicting information and mixed messages being given
- The doctor should be sensitive of religious, cultural or other needs of the family
- A good starting point is to find out what the family already know about the patient's current condition.
- Bad news should be communicated in a timely and sensitive way, avoiding euphemisms and jargon.
- Listening is as important as talking when breaking bad news.
- A nurse should accompany the doctor when breaking bad news in order to support the family
- 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
- It is good practice to provide follow up for the relatives of a deceased patient
- A letter of condolence to the family after the event is appreciated
- Departments should consider giving the name and telephone number of a Consultant that relatives can contact at a later date.
- Providing the family with an appointment a few weeks after the death to discuss the events has been shown to help families with their grieving process

Staff Support

- After every death or incident staff should be encouraged to talk together about the event. In many cases a formal debrief can be valuable

Further support should be available to staff through their supervisor or from occupational health

PLANNED WITHDRAWAL OF LIFE SUSTAINING TREATMENT

Where withdrawal of life sustaining treatment is being considered the following steps should be taken

Communication with relatives

- Information should be provided in a timely and open manner by the most experienced clinician familiar with the patient including details of their relatives condition, possible outcomes, assurances their relative is not experiencing pain or distress and when appropriate, 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

General Points

- 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**.** This should be explained to relatives
- **No discussion about organ donation should take place in the ED when an ICU admission is planned**
- 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
- 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.
- At NBT, SNODs are located in the ICU administration office during office hours and via **03000 20 30 40** at all other times. A green folder containing information relating to organ and tissue donation can be found in the office behind 'see and treat' in ED. Information is also available on the intranet or from the SNOD

Staff Support

- After every death or incident staff should be encouraged to talk together about the event. In many cases a formal debrief can be valuable
- Further support should be available to staff through their supervisor or from occupational health

FOLLOWING DEATH

- Verification of death must be completed as per NBT policy and documented on NBT verification of death paperwork.
- Where required, a death must be reported to the coroner as soon as possible.
- 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
- Tissue Donation must be considered in all patients after death. The completed referral form should be emailed to the National Referral Centre at National.ReferralCentre@nhsbt.nhs.uk
- 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

Planning

Who: Consultant, SNOD and nurse
Why:

- Clarify clinical situation
- Seek evidence of prior consent/authorisation (eg ODR or other)
- Identify key family members by name
- Define key family issues
- Agree a process of approach and who will be involved
- Agree timing and setting, ensuring these are appropriate to daily needs
- Involve others as required, eg faith leaders

When and where: in private and before meeting the family to confirm understanding and acceptance of loss

Confirming understanding and acceptance

For a potential DBD donor, ensure the family understand that death has occurred. Spend time with the concept, using diagrams or scans if necessary. In the DCD setting, ensure the family understand and accept the reasons for treatment withdrawal and the inevitability of death thereafter. Donation should only be raised at this point if it is clear that a family has understood and accepted their loss. If this is not the case, suggest a break. The key is to ensure that the family have accepted and understood the clinical situation before donation is raised.

Discussing donation

- **Re-confirm the family's understanding of the clinical situation**
- **Provide specific information on process before expecting a response**
- **Avoid negative or apologetic language**
- **Avoid manipulative or coercive language**
- **Emphasise the benefits of transplantation - the ability to save and transform several lives**
- **Sensitively explore an initial 'No', so of the causes of which can be addressed or are a result of misconceptions about donation**

Recognising their training and experience, wherever possible utilise the SNOD throughout the family approach to:

Provide knowledge and expertise
Discuss options
Help recognise modifiable factors and challenge misconceptions
Support and spend time with the family

CHAPTER 4

AIRWAY AND ANAESTHESIA

EMERGENCY ANAESTHESIA FOR MAJOR TRAUMA

KEY POINTS

- Emergency anaesthesia for the major trauma patient is a high-risk intervention that has significant potential benefits.
- 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.
- 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).
- It is strongly recommended that ketamine is used as the induction agent of choice in major trauma.
- 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.
- 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.
- In addition to standard intubating equipment, consideration of video laryngoscopy and equipment for “Plan B” & “Plan D – CICO” must be confirmed in all cases.

BACKGROUND

Modified 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 signposting to this document and resuscitation areas so they can orientate themselves appropriately. They are included on the major trauma bleep list but can be contacted on bleep 9033 if they have not attended or a trauma call has not gone out. In addition, the co-ordinating anaesthetic consultant is on bleep 9030 during daytime working and is an alternate contact if required.

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 jointly by the Trauma Team Leader and the trauma team anaesthetist(s).

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

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.*

Breathing – Oxygenation and ventilation are inadequate or potentially inadequate.

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 whilst facilitating radiological investigation and surgical control as required. Administration of blood products (when indicated) should be done prior to, and during, induction of anaesthesia to counteract the physiological instability associated with anaesthesia and positive pressure ventilation in the context of the major trauma patient.

In some circumstance's 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 and planned for.
- **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?

PREPARATION FOR RSI

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 (see Page 95).
- 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 (See Page 97). Ensure there is 360-degree access to the patient to allow for further interventions as required (e.g. thoracostomy).
- Airway trolleys are arranged similar to the standard airway trolleys found in theatres, with the exception being an additional "Resuscitation Trolley" that contains basic airway and cardiac arrest drugs.
- 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, TTL, or ICU)
- Airway "Nurse 1" – airway equipment, cricoid pressure and external laryngeal manipulation.
- Drug delivery

Monitoring:

- Full monitoring (ECG, NIBP, SpO_2, $EtCO_2$). Ensure monitoring is switched on, particularly the end tidal CO_2 module as it takes 1-2 minutes to warm up.
- Consider tying monitoring cables together to reduce possibility of tangle during transferring.
- Do not delay RSI for insertion of arterial line.

EQUIPMENT FOR RSI

Suction:

Confirm suction is working with appropriately 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 contain a Hamilton-T1 ventilator, ensure you are competent in their use.
- Daily ventilator checks should have been performed by ED staff.
- If the ventilator circuit is changed, the seal / tightness checks should be performed.
- Dräger Oxylog 3000 ventilators may be utilised during major incident / resilience scenarios.
- The ventilator should be switched on to ensure it's working, and any tests performed if required.
- Confirm suitable initial settings for the patient: e.g. Tidal volumes of 400mL, respiratory rate 18 breaths/minute, PEEP 5cmH_20, 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 $EtCO_2$.
- 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. (Mapleson C/Waters circuits can be used for pre-oxygenation, but a self-inflating bag must be able as well.)

Video laryngoscope:

- A CMAC video laryngoscope is available in ED; 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 ideally 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 $EtCO_2$ attached.
- (Mapleson “C”/ Waters 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).

DRUGS FOR RSI

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.

This regime is suitable for patients with very stable cardiovascular system, e.g. young patient with an isolated head injury, and arguably alternative opiate / propofol induction regimes can be used at the discretion of the anaesthetist.

Hypovolaemic "1:1:1"

Fentanyl **1mcg/kg**, Ketamine **1mg/kg** and Rocuronium **1mg/kg**

If severe hypovolaemia is suspected fentanyl should be omitted.
In some (rare) 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

The use of vasopressors for the management of hypotension due to hypovolaemia in trauma is associated with increased mortality. The aim is to avoid vasopressor use to counteract hypotension caused by hypovolaemia and over use of anaesthetic agents, rather use proactive blood product volume resuscitation and judicious bolus doses of anaesthesia (especially fentanyl).
However vasoactive drugs can be beneficial in counteracting vasodilation and cardiac failure by other causes: comorbidity, high spinal injury, therapeutic or illicit drug use / overdose, SIRS response.

In the latter cohort Adrenaline 10-20mcg bolus may be more effective than metaraminol 0.5-1mg boluses due to the additional inotropic and chronotropic effects.

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, as part of a neuroprotective anaesthesia approach. Transient hypotension is extremely detrimental to patient outcomes and therefore if in doubt use the most cardiovascular stable anaesthetic technique and adjust according to CT findings once available.
In those patients with head injury and severe hypovolaemia due to other injuries a balanced approach should be taken. In the "average" patient a target systolic of 100mmHg is suggested, which is then adjusted according to age, injury of greater consequence, and results of investigations.
In the case of isolated spinal cord injuries resulting in cardiovascular collapse they will require therapy to hypertense them for cord preservation. Blood pressure targets should be discussed with ICU and/or Neurosurgeons but are general 10-15% above baseline (MAP 85-90mmHg).

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 can be used e.g. 10-20mg Ketamine boluses titrated to effect. 1-2mg Midazolam can also 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 (10 min 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 cervical-spine injury the head should be placed in the neutral position and maintained 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 cannula 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. "MAC" lines are available in the resus bays.

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 post induction).
- Abdominal tenderness and guarding
- Neurological function distal to significant limb injury
- Limb movements

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.

Personal Protective Equipment:

Minimum PPE for trauma anaesthesia includes:

- Gloves
- Apron
- +/- Eye protection at the discretion of the anaesthetist.
- PPE should be adjusted to the prevailing disease risk in the community or specific pathogen or chemical risk from to the patient. E.g. SARS-CoV-2
  - Appropriate respirator for the risk. E.g. FFP3 or FFP2
  - Eye protection
  - Surgical gown, full body suit.
- If the pathogen / chemical risk requires a higher level of PPE e.g. BioHazard suits, this should only be performed by those trained in their use.
- Local trust Infection Prevention and Control (IPC) / PPE procedures will take precedence.

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 can be performed, 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 can be considered. On induction of anaesthesia flow is increased to 15l/min. (If there is a risk of infected aerosols being generated as a result of the procedure, apnoeic oxygenation can be omitted following the dynamic risk assessment).

CONDUCT PREDICTED STEPS IN PROCESS

Decision to RSI

- Appropriate people alerted
- Pre-oxygenation commenced
- Equipment assembled
- Challenge response checklist (see Page 95)
- 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
- Post RSI checklists completed
- Prepare for transfer and transfer checklist

Post Intubation Checks

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 CO_2 trace on monitor and direct visualisation at the time of intubation.
- Monitor values: SpO_2, NIBP, ECG, $EtCO_2$, 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 when moving to CT/ Theatres.
- ANY subsequent changes to ventilator settings or maintenance drugs
- Complete RSI audit form.

EMERGENCY ACTIONS

Anticipated or Unanticipated Difficult Intubation:

1. As per the difficult airway society guidelines (See Page 99)
2. In the majority of trauma patients' reversal of the muscle relaxant is not an option.
3. "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.
4. 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.

De-saturation:

1. Confirm oxygen supply by tracing from cylinder / wall supply to tracheal tube.
2. Confirm correct tube placement with $EtCO_2$ and auscultation of the chest
3. Confirm adequate cardiac output – NIBP, pulse, $EtCO_2$
4. Exclude/ treat pathology:
   i. Pneumothorax +/- tension (Often predictable, peak pressures / minute ventilation on ventilator may suggest a problem)
   ii. Anaphylaxis
   iii. Bronchospasm of other cause e.g. asthma
   iv. Malignant hyperpyrexia

Hypotension:

Exclude the following causes of hypotension post induction:

1. Drug induced vasodilation.
2. Tension Pneumothorax.
   i. Treatment involves finger thoracostomy anterior to the mid axillary line in the fourth intercostal space on the affected side.
   ii. If suspected and unilateral decompression does not relieve the problem repeat on the opposite side of the chest.
   iii. If performed in a sterile manner with skin prep the thoracostomy may be converted to a formal chest drain.
   iv. Ultrasound Scanning can assist in differential if unclear.
3. 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.
4. Myocardial impairment - direct injury, hypovolaemia, pericardial effusion.

PAEDIATRICS

Whilst NBT is designated an Adult MTC, as an Emergency Department they still receive a large proportion of “Walk in” patients who are under the age of 16 and have sustained trauma. On very rare occasions these patients may deteriorate and require anaesthetic input. The principles of practice remain the same. The paediatric specific airway trolley is kept in Resus Bay 4.

Paediatric airway trolley -
Resus Bay 4

WATCh
The Wales and West Acute Transport for Children WATCh offer a 24-hour referral and trauma helpline: 0300 0300 789

This helpline is staffed by paediatric specialists who will be able to assist by phone if required, and will facilitate the transfer of a child to Bristol Royal Hospital for Children, (Paediatric MTC)
They can also be contacted via their website
https://www.watch.nhs.uk/referrals/

In addition, they have an extremely helpful drugs calculator which can be downloaded from the website or by scanning the QR code below.

SCAN ME

RSI CHECKLIST

- Allows a defined period of pre-oxygenation
- Check that all the necessary equipment is present and working
- Ensure the position of the patient is ideal for intubating
- Reduce the chance of failed intubation

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 with respiration throughout the conduct of the checklist. In extreme cases the rapid checklist may be used.

Emergency induction checklist

Prepare Patient

- ❑ Is preoxygenation optimal?
- ❑ Is the patient's position optimal?
- ❑ Can the patient's condition be optimised any further before intubation?
- ❑ How will anaesthesia be maintained after induction?

Prepare Equipment

❑What monitoring is applied?

- ❑ECG
- ❑Blood pressure
- ❑Sats probe
- ❑Capnography

❑What equipment is checked and available?

- ❑Self-inflating bag
- ❑Suction
- ❑2 ET tubes
- ❑2 laryngoscopes
- ❑Bougie

❑ Do you have all the drugs required, including vasopressors?

Prepare Team

❑ Who is ..?

- ❑Team leader
- ❑First Intubator
- ❑Second Intubator
- ❑Cricoid Pressure
- ❑Intubator's Assistant
- ❑Drugs
- ❑MILS (if indicated)

❑ How do we contact further help if required?

Prepare for difficulty

- ❑ If the airway is difficult, could we wake the patient up?
- ❑ If the intubation is difficult, how will you maintain oxygenation? (Plans A,B,C D)
- ❑ Where is the relevant equipment, including alternative airway?
- ❑ Are any specific complications anticipated?

Role Allocation	Intubator (1&2), assistant
	?Cricoid
	MILS
Oxygenation & Assessment	Pre-oxygenate 3 minutes
	Best GCS, limb movements and pupils
Equipment	
	SAD
	Surgical airway
	Ventilator ready
Drill	Verbalise intubation plan A, B, C
Monitoring	ECG
	NIBP 1-2 minute cycle
	SpO_2
Vascular Access	
Drugs	
	Maintenance
	Resus
Patient position	Head-up tilt
	Optimal airway positioning
	Trolley height

2. POST RSI CHECKLIST	
A & B	$ETCO_2$
	Oxygenated
	Adequate ventilation
	ETT length & secured
C	Post induction BP
	Vasopressor or fluids required
	Vascular access adequate
D	Maintain anaesthesia
E	Temperature management plan

3. TRANSFER CHECKLIST	
A	Tube secure, BVM & mask, laryngoscope, suction
B	Sufficient O_2
	Optimal ventilation
	Thoracostomy or other interventional procedure
C	Lines patent and accessible
	Resus drugs and vasopressor support
D	Maintain anaesthesia
Alert	ICU pod or theatre. Scanned paperwork. Transfer bag

NOTE: In extreme cases, only the boxes highlighted need to be used

RESUS 1 LAYOUT. NOTE LOCATION OF THE AIRWAY TROLLEY

NBT EMERGENCY DEPARTMENT RSI DRUG ROLL

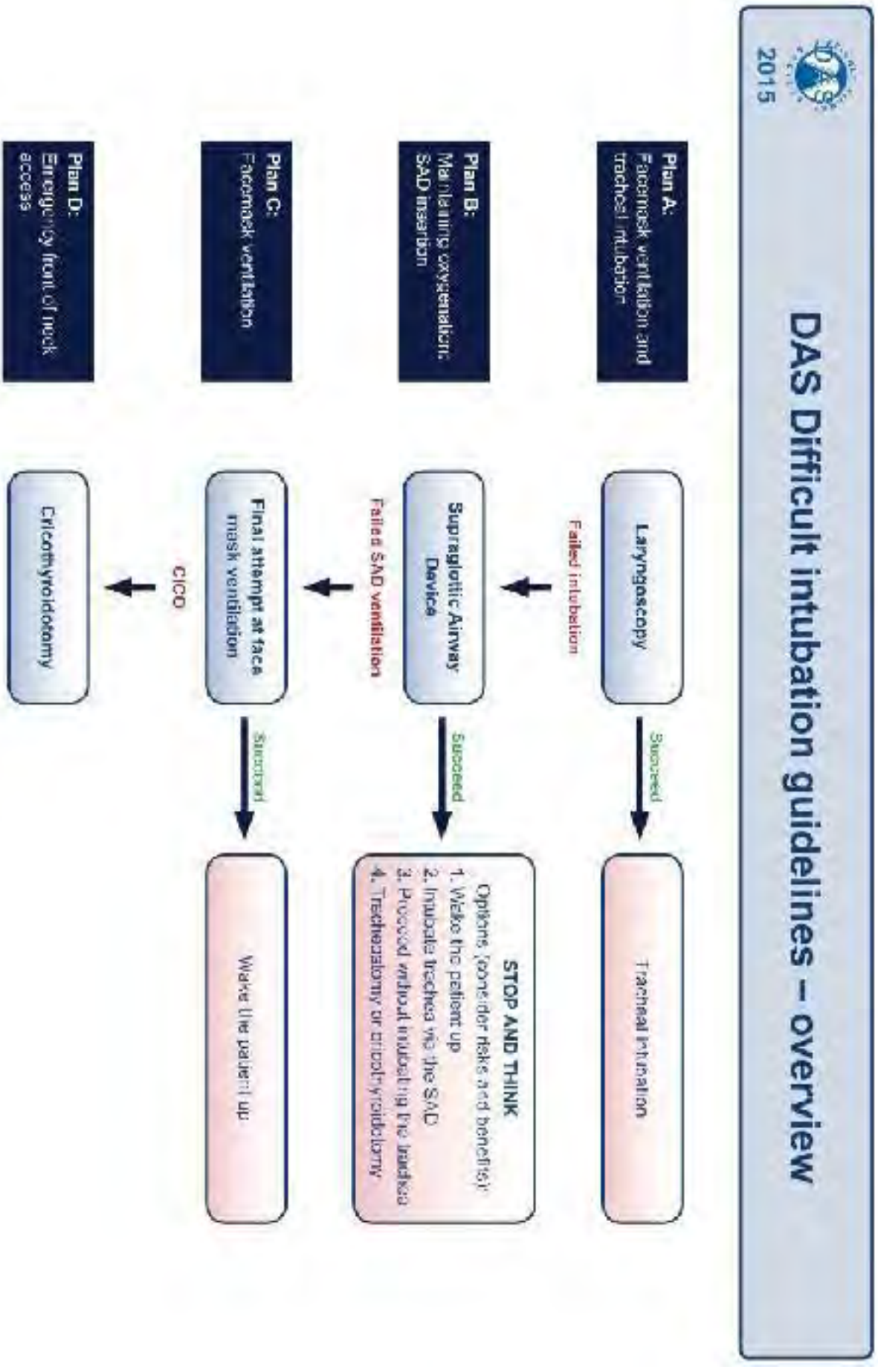
The Emergency Department stock drugs for emergency anaesthesia in a “drug roll”. The contents are listed and displayed below. The airway nurse will collect a drug roll and any other drugs specified from the drug cupboard(s) in Resus.

Propofol 50ml PFS

2 x Suxamethonium 50mg/ml, [2ml]
2 x Morphine 10mg/ml, [1ml]
2 x Rocuronium 10mg/ml, [5ml]
1 x Ketamine 50mg/ml, [10ml]
1 x Lorazepam 4mg/ml, [1ml]
1 x Midazolam 1mg/ml, [5ml]

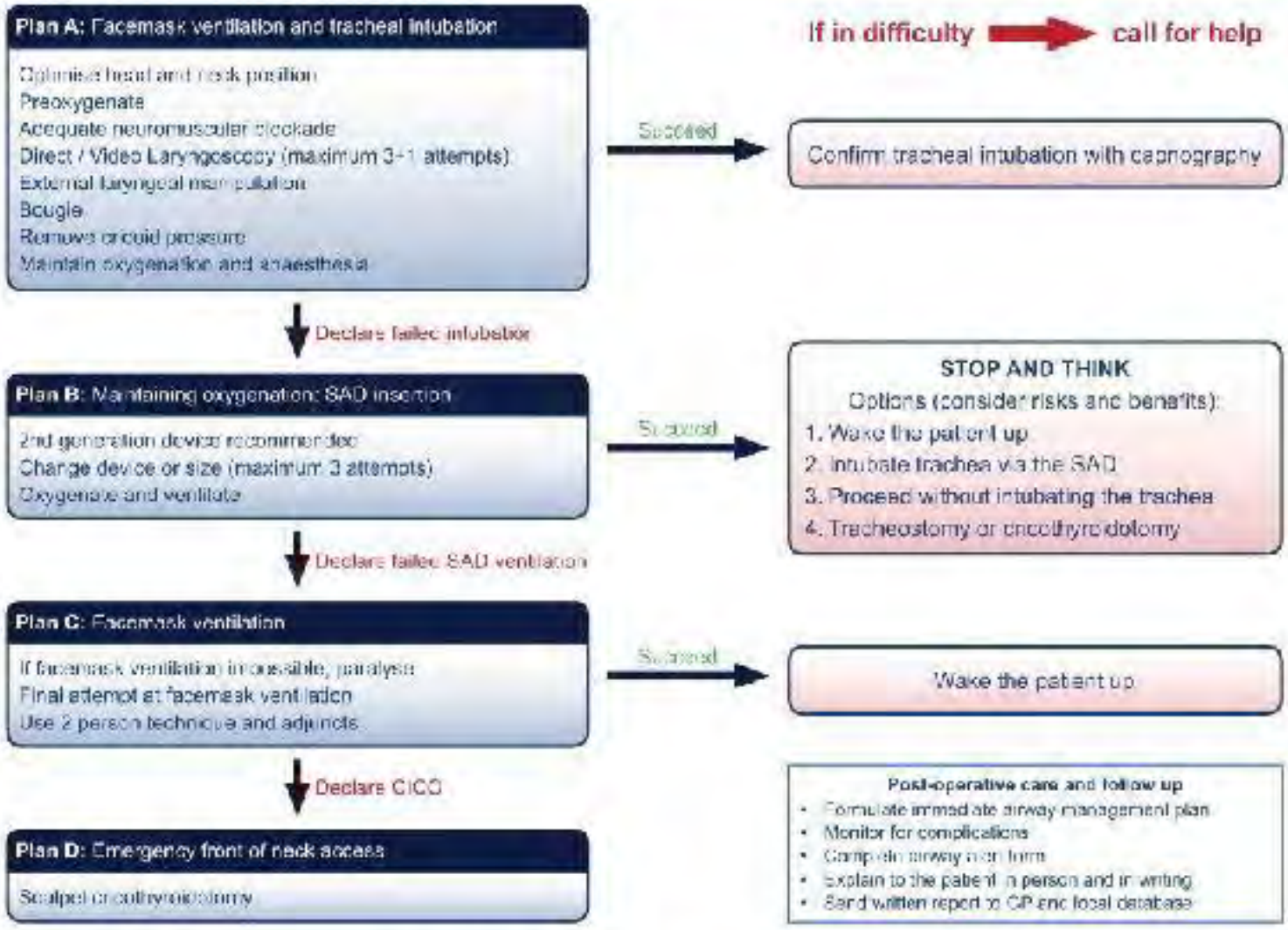
1 x Propofol 10mg/ml, [20ml]
2 x Tranexamic acid 100mg/ml, [5ml]
1 x Fentanyl 50mcg/ml, [10ml]

DIFFICULT AIRWAY



Management of unanticipated difficult tracheal intubation in adults

2015



This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.

EMERGENCY SURGICAL AIRWAY

KEY POINTS

- 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.

- 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.

- 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.

- The DAS unanticipated difficult intubation algorithm should be followed in all cases.

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:

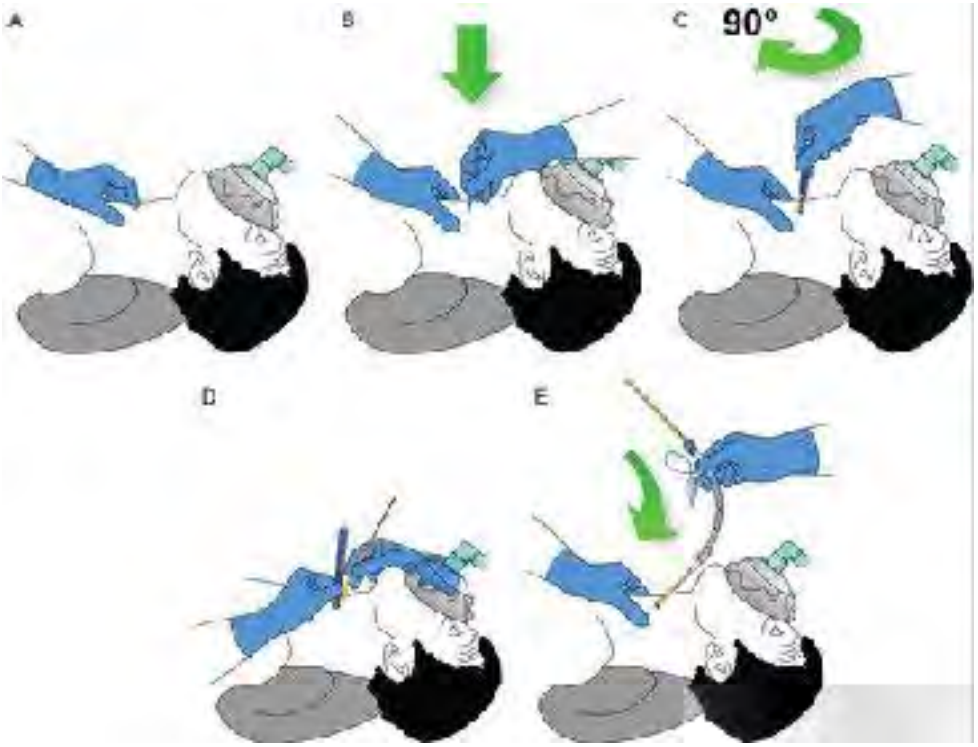
- Airway trauma
- Difficult anatomy
- Burns to face and neck precluding jaw movement
- Possible airway burns
- Severe maxillo-facial trauma

Equipment

- Scalpel (number 10 blade)
- Bougie
- Tube (cuffed 6.0mm ID)

Method

- Extend the patients neck as much as feasible. In this setting airway management should take precedence over the risk of cervical spine instability.
- Laryngeal handshake to identify cricothyroid membrane
- Palpable cricothyroid membrane:
  - Transverse stab incision through cricothyroid membrane
  - Turn blade through 90˚ (sharp edge caudally)
  - Slide coude dip of bougie along blade 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



Cricothyroidotomy technique. Cricothyroid membrane palpable: scalpel technique; 'stab, twist, bougie, tube'. **(A)** Identify cricothyroid membrane. **(B)** Make transverse stab incision through cricothyroid membrane. **(C)** Rotate scalpel so that sharp edge points caudally. **(D)** Pulling scalpel towards you to open up the incision, slide coude >p of bougie down scalpel blade into trachea. **(E)** Railroad tube into trachea.

Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults
C. Frerk, V. S. Mitchell, A. F. McNarry, C. Mendonca, R. Bhagrath, A. Patel, E. P. O'Sullivan, N. M. Woodall and I. Ahmad, Difficult Airway Society intubation guidelines working group
British Journal of Anaesthesia, 115 (6): 827–848 (2015) doi:10.1093/bja/aev371

Failed intubation, failed oxygenation in the paralysed, anaesthetised patient

2015

CALL FOR HELP

↓ Continue 100% O_2
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 the unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text

ORAL AND MAXILLOFACIAL INJURIES

KEY POINTS

- Initial assessment of maxillofacial injury should be done by Emergency Department staff
  - Emergency evaluation of a maxillofacial injury patient should always begin with ABCs
  - The primary survey is the first priority in trauma management
- There must be an assessment for cervical spine injury
  - The must be clearly documented in the medical notes and discharge summary
  - Maxillofacial injuries are commonly associated with cervical spine and intracranial injuries; there must be an assessment for both cervical spine injury and head injury (documented and handed over to the on call Maxfacs team)
- Clinical signs and symptoms of maxillofacial injuries
  - Pearls for identifying injuries requiring urgent intervention (e.g. retrobulbar haemorrhage, orbital muscle entrapment)
- Specific imaging is required for maxillofacial injuries
  - Imaging requirements are described in guidelines below
- The on-call maxillofacial surgery team, based at the Bristol Royal Infirmary, are available 24/7 through switchboard
  - Full contact information is outlined opposite

MAXILLOFACIAL SURGERY TEAM CONTACT INFORMATION

On-call Maxillofacial Surgical team available 24/7

Based at the Bristol Royal Infirmary (BRI), but can assess patients at NBT

Please allow travel time as team cross-covers BRI, Bristol Royal Hospital for Children and Royal United Hospitals Bath.

On-call Maxillofacial Surgical team:

1st on-call: Maxfacs SHO

- First point of contact
- Dentally qualified
- On-site (BRI) and available 24/7 on bleep 6099

2nd on-call: Maxfacs SpR

- Dually qualified medicine and dentistry
- Available via switchboard

3rd on-call: Maxfacs Consultant

- Available via switchboard

Contact through switchboard

- Rota is with switchboard of NBT, University Hospitals Bristol and Weston, and RUH.
- If no reply from 1st on call then move up to 2nd on call then 3rd (consultant) as team may be between hospitals or operating.
- Registrar and Consultant on call 1700 – 0900h. Before then 1st on call will discuss with available Maxfacs registrar/ consultant at closest relevant hospital.

Maxillofacial Surgery Trauma Multidisciplinary Team Clinic

- Discussion held Wednesdays at 1330h with subsequent patient clinic
- Dedicated weekly Trauma SHO contacts NBT Wednesday morning for inpatient updates

Note: All referrals to this clinic go through the Maxfacs SHO

MAXILLOFACIAL TRAUMA

Physical trauma to the head and neck

Broad scope of injuries varying from simple to complex

ATLS:

- The Primary Survey is the first priority in trauma management
- Maxillofacial injuries may require immediate airway intervention

Unique challenges

- Concomitant cranial and cervical injuries
  - Up to 8% associated with c-spine injuries[1]
- Upper airway involvement
- Highly vascularised region

Primary Survey

- Airway with c-spine stabilisation
  - Cervical spine must be stabilised and protected until further assessment for c-spine injury is undertaken
- Blood, vomitus, tooth fragments and foreign bodies may obstruct the airway and clearance of the upper aerodigestive tract of all debris is a priority
- Tongue displacement secondary to comminuted anterior mandible fractures may also compromise the airway
- Bleeding may be profuse from scalp lacerations and mid-face fractures

Secondary Survey

- Craniomaxillofacial examination should be carried out after initial stabilisation of the patient
- Includes visual acuity testing (even with marked periorbital oedema)

CATEGORIES OF FACIAL INJURIES

Based on urgency to treat

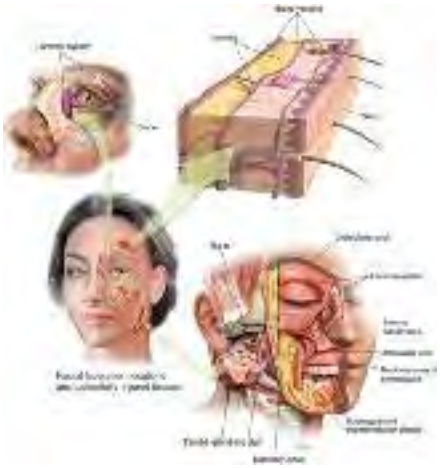
- Severe Facial Injuries e.g. severe haemorrhage, craniofacial injuries, ophthalmologic emergencies
  - Require immediate and resuscitative treatment
- Urgent Facial Injuries e.g. soft tissue injuries, contaminated wounds
  - Can often wait a few hours for completion of initial trauma management
- Non-Urgent Facial Injuries - *most facial fractures*
  - May be addressed safely in a delayed manner
    - 'Open' fractures (e.g. mandible #) ideally treated within 24 hrs - 5 days
    - 'Closed' fractures ideally treated within 3 weeks

Maxillofacial Trauma: Scope

- Soft tissue injuries
  - Lacerations
  - Dog bites
- Bony injuries
  - Fractures of the craniofacial skeleton
- Unique Considerations
  - Airway
  - Penetrating neck wounds
  - Eye injuries (globe, lid, nasolacrimal apparatus – joint ophthalmology care)

Soft Tissue Injuries - Lacerations

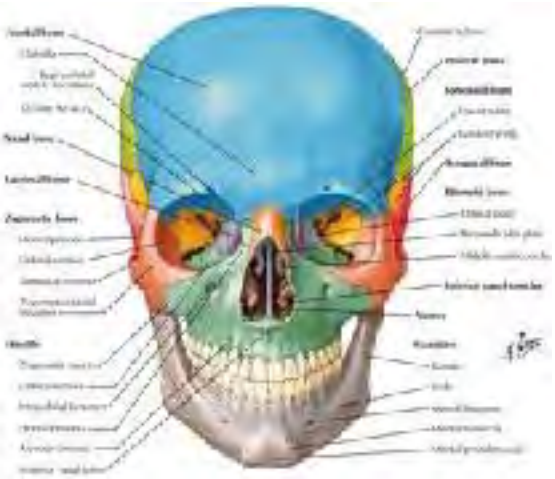
- Simple
- Complex
- Important anatomical structures
  - Wounds deep to skin may damage multiple structures in the face
  - Facial nerve
  - Parotid duct
  - Artery and veins of the head and neck



Treasure, Trevor., 'Facial Laceration Repair'. Kademani, D. and Tiwana, P., (2016) *Atlas of Oral and Maxillofacial Surgery*. Missouri: Elsevier 2016, page 628.

Bony Injuries - Fractures of the Craniofacial Skeleton

- Frontal Sinus
- Naso-orbito-ethmoid (NOE)
- Orbit
- Zygomaticomaxillary Complex (ZMC)
- Nasal
- Maxillary
- Mandibular
- Dentoalveolar
- Special note: concomitant cervical spine injuries



Netter, F. H. , Atlas of Human Anatomy, 4th Edition. Saunders Elsevier 2006

MAXILLOFACIAL TRAUMA ANTIBIOTIC SELECTION

Antibiotic Selection:

Co-amoxiclav 1.2g IV TDS

or

Clindamycin 600mg IV TDS (if penicillin allergic)

Indications: Open fracture, ?CSF leak

MAXILLOFACIAL TRAUMA SINUS PRECAUTIONS

Sinus Precautions:

No blowing nose

No straws

Sneeze with mouth open

Maintain precautions for two weeks

FRONTAL SINUS FRACTURES

Patient assessed by Trauma Team as per standard trauma primary survey principles

Mechanism of injury (MOI)

High velocity injuries (e.g. RTA)

- Co-morbid with neurologic, ophthalmologic, and extensive facial injuries
- Thorough neurologic and ophthalmologic examination needed

Blunt injury

- Isolated

Maintain high level of suspicion based on history and MOI

- May be clinically obvious, but may also have no clinical signs

Clinical features:

Soft tissue oedema over frontal region

Periorbital oedema and ecchymosis

- Should not preclude thorough ophthalmologic exam

Lacerations to frontal or glabellar region

Depression in frontal region

CSF rhinorrhea, epistaxis

Imaging:

Often MOI warrants imaging of face, as well as head and cervical spine

CT scan: brain and bony window assessment of the cranium, orbits in axial, coronal and sagittal planes

- Assessment of the anterior and posterior tables

Multidisciplinary Team Care:

Consultation with maxillofacial Surgery - referral via Maxfacs SHO

- Senior review at NBT or outpatient follow up as appropriate

Discuss with neurosurgical team at NBT as required

- Often joint surgical cases

Consultation with ophthalmology often required

Treatment:

Urgent Category

- Overlying lacerations should be repaired promptly

Non-urgent Category

- Fracture management often safe to address in delayed manner

Advise patient on sinus precautions; antibiotics may be indicated

NASO ORBITO ETHMOID FRACTURES

Patient assessed by Trauma Team as per standard trauma primary survey principles

Mechanism of injury (MOI):

High velocity injuries (e.g. RTA)

- Co-morbid with neurologic, ophthalmologic, and extensive facial injuries
- Thorough neurologic and ophthalmologic examination required

Clinical features:

Periorbital oedema and ecchymosis

Traumatic telecanthus

- Medial intercanthal distance >1/2 intrapupillary distance

Saddle nose deformity

CSF rhinorrhea

Imaging:

Often MOI warrants imaging of head, face and cervical spine

CT scan: brain and bony window assessment of the cranium, facial bones in axial, coronal and sagittal planes

- Fine cut CT from inferior border of mandible to vertex

Multidisciplinary Team Care:

Consultation with maxillofacial Surgery - referral via Maxfacs SHO

- Senior review at NBT or outpatient follow up as appropriate

Discuss with neurosurgical team at NBT as required

Consultation with ophthalmology often required

Treatment:

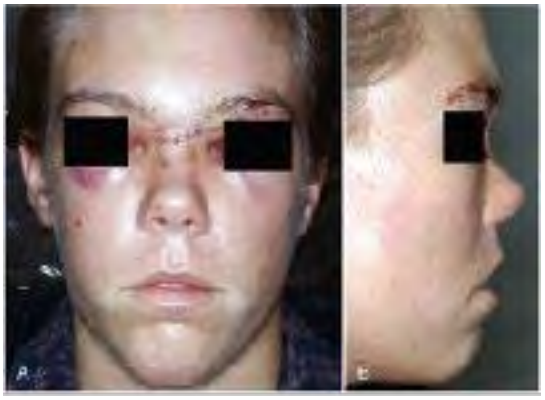
Urgent Category

- Overlying lacerations should be repaired promptly

Non-urgent Category

- Fracture management often safe to address in delayed manner

Advise patient on sinus precautions; antibiotics may be indicated



Engelstad, M., 'Naso-orbito-ethmoid Fractures'. Bagheri, S.C., Bell, R.B., and Ali Khan, H., (2012) *Current Therapies in Oral and Maxillofacial Surgery*. Saunders 2012, page 340

ORBIT FRACTURES

Patient assessed by Trauma Team as per standard trauma primary survey principles

Mechanism of injury (MOI):
Blunt trauma
High velocity injuries (e.g. RTA)

- Often in combination with other facial fractures
- Thorough neurologic and ophthalmologic examination required

Classification of orbital fractures:
Isolated orbital fracture

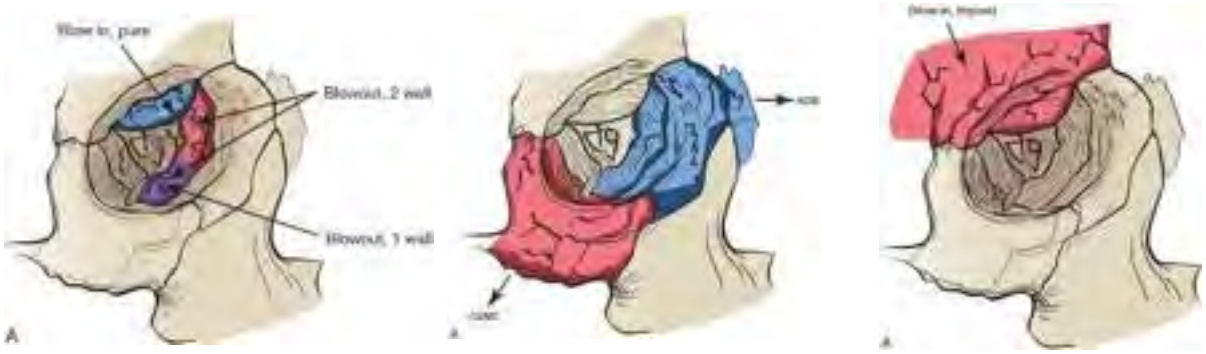
- Orbital floor ('blow out')
  - Anterior medial orbital floor most common location
  - Medial orbital wall (# of lamina papyracea)
- Orbital roof ('blow in')

As part of other facial fracture patterns

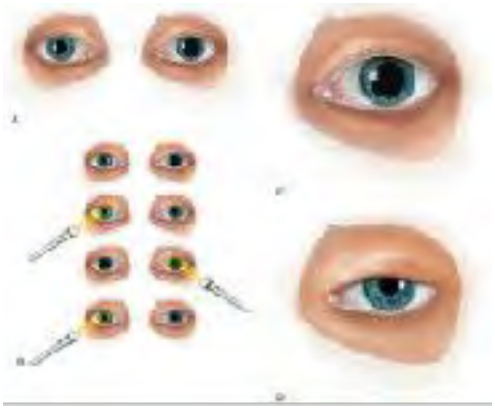
- E.g. NOE #, ZMC #, LeFort pattern #s, frontal sinus #

Globe injuries in 30% of cases[8]

- Corneal abrasion, globe rupture, hyphema



Clinical findings:
Subconjunctival haemorrhage
Periorbital ecchymosis
Diplopia
Limited ocular movements
Palpable bony steps
Pupillary abnormalities (e.g. anisocoria, relative afferent pupillary defect)
Increased intraocular pressure (IOP)
Retrobulbar haemorrhage
Intractable nausea/vomiting (*paeds)



A: Anisocoria, B: RAPD, C: Fixed dilated pupil, D: Ptosis, E: Conjunctival injection, F: Subconjunctival haemorrhage, G: Hyphema, H: Restriction in the upward gaze of the left eye caused by muscle entrapment will result in binocular diplopia

Cunningham, L.L. and Khader, R. 'Early Assessment and Treatment Planning of the Maxillofacial Trauma Patient'. Fonseca, R.J., *et al*. (2013) *Oral and Maxillofacial Trauma*, 4th Edition. Missouri: Saunders 2013, Pages 224-225

Imaging:

Often MOI warrants imaging of face, as well as head and cervical spine

CT scan: brain and bony window assessment of the cranium, facial bones in axial, coronal and sagittal planes

- Fine cut CT

Multidisciplinary Team Care:

Consultation with Ophthalmology required

Consultation with Maxillofacial Surgery - referral via Maxfacs SHO

- Senior review at NBT or outpatient follow up as appropriate

Treatment

Severe/Emergent Category

- Ophthalmologic injuries
  - Extraocular muscle entrapment
    - Requires emergent surgical intervention to release entrapped contents; 'function-saving' surgery
  - Retrobulbar haematoma (see page 114 for management)

Urgent Category

- Overlying lacerations should be repaired promptly

Non-urgent Category

- Fracture management often safe to address in delayed manner

Advise patient on sinus precautions; antibiotics usually not required

See page 126 for treatment flowchart

EMERGENCY MANAGEMENT OF RETROBULBAR HAEMATOMA: LATERAL CANTHOTOMY AND INFERIOR CANTHOLYSIS

Indications:

Tense proptosed globe +/- acute visual changes
Decreased extra-ocular movements
Severe pain
Elevated IOP (>22mmHg)
Do not delay for imaging - sight preserving procedure

Technique:

Inject local anaesthetic into lateral canthus with needle directed laterally down to bone

- Lidocaine 1 or 2% (with adrenaline)

Straight haemostat inserted at the lateral aspect of the palpebral fissure to compress soft tissue

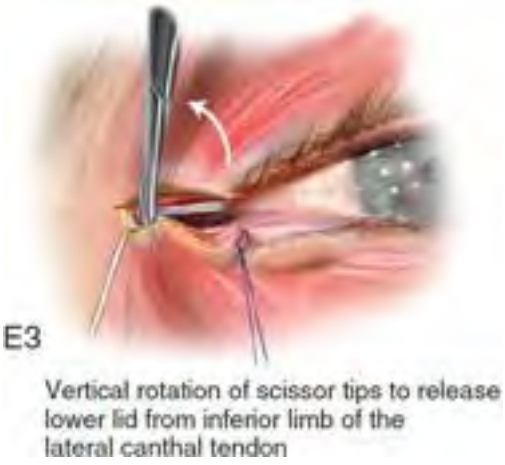
- Insert to the depth of the bony orbital wall
- Leave 60-90 seconds to help with haemostasis and demarcation

Tenotomy scissors used to make a 1 – 2 cm incision extending laterally outward and in an inferior direction

- Tips of scissors should be inside the lid, touching the orbital rim

Inferior lid then retracted downwards and anterior-inferior limb of the lateral canthus is released with scissors

- Direct tips along lateral orbital wall, away from globe



Cunningham Jr., L. and Khader, R., 'Zygoma Fractures'. Kademani, D. and Tiwana, P., (2016) *Atlas of Oral and Maxillofacial Surgery*. Missouri: Elsevier 2016, page 767

ZYGOMATICOMAXILLARY COMPLEX AND ARCH FRACTURES

Patient assessed by Trauma Team as per standard trauma primary survey principles

Mechanism of injury:

- Second most common facial fracture (following nasal bone #s)
- Varies from low-energy (e.g. interpersonal violence) to high-energy (e.g. RTA)

ZMC "Tetrapod" Fracture: Four processes of the zygoma

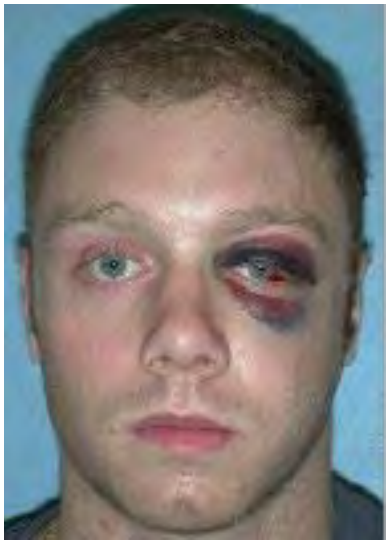
- Frontal, Temporal, Orbital, Maxillary

Zygomatic arch Fracture

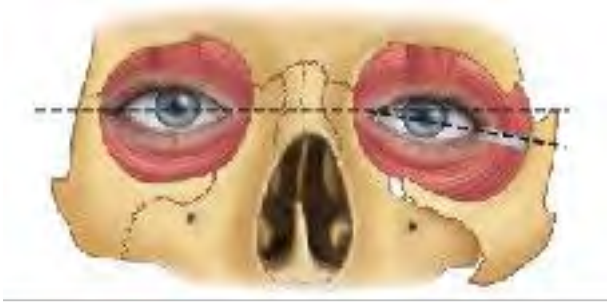
- Often isolated

Clinical features:

Periorbital ecchymosis and oedema
Subconjunctival ecchymosis
Palpable step in orbital rim (infraorbital and lateral rims)
Ocular signs (diplopia, vertical dystopia, pupillary changes, restriction of eye movements, displacement of palpebral fissure)
Enophthalmos
Flat malar prominence
Flattening over zygomatic arch
Epistaxis
Ecchymosis of the maxillary buccal sulcus
Trismus
Infraorbital paresthesia
Isolated zygomatic arch # unlikely to have ocular clinical signs



Miloro, M., *et al.*, *Peterson's* Principles of Oral and Maxillofacial Surgery, 3rd Edition. People's Medical Publishing House – USA 2012, page 2163.



Ellis III, Edward. 'Fractures of the Zygomatic Complex and Arch'. Fonseca, R.J., *et al.* (2013) *Oral and Maxillofacial Trauma*, 4th Edition. Missouri: Saunders 2013, Pages 360

Imaging:

Often MOI warrants imaging of face, as well as head and cervical spine

CT scan: brain and bony window assessment of the cranium, facial bones in axial, coronal and sagittal planes

- Fine cut CT

Isolated low-velocity injuries may only require plain film imaging

- Facial Bones (OM views, submental vertex)

Multidisciplinary Team Care

Consultation with Maxillofacial Surgery - referral via Maxfacs SHO

- Senior review at NBT or outpatient follow up as appropriate

Consultation with Ophthalmology as required

Treatment

Severe/Emergent Category

- Ophthalmologic injuries including retrobulbar haematoma
  - See orbital trauma section for management

Urgent Category

- Overlying lacerations should be repaired promptly

Non-urgent Category

- Fracture management often safe to address in delayed manner
- Advise patient on sinus precautions; antibiotics usually not required

See page 127 for treatment flowchart

MAXILLARY FRACTURES

Patient assessed by Trauma Team as per standard trauma primary survey principles

Mechanism of injury:

High velocity injuries (e.g. RTA) common

- Co-morbid with neurologic, ophthalmologic, and extensive facial injuries
- Thorough neurologic and ophthalmologic examination required

Frequently associated with other facial fractures

Le Fort Classification System

Le Fort I – maxillary fracture

Le Fort II – midface disjunction

Le Fort III – complete facial disjunction

Fractures patterns may overlap

Morris, C.D. and Tiwana, P.S., 'Diagnosis and Treatment of Midface Fractures'. Fonseca, R.J., *et al.* (2013) *Oral and Maxillofacial Trauma*, 4th Edition. Missouri: Saunders 2013, Page 417.

Clinical Findings:

Elongated face

Bilateral peri-orbital swelling and ecchymosis

Traumatic telecanthus (see NOE section)

- Medial intercanthal distance >1/2 intrapupillary distance

Infraorbital paraesthesia

Saddle nose deformity

CSF rhinorrhea

Mobile maxilla

Palatal haematoma

Malocclusion: anterior open bite

Imaging:

Often MOI warrants imaging of face, as well as head and cervical spine

CT scan: brain and bony window assessment of the cranium, facial bones in axial, coronal and sagittal planes

- Fine cut CT from inferior border of mandible to vertex

Multidisciplinary Team Care:

Consultation with Maxillofacial Surgery - Maxfacs SHO will take details

- Senior review at NBT or outpatient follow up as appropriate

Discuss with Neurosurgical team at NBT as required

Consultation with Ophthalmology as required

Treatment

Severe/Emergent Category

- Haemorrhage from midface vessels
- Ophthalmologic injuries
  - Retrobulbar haematoma (see orbital section)

Urgent Category

- Overlying lacerations should be repaired promptly

Non-urgent Category

- Fracture management often safe to address in delayed manner

Advise patient on sinus precautions; antibiotics may be indicated

MANDIBULAR FRACTURES

Patient assessed by Trauma Team as per standard trauma primary survey principles

Mechanism of injury (MOI):

Athletic injuries, interpersonal violence, falls and RTA

Blast injuries (e.g. gunshot wounds)

Pathologic fractures (bony metastatic disease, benign bone pathology)

- *Does not require a history of trauma*

Classification of Mandibular Fractures

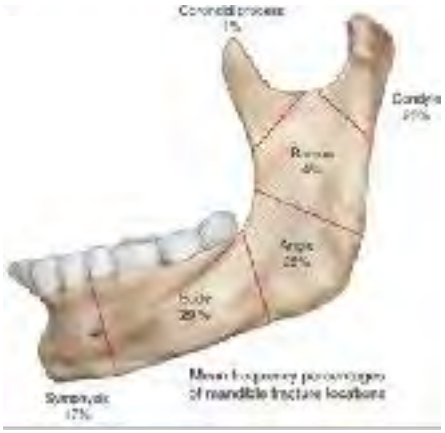
Simple/closed

Compound/open

- Fractures through tooth-bearing segments considered open

Other types: comminuted, greenstick, pathologic, atrophic

Anatomic location:



Stevens, M.R. and Emam, H.A., 'Mandibular Body Fractures'. Kademani, D. and Tiwana, P., (2016) *Atlas of Oral and Maxillofacial Surgery*. Missouri: Elsevier 2016, page 690.

Clinical features:

Pain

Swelling

Numb lip/chin

Trismus

Malocclusion – objective or subjective

Sublingual haematoma

Gingival tear

N.B. Maintain high level of clinical suspicion

- Mandible often fractures in two places

Imaging:

Often MOI warrants imaging of face, as well as head and cervical spine

Gold standard: Orthopantogram (OPG) and PA Mandible films

- Lateral mandibular series not of use
- OPG only presently available at BRI

CT Mandible may be required

- Discuss with Maxfacs team first
- May be most suitable for Maxfacs to arrange at BRI

Multidisciplinary Team Care:

Consultation with Maxillofacial Surgery - Maxfacs SHO will take details

- Likely for immediate transfer to BRI for assessment, admission, IV antibiotics and plan for surgery

If concomitant head/facial injuries:

- Discuss with Neurosurgical team at NBT as required
- Discuss with ENT/Ophthalmology teams as required
- Senior review/theatre at NBT as appropriate

Treatment:

Severe/Emergent Category

- Airway threatening injury

Urgent Category

- Overlying lacerations should be repaired promptly

Non-urgent Category

- Fracture management often safe to address in delayed manner
- Ideal treatment within 24hrs – 5 days

See page 125 for treatment flowchart

Patient likely to be transferred immediately to BRI for management

- Maxfacs to assess, admit, administer antibiotics, plan for surgery
- NOTE: some patients may be suitable for *'Day Case Fractured Mandible Surgery Pathway'* recently developed at BRI.

NASAL FRACTURES

Note: Isolated nasal bone fractures require ENT referral

Patient assessed by Trauma Team as per standard trauma primary survey principles

Most common facial fracture

Mechanism of injury:
Athletic injuries, interpersonal violence, falls and RTA

Clinical features:
Nasal deviation
Epistaxis
Pain and crepitus on palpation
Septal haematoma

Imaging:
Imaging may not be required
CT scan: bony windows (no contrast required)

Multidisciplinary Team Care
Consultation with ENT
Consultation with Maxillofacial Surgery if multiple facial fractures - referral via Maxfacs SHO

Treatment:
Urgent category

- Epistaxis
  - May require packing in ED (see Figure below)
- Septal haematoma
  - Inspection with nasal speculum
  - Requires evacuation and subsequent packing
  - Late recognition may result in severe deformities

Non-urgent Category

- Fracture management often safe to address in delayed manner

Advise patient on nose-blowing precautions; antibiotics usually not required

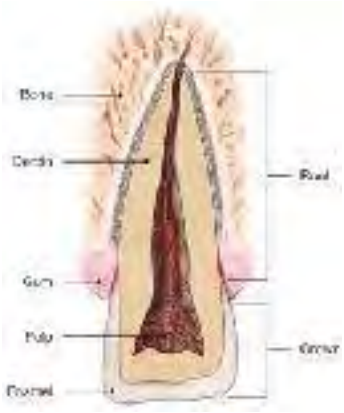
DENTOALVEOLAR TRAUMA

Injury to the teeth, gums and supporting bone

Patient assessed by Trauma Team as per standard trauma primary survey principles

Mechanism of injury:
Falls, playground accidents, interpersonal violence, sports injuries, RTAs
- N.B consideration of abuse and domestic violence

Anatomy



Classification:
Hard dental tissue – crown and root
Fracture or 'chip' to the hard white covering of the tooth is an enamel fracture
Where the yellow dentine is exposed this is an enamel-dentine fracture
If the pulp or 'nerve' of the tooth is exposed (seen as a pink spot or bleeding from the centre of the tooth) then this a crown fracture with pulp exposure

Enamel fracture

Enamel and dentine fracture

Enamel and dentine fracture with pulp exposure

Exposed dentine and pulp tissue can be very sensitive. Analgesia is only mildly effective so timely dental treatment is recommended

Injuries to periodontal tissue and supporting alveolar bone:

Concussion: tooth position is unchanged but is tender due to trauma of the periodontal ligament

Subluxation: the tooth is slightly mobile and tender, however the position is unchanged and the occlusion is normal.

Intrusion: tooth is impacted into the tissues resulting in a reduction in crown height (often mistaken for crown fracture)

Extrusion: the tooth appears elongated and is often mobile

Luxation: the tooth is displaced, commonly towards the oral cavity or towards the lips. Mobility can vary.

Avulsion: the tooth has been completely dislodged from the socket

Intrusion Extrusion Luxation Avulsion

Clinical Features:

Pain

Swelling

Bleeding / gingival tears

Displaced or missing teeth

Fractured teeth

Malocclusion

Associated soft tissue injuries or laceration

Imaging:

MOI may warrant imaging of head, face and cervical spine.

Plain films

- OPG is gold standard but clarity of central teeth is compromised by overlying cervical spine
- Peri-apical films – undertaken by dentists or at the dental hospital,
- Soft tissue views – if tooth or tooth fragments are suspected to be buried within soft tissues then lateral facial views are helpful to visualise foreign bodies.

CXR – if a tooth is unaccounted for then a CXR is required to rule out aspiration. If CT chest is done as part of trauma series then be sure to add details of missing tooth on request form.

CT facial bones – request if there is suspicion of Le Fort pattern injuries or complex alveolar bone injuries

Multi-disciplinary care:

Direct to appropriate dental service.

Consult with Maxfacs if tooth/teeth displaced or avulsed.

Involve other teams as required for concomitant injuries

Treatment:

Urgent Category

- Avulsed teeth
  - Ensure that missing tooth is a permanent tooth; avulsed primary (deciduous) teeth do not need to be replanted
  - Handle the tooth by the crown, avoid touching the root
  - If it is visibly dirty then wash in normal saline; the tooth can also be stored in normal saline, or in a pot with the patient's own saliva
  - The survival of the tooth is time dependant so replantation of the tooth as soon as possible is vital
  - Ensuring the tooth is the correct way round, replant the tooth into the empty socket and ask the patient o gently bite down on gauze or a handkerchief to hold in position
  - Seek emergency dental treatment for splinting of the teeth

Non-urgent Category

- Displaced teeth, particularly those that are mobile or causing a traumatic occlusion need to be splinted or extracted - consult with Maxfacs SHO
- Isolated injuries of the crown or root require dental assessment. This can be done by the patient's own dentist, via NHS 111 or by self-referral to The University of Bristol Dental Hospital on telephone 0117 342 9525
  - These injuries do not routinely need assessment by the Maxfacs team but if in doubt seek telephone advice via the oncall Maxfacs SHO

COMMON FRACTURE PATHWAYS

FRACTURED MANDIBLE

MOI: RTAs, sports injuries, interpersonal violence, blast injuries

↓ Clinical examination

Pain
Swelling
Numb lip / chin
Trismus
Malocclusion - objective or subjective
Sublingual haematoma
Gingival tear

↓ Investigations

Plain films: OPG, PA mandible
CT mandible not routinely requested unless part of trauma series
Consider c-spine imaging

↓ No fracture

Soft diet for 7 days
Simple analgesia
No Maxfacs follow-up required

↓ Fracture confirmed

Give antibiotics (not required for isolated condyle fractures)
Refer to Maxfacs SHO on 6099
Patient may be suitable for day case mandible pathway

FRACTURED ORBIT

MOI: RTAs, sports injuries, interpersonal violence

↓ Clinical examination

Subconjunctival haemorrhage
Periorbital ecchymosis
Diplopia
Limited ocular movements
Palpable bony steps
Pupillary abnormalities
Increased intraocular pressure (IOP)
Retrobulbar haemorrhage (see page 114 for emergency management)
Intractable nausea/vomiting - *common in paediatric patients with entrapment, ocular muscle entrapment in children is a surgical emergency*

↓ Investigations

CT facial bones gold standard

↓ No fracture

Refer to ophthalmology if decreased visual acuity - traumatic optic nerve injury
No maxfacs follow up required

↓ Fracture confirmed

Refer to maxfacs SHO on 6099
Refer to ophthalmology if decreased visual acuity - traumatic optic nerve injury
Sinus precautions advice

FRACTURED ZYGOMA

MOI: RTAs, sports injuries, interpersonal violence, blast injuries

↓ Clinical examination

Periorbital ecchymosis and oedema
Subconjunctival ecchymosis
Palpable bony steps
Ocular signs (diplopia, pupillary changes, restriction of eye movements, enopthalmos and hypoglobus)
Flattened malar prominence
Flattened or dented zygomatic arch
Epistaxis
Ecchymosis of the maxillary buccal sulcus
Trismus
Infraorbital paraesthesia

↓ Investigations

Facial (OM views) + submental vertex view: for low energy injuries or isolated arch fracture
CT facial bones: gold standard to assess ZMC and orbital floor

↓ No fracture

Reassurance neuropraxia will improve
Simple analgesia
No maxfacs follow-up required

↓ Fracture confirmed

Refer to maxfacs SHO on 6099
Treat eye injuries as appropriate - refer to ophthalmology if needed
Sinus precautions advice

CHAPTER 5

THORACIC INJURIES

CHEST INJURIES IN MAJOR TRAUMA

Background:

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.

Major chest injuries and their prevalence:

Condition	Frequency
Tension Pneumothorax	1 in 250 (0.4%)
Open Pneumothorax	1 in 10,000 (0.01%)
Massive Haemothorax	1 in 1000 (0.1%)
Flail Chest (includes >3 rib fractures)	1 in 50 (2.2%)
Cardiac Tamponade	1 in 1250 (0.08%)

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 O_2 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)
- Ausculatation – asymmetry of air entry

Imaging

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)

CT is the gold standard investigation and should not be delayed if physiology is stable.

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)

PNEUMOTHORAX: SIMPLE

A non-expanding collection of free air in the pleural space leading to a degree of lung collapse.

CLINICAL FEATURES OF SIMPLE PNEUMOTHORAX

- Chest pain
- Decreased air entry on the affected side
- Hyper-resonance to percussion on the affected side
- Crepitus

MANAGEMENT OF SIMPLE PNEUMOTHORAX

Not all pneumothoraces require chest drain insertion. There are ongoing multi-centre trials looking at the need for intercostal drain insertion following traumatic pneumothorax.

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:

- Respiratory compromise is present
- 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 pneumothoraces must be vigilantly observed. Deterioration should prompt urgent treatment and exclusion of tension pneumothorax.

PNEUMOTHORAX: TENSION

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.

CLINICAL FEATURES OF TENSION PNEUMOTHORAX

Features are the same as for simple pneumothorax, as well as:

- Haemodynamic instability
- Tracheal deviation away from the affected side
- Mediastinal shift on chest x-ray
- Severe respiratory distress
- Increased central venous pressure

MANAGEMENT OF TENSION PNEUMOTHORAX

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 it is 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, if required, should be performed using a 14G cannula in the 2nd intercostal space in the mid-clavicular line on the affected side. If decompression unsuccessful then a second attempt may be made laterally in the 5th intercostal space, just anteriorly to mid-axillary line.

PNEUMOTHORAX: OPEN

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.

CLINICAL FEATURES OF OPEN PNEUMOTHORAX

- Large sucking / bubbling chest wound
- Clinical features of an underlying pneumothorax (as described above)

MANAGEMENT OF OPEN PNEUMOTHORAX

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

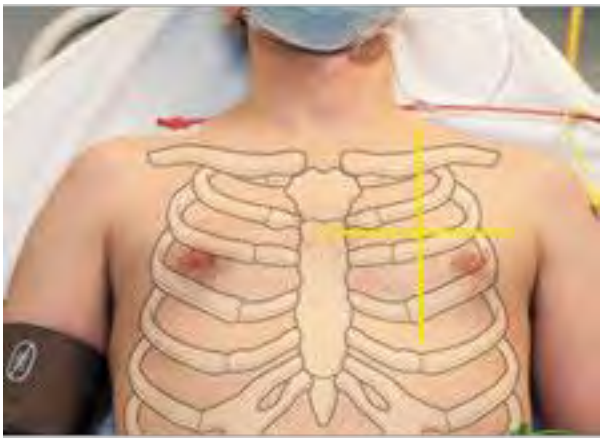
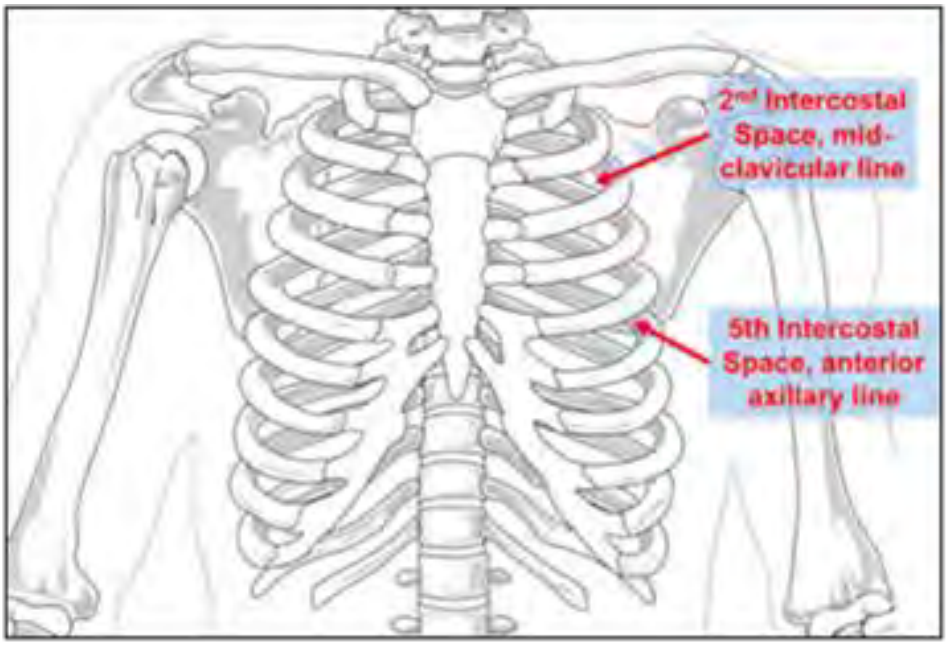


Image from: Needle Aspiration of Primary Spontaneous Pneumothorax.
Pasquier M, Hugli O, Carron P. N Engl J Med 2013; 368:e24

Needle decompression has a high failure rate (40-60%) due to many factors including cannula obstruction by blood, tissue, kinking and failure to reach pleural space. Hence, ***thoracostomy is the first line intervention for tension pneumothorax.***



Anatomical sites for chest decompression

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.

CLINICAL FEATURES OF MASSIVE HAEMOTHORAX

- Signs of significant chest trauma (bruising, lacerations, penetrating chest injury)
- Crepitus
- Dullness to percussion
- Reduced air entry
- Reduced chest expansion on the 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.

IMAGING

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.

MANAGEMENT OF MASSIVE HAEMOTHORAX

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.

MANAGEMENT OF FRACTURED RIBS AND FLAIL CHEST

Chest wall 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.

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.

This management will include the following components:

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

Assessment of Injury

The assessment of injury will be guided by the mechanism of injury; the patients 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 (splenic 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.

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 complications.

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.

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

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, monitoring and assistance.

The table on page 149 details the indications, sites of insertion, relative contraindications and local anaesthetic doses/volumes for each technique.

If two catheters are required ensure local anaesthetic dose limits are not exceeded.

Procedure Notes

1. All infusion catheters should be clearly labelled.
2. All procedures should be documented in the patient's notes.
3. All administered doses of local anaesthetic should be **prescribed and signed for on the drug chart.**

SERRATUS ANTERIOR PLANE (SAP) 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

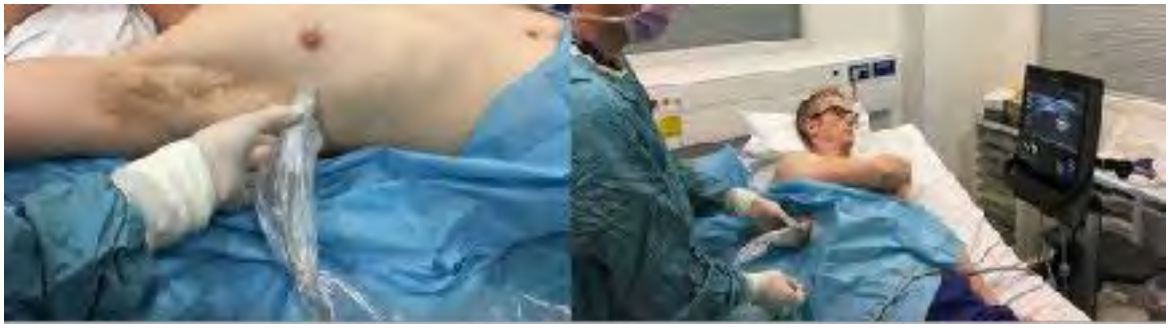
0.5% Chlorhexidine to skin

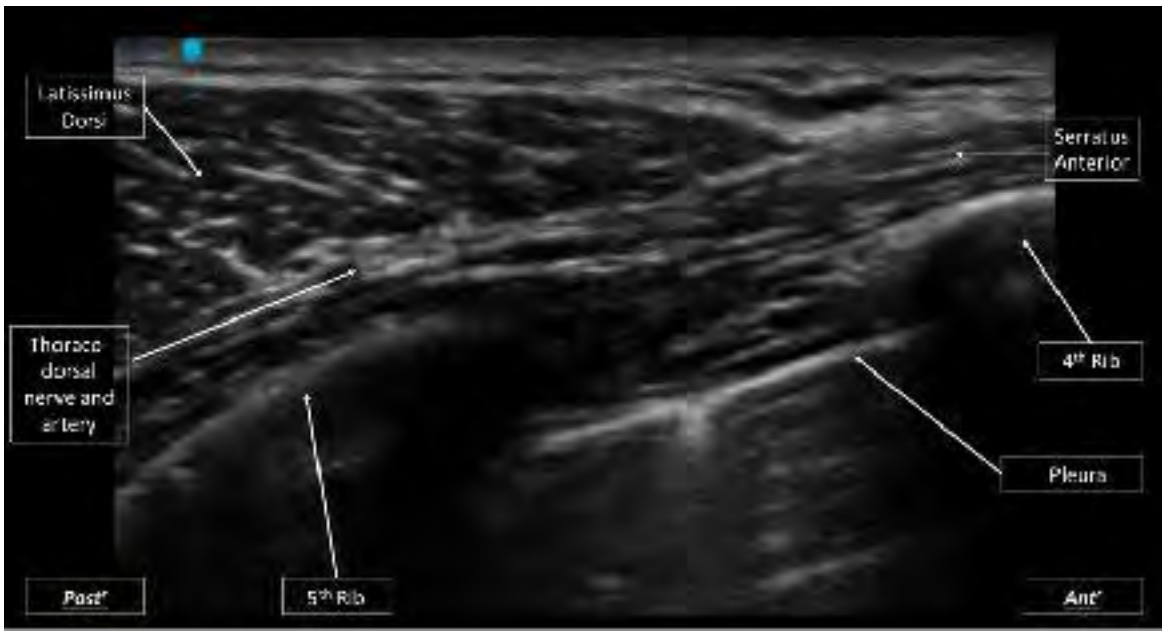
Transverse scan at T5, mid-axillary line

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

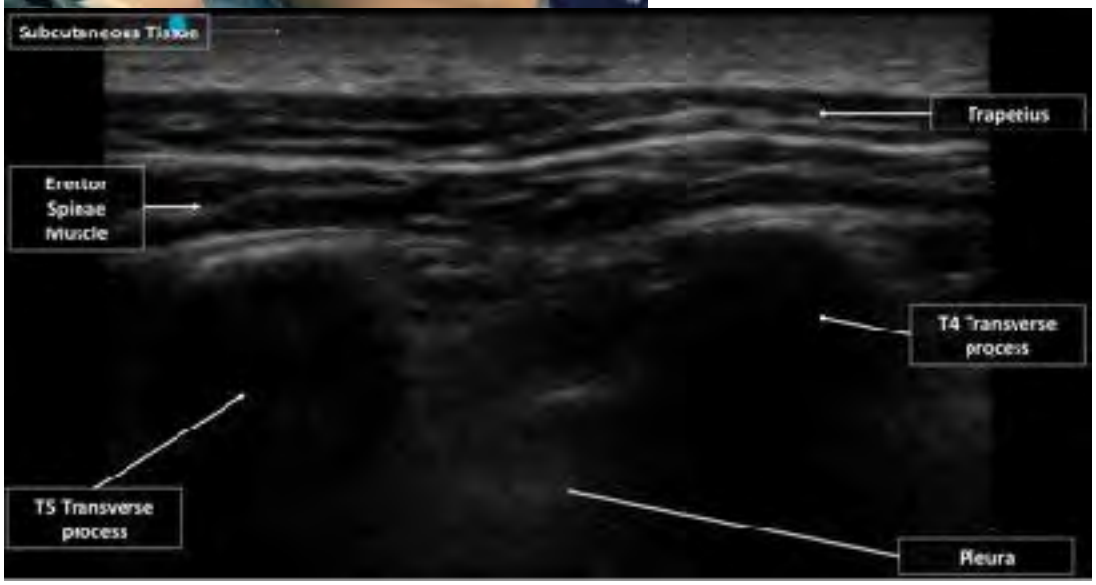
0.5% Chlorhexidine to skin

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.



MAINTENANCE OF CONTINUOUS REGIONAL ANAESTHESIA

1. Ensure local anaesthetic doses do not exceed recommended limits. Base dosing on ideal body weight.

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 **acutepainservice@nbt.nhs.uk** or Bleeps 1509 or 9670

Affix Patient ID Sticker

Forename:……..

Surname:……

DoB:……

MRN:……

North Bristol NHS Trust

Chest Wall Injury and Rib Fracture Pathway

Major Trauma Call

Alert senior clinician with regard discussing with TTL +/- activating Trauma Team

3rd on call to assess pain & need for advanced analgesia techniques.

Admitting team +/- ICU to agree location of patient's onward care.

Non Major Trauma

Is this an isolated injury?

Conduct full 2nd survey to assess for other injuries

Does the patient meet the criteria for;
- Major Trauma?
- Silver Trauma (>65 yrs)?

(Think low impact injury incl. fall from standing and more subtle physiological changes)

YES

NO

YES

Risk Factors:

- Unable to take deep breath and cough without restriction on simple oral analgesia.
- Flail segment, pulmonary contusions or large haemo/ pneumothorax
- Multiple rib fractures ≥3
- Consider STUMBL rib fracture score >11
- Pre-injury anticoagulation

THORACCS Form

Admit under most appropriate specialty
- If isolated chest injury admit under Gen Surgery (Emergency GI Surgery)
- Consider ICU

ADMIT

NO

Early advanced analgesia (PCA, regional anaesthesia, epidural)

Consider discharge, ED observation or medical admission.

Low threshold for admission with;
- >65 years

Clinical Frailty Score

1 Very Fit – People who are robust, active, energetic and motivated.These people commonly exercise regularly. They are among the fittest for their age.

2 Well – People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g. seasonally.

3 Managing Well – People whose medical problems are well controlled, but are not regularly active beyond routine walking.

4 Vulnerable – While not dependent on others for daily help, often symptoms limit activities. A common complaint is being "slowed up", and/or being tired during the day.

5 Mildly Frail – These people often have more evident slowing, and need help in high order IADLs (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.

6 Moderately Frail – People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.

7 Severely Frail – Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).

8 Very Severely Frail – Completely dependent, approaching the end of life.Typically, they could not recover even from a minor illness.

9.Terminally Ill - Approaching the end of life.This category applies to people with a life expectancy <6 months, who are not otherwise evidently frail.

STUMBL Trial Prognostication

T.H.O.R.A.CCS

Treat **HYPOXIA** and ASSESS FOR HYPERCARBIA

- Aim SpO2 >94% (88-92% in COPD)
- ABG if requiring oxygen

Performed? ☐

Time……..

HAEMATOLOGY / BLOODS

- Trauma Set and G&S x2 on arrival (FBC, U&ES, LFTs, Clotting, Trop, Bone profile, glucose, CRP)
- Discuss with Haematology if bleeding concerns and DOAC
- Low threshold for anticoagulation reversal (consider indication)
- If not reversed state rationale and decision maker below:

……

Performed? ☐

Time……..

ORGANISE CT

- Low threshold for CT chest
- Consider CT abdomen if ≥ 3 lower rib # (7-12)

Performed? ☐

Time……..

REFERRAL

- TTL/Major Trauma Practitioner to refer to Acute Pain Service (APS) via ICE
- If not major trauma then admitting team to refer to APS
- For any trauma in older patients (>65 yrs old) or scoring >4 on the Clinical Frailty Scale refer to the Silver Trauma Team for triage and follow us; (COTEInpatientReferrals@nbt.nhs.uk)

Performed? ☐

Time……..

ANALGESIA

- Regular and PRN analgesia to be prescribed prior to leaving ED (see charts on following pages)
- Further advice can be gained by the following routes
  - Acute Pain Service Bleep 1509 (core hours)
  - On call anaesthetics Bleep 1st 9031, Senior 0930/9034)

CRITICAL **C**ARE **S**UPPORT

- Consider ICU if
  - Respiratory compromise
  - PaO_2 <8 kPa on high flow oxygen
  - Other associated injuries
  - If Thoracics referral maybe indicated (Flail etc.)

Performed? ☐

Time……..

Flowchart for Ward Based Acute Pain Management of Patients with Rib Fractures

Review patient and assess dynamic pain score

(Pain score out of 10 (0 = no pain, 10 = worst pain imaginable) on deep breathing or coughing, associated with rib fractures/ chest injury

Review drug chart – has patient been receiving prescribed regular analgesia, assess use of PRNs

Based on patient's dynamic pain score and current prescribed medication select one of the pain regimes below

If >65 years or CFS >4, consider using Silver Trauma dose adaptions found in Guidelines for Management of Acute Pain due to Trauma & Rib Fracture

Ongoing **mild** pain:
Pain score 1-3

Regular:
Paracetamol
+/- PO weak opioid
OR +/- NSAID if more appropriate

PRN:
+/- PO weak opioid
OR +/- NSAID if more appropriate
IV Paracetamol
Antiemetics & Naloxone with opioids

Rescue:
PO strong immediate release opioid
Lidocaine plasters for rib fractures in Silver Trauma Patients (to reduce opioid requirements) Advice on prescribing see next page.

Pain Observations: Hourly
Analgesia review within 8 hours

Ongoing **moderate** pain
Pain score 4-6

Regular:
Paracetamol
PO weak opioid
Lidocaine plasters

PRN:
- PO strong immediate release opioid
- IV Paracetamol
- +/- NSAID if more appropriate
- Antiemetics & Naloxone with opioids

Rescue:
Advanced analgesia (see NOTE next page)
PCA Strong opioids
Regional anaesthesia

Pain Observations: Hourly
Analgesia review within 6 hours

Ongoing **severe** pain
Pain score >7

Regular:
Paracetamol
+/- PO weak opioid
Lidocaine plaster

PRN:
PO strong immediate release opioid
IV Paracetamol
Antiemetics & Naloxone with opioids
Advanced analgesia (see NOTE next page)
PCA strong opioid

Rescue:
Call for help early APS #1509 (core hours)
Anaesthetics #9031 (out of hours **ONLY**)
Regional anaesthesia
IV ketamine infusion

Pain Observations: Hourly
Analgesia review within 4 hours

4 – 8 hourly pain review: Consider previous pain scores and ability to comply with physiotherapy

If pain score improved

Continue analgesia regime and review patient 12 hourly

As pain improves deescalate in a stepwise fashion every 24 hrs

If pain score unchanged or worsening

Increase analgesia regime to next protocol

Review every 4 – 8 hours

NOTES:
Advanced analgesia techniques: To be prescribed only with the support and supervision from APS (core hours) or on call anaesthetist (Bleep 9031 out of hours). Inpatient pain management is a shared responsibility. If the patient is admitted to ICU, Senior ICU doctor can implement IV opioids (bolus, infusion or PCA) and IV ketamine infusion independently.
For regional anaesthesia for rib fracture pain management contact APS Bleep 1509 (core hours) or senior anaesthetist bleep 9030/4 (out of hours).

Analgesia Prescribing Guide

Abbreviated version of analgesia guidance from Guidelines for Management of Acute Pain due to Trauma & Rib Fractures. Please refer to guideline if further information required (QR code to right).

			-					
		-	-		-	-		
		-	-		-	-		
					-	-		

- All opioids should be co-prescribed with antiemetics and Naloxone. Also review bowels and consider laxatives if concerns over constipation and opioids.
- For more information on dose reductions, cautions, contraindications please refer to the Guidelines for Management of Acute Pain due to Trauma & Rib Fractures or BNF.

Prescribing Lidocaine Plasters for Rib Fractures

Prescription stickers are available in Acute Pain Folders found on the ICU and the Medirooms, Emergency Department and designated Trauma Ward.
If stickers unavailable, ensure the prescription states for fractured ribs as this is the only formulary authorised acute indication, use the exact wording in box

LIDOCAINE PLASTERS 5%
Number of plasters to be applied (max 3 plasters): ……
Route: Topical.
Place over rib fracture site on the **RIGHT** and/or **LEFT** (circle the side)
APPLY for **12 hours** during day, **REMOVE** for **12 hours** overnight (discard old patch). Apply to dry intact skin only
Review after 3 days. Max use 5 days.

Indications

Suitable if patient experiencing pain and difficulty deep breathing and coughing from rib fractures.
Please ensure the Trauma Analgesia and NBT Acute Pain Guidelines have been fully utilised.
Consider lidocaine plasters if high dose strong opioid analgesia fails or inappropriate e.g. respiratory compromise, renal impairment, frailty, or regional anaesthesia not appropriate

Use

The plaster must be applied to dry **intact skin**, over the site of the fracture.
Up to 3 plasters can be used if multiple fractures, usually only 1 or 2 needed. Plasters can be cut to size if needed.
The 12-hour break from the plaster is important. This break should be overnight
Review after 72 hours; **not to be used for more than 5 days** in total

Cautions

Caution in patients with severe renal/hepatic/cardiac impairment
Not to be used in pregnancy
Not to be used in patients under 18 years of age

	Indications	Site	Relative Contraindications	Dose
Thoracic Epidural	Consider for bilateral, high or multilevel fracture	Insert at vertebral level of middle fractured rib	- Unable to position patient - Spinal cord injury/ Neuraxial haematoma - Thoracic vertebral body fracture - Severe traumatic brain injury - Anticoagulation/coagulopathy - Hypotension/Hypovolaemia	**Loading:** 0.25% Levobupiv 7-12 mls **Infusion:** 5-15 mls/hr 0.1% Bupiv (+/- fentanyl 2 mcg/ml) **Rescue:** Bolus infusion mixture 5-10 mls or 0.25% Levobupiv 5-10 mls
Paravertebral	Up to six consecutive, unilateral rib fractures. Consider 2 catheters if >6, multilevel or bilateral fractures and other techniques contraindicated	Insert at vertebral level of middle fractured rib	- Unable to position patient - Transverse process fractures at the level of the intended block - Unstable vertebral body fractures - Anticoagulation/coagulopathy	**Loading:** 0.25% Levobupiv 20-30 mls **Infusion:** 5-12 mls/hr 0.1% Bupiv **Rescue:** 10 - 20 mls 0.25% Levobupiv
Serratus Anterior Plane	Probably effective for 2nd – 9th fractures. Reduced efficacy possible for posterior fractures.	Midaxillary line, superficial to Serratus Anterior at level of 5th rib.	- Distorted anatomy - Previous surgery at site - Surgical Emphysema - Intercostal drain sited	**Loading:** 0.25% Levobupiv 20-30 mls **Infusion:** 5 mls/hr 0.25% Bupiv via elastomeric pump OR 5-12 mls/hr 0.1% Bupiv via electronic[1] pump **Rescue:** 10 mls 0.25% Levobupiv
Erector Spinae Plane	Probably effective for 2nd – 10th fractures, including posterior. Alternative to Serratus Anterior Plane if chest drain in situ	Erector spinae plane (deep to erector spinae, immeadiately superficial to a transverse process) in mid thoracic region	- Distorted anatomy - Previous surgery at site - Surgical Emphysema	**Loading:** 0.25% Levobupiv 20-30 mls **Infusion:** 5-12 mls/hr 0.1% Bupiv via electronic[2] pump **Rescue:** 10 mls 0.25% Levobupiv

MANAGEMENT OF CARDIAC INJURIES

KEY POINTS

- Stable penetrating trauma with suspected cardiac tamponade should be transferred to theatre to await cardiothoracic team for thoracotomy.

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

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

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

- 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.

- The Thoracic Surgical Consultant must be informed of every trauma patient with non-life-threatening chest injury whether blunt or penetrating.

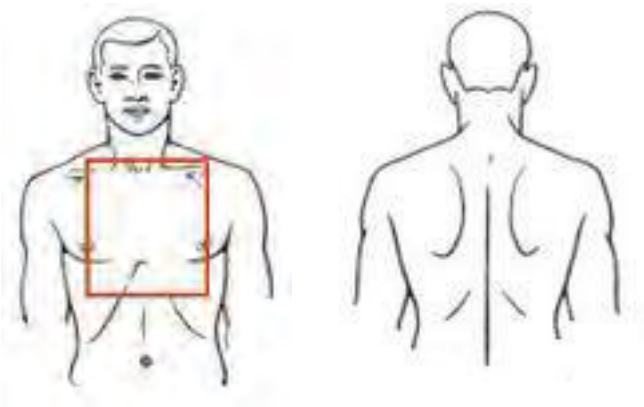
- There are three mechanisms to call the Thoracic Surgical team. For ‘Code Red’ patients, the On-call Thoracic Surgical Consultant is notified via switchboard.

PENETRATING CARDIAC INJURY

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.

Effective and timely communication with relatives is crucial.

CARDIAC TAMPONADE

Cardiac tamponade is a life threatening event.

Increasing fluid (blood) and pressure in the pericardial sac reduces atrial and ventricular filling, ultimately reducing cardiac output.

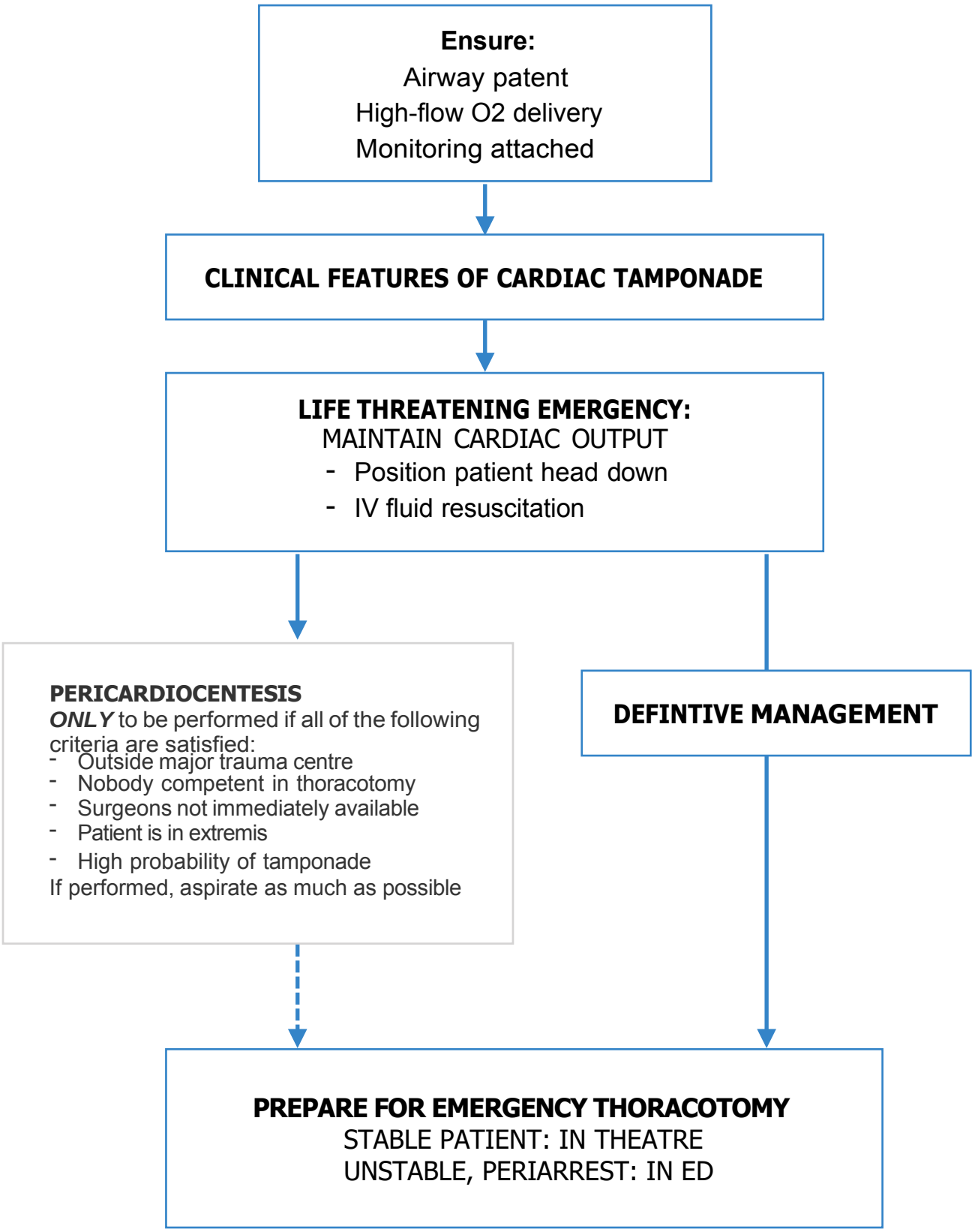
It is a common cause of traumatic cardiac arrest, especially where there is a penetrating injury to the chest.
Rapid diagnosis is key and is largely based on high index of clinical suspicion rather than any classic signs or symptoms. Signs of cardiac tamponade are either non-specific or difficult to detect.

Patients with cardiac tamponade often present in traumatic cardiac arrest and a decision must be made whether to perform an ED resuscitative thoracotomy.

CLINICAL FEATURES SUGGESTIVE OF CARDIAC TAMPONADE

- Trauma to the chest or abdomen (penetrating or blunt)
- Hypotension, tachycardia, elevated JVP
- Pulsus paradoxus (>10 mmHg fall in blood pressure with inspiration)
- Kussmaul's sign - raised JVP on inspiration (not always seen)
- Muffled heart sounds
- Radiological evidence of cardiac tamponade (TTE or other)

MANAGEMENT OF CARDIAC TAMPONADE



PENETRATING THORACIC TRAUMA, SUSPECTED CARDIAC TAMPONADE: *STABLE PATIENT*

Suspected cardiac tamponade, maintaining output on arrival and immediate assessment

- Move to theatre to await Thoracic team for thoracotomy
- Thoracic Surgical Consultant will be called as soon as injury identified – either by pre-hospital alert or on primary survey
- TTL 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 Thoracic Surgical Consultant.

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

In the event of the TTL performing an ED thoracotomy

- The trauma team will be present, including the General Surgical Registrar
- Cardiothoracic Consultant will be called as soon as an injury requiring thoracotomy is identified – either by pre-hospital alert or on arrival to ED.
- Consultant General Surgeon on call if on site to be notified and immediate assistance requested.
- 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 it use.
- The purpose will be to release tamponade and control cardiac bleeding – no other procedures will normally be undertaken.
- 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 cardiothoracic team when required

INDICATIONS TO CALL THE THORACIC SURGICAL CONSULTANT

On Pre-alert of patient (before arrival)

- Pre-alert from pre-hospital emergency service: call Thoracic Surgical Consultant
- Pre-alert from SWASFT crew indicating significant haemorrhage from cardiothoracic injury – SEE CALL OUT MECHANISM A (page 157)
- SWASFT crew pre-alert suggesting significant blunt thoracic injury or penetrating trauma to torso

Indications to call cardiothoracic team after the patient has arrived:

1. 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

2. Non-life-threatening cardiothoracic injury identified during the primary or secondary survey:

- The Thoracic Surgical Consultant 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 Thoracic Surgical Consultant. If the General Surgical Registrar is in the theatres then the TTL may liaise with Thoracic Surgical Consultant or nominate someone appropriate to do this.
- Contact will be via the normal pager system currently in place
- The Thoracic Surgical Consultant will review the relevant images
- The management plan decided in discussion with the Thoracic Surgical Consultant will be clearly documented in the notes and the contact details for the Thoracic Surgical Consultant recorded.
- The drug chart will be completed by the general surgical SHO
- There will be a daily review of in-patients with cardiothoracic injury by the Thoracic Surgical Consultant.
- The Thoracic Surgical Consultant 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 cardiothoracic 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 THORACIC SURGICAL CONSULTANT

A: Major Haemorrhage Patients

A "Code Red" call will result in the Thoracic Surgical Consultant being notified via switchboard

- The instruction will be "Code Red trauma call for Thoracic Surgical Consultant"
- 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 Southmead.
- 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.

Thoracic Surgical Consultant 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 Thoracic Surgical Consultant 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 Thoracic Surgical Consultant
- There will be no discussion with the TTL about the need to attend. The assumption is that they leave urgently for Southmead.
- Thoracic Surgical Consultant 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 Thoracic Surgical Consultant

Additional Notes on the Cardiothoracic Team

On arrival, the Thoracic Surgical Consultant to go to Bay 1 ED Resus Room to manage the patient there or be directed 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

INDICATIONS FOR THORACIC SURGICAL 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 comorbidities, 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.

REFERRAL PROCESS

Emergency referral (resuscitative thoracotomy)

As per Page 157. 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 Thoracic Surgical Consultant 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.

OVERVIEW OF CHEST DRAIN INSERTION AND MANAGEMENT

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.

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:

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

EQUIPMENT

Equipment Required For Thoracostomy:

- Sterile gloves and gown
- 2% chlorhexidine and gauze
- Large scalpel (i.e. size 22)
- Spencer Wells forceps (8")

Equipment Required For Chest Drain:

- Sterile gloves and gown
- 2% chlorhexidine and gauze
- Large scalpel (i.e. size 22)
- Spencer Wells forceps (8")
- Chest Drains (20-28Fr in Adults)
    - *28 Fr drain for males*
    - *24 Fr drain for females*
    - *20 Fr for slight / very thin patients)*
- Closed underwater seal (containing sterile water up to marker)
- Connecting tubing
- Suture (2-0 silk)
- Gauze, Large Tegaderm dressings and insertion stickers

MONITORING

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.

FINGER THORACOSTOMY

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).
- Clean the skin with 2% chlorhexidine
- Identify the "triangle of safety" defined by the lateral border of pectoralis major, anterior border of latassimus dorsi and the 5th intercostal space.

Incision (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 border 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 extensive surgical emphysema the distance to the thoracic cage will be increased and a longer incision may be required.

Blunt Dissection (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 border of the rib to strip the intercostal muscle from the periosteum.
- Finally, open 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 (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

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.

Insertion (Figures 9-11)

- 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 into the pleural cavity alongside the 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 (Figures 12-14)

- 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 'omental' 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 (1g) and Gentamicin (3 mg/kg) in those under 65 years old (Teicoplanin 400mg and Gentamicin in penicillin allergic patients) and a single dose of Co-trimoxazole (960mg) in those over 65 years old.

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
- Confirmation that the drain is in position on imaging.

ONGOING MANAGEMENT

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.

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
- Continuing air leak after 48 hours.

Full indications for referral and the referral process can be found on page 159.

UNNECESSARY THORACOSTOMIES

A small cohort of patients who have had thoracostomies, predominantly in the pre-hospital setting but occasionally in the Emergency Department, 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.

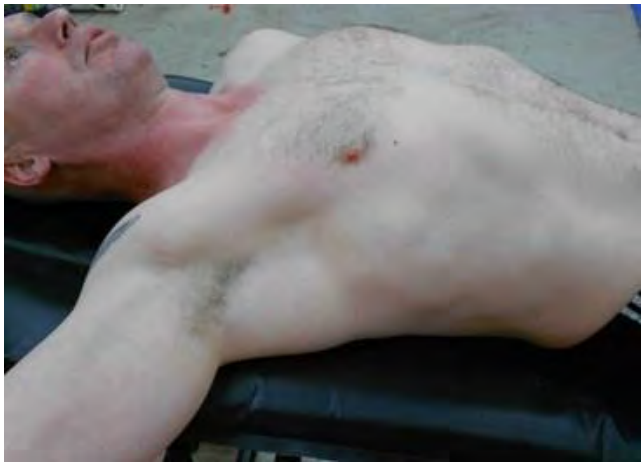


Figure 1: Patient Position

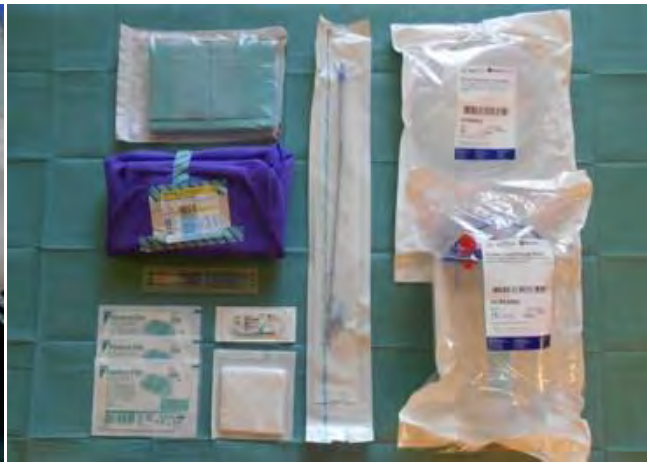


Figure 2: Equipment

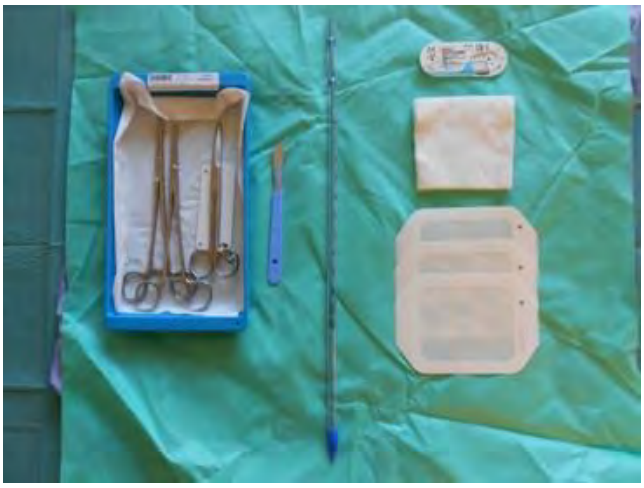


Figure 3: Equipment

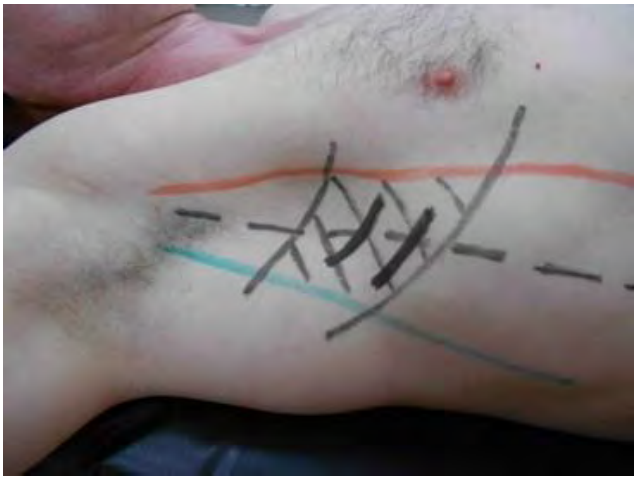


Figure 4: Triangle of Safety

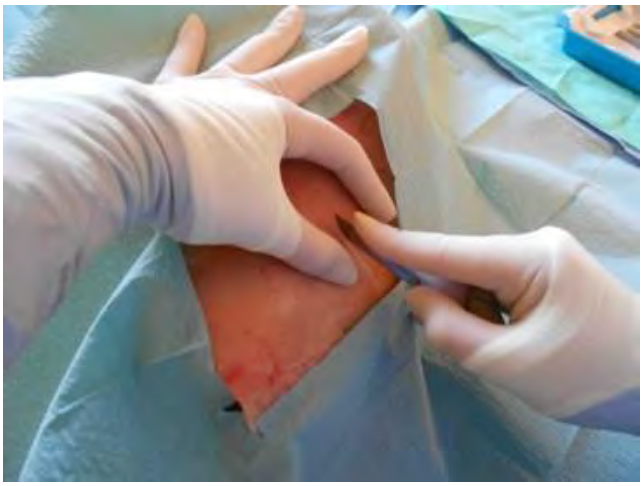


Figure 5: Incision

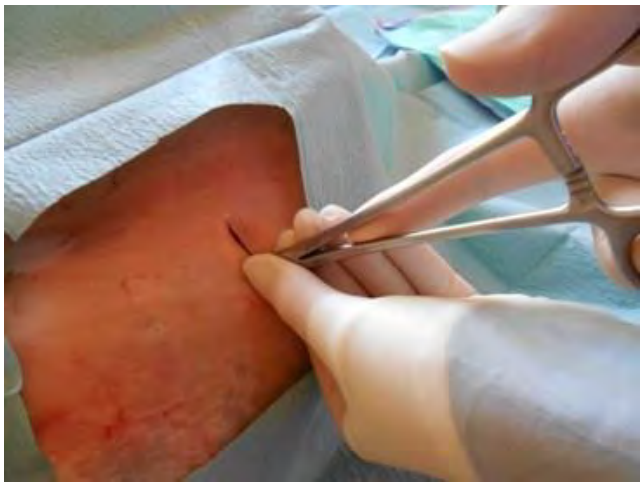


Figure 6: Blunt Dissection

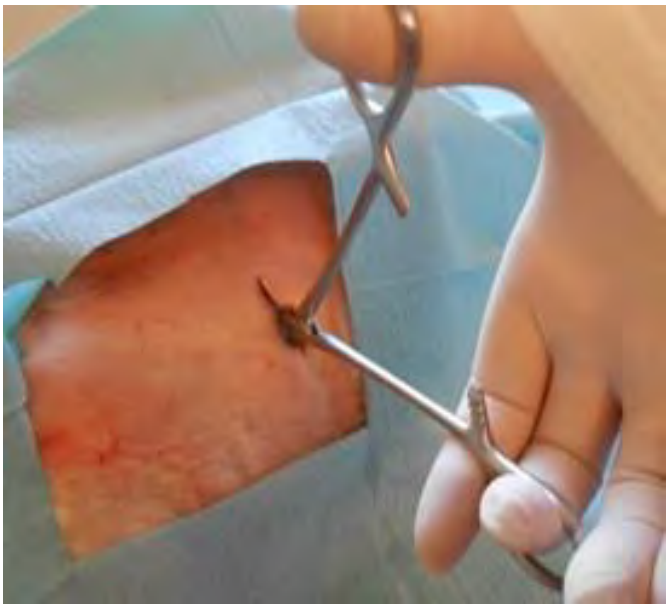


Figure 7: Blunt Dissection

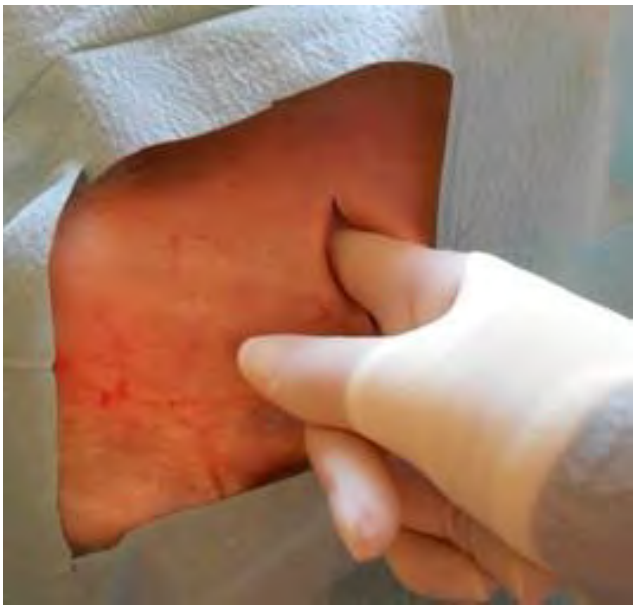


Figure 8: Finger Sweep

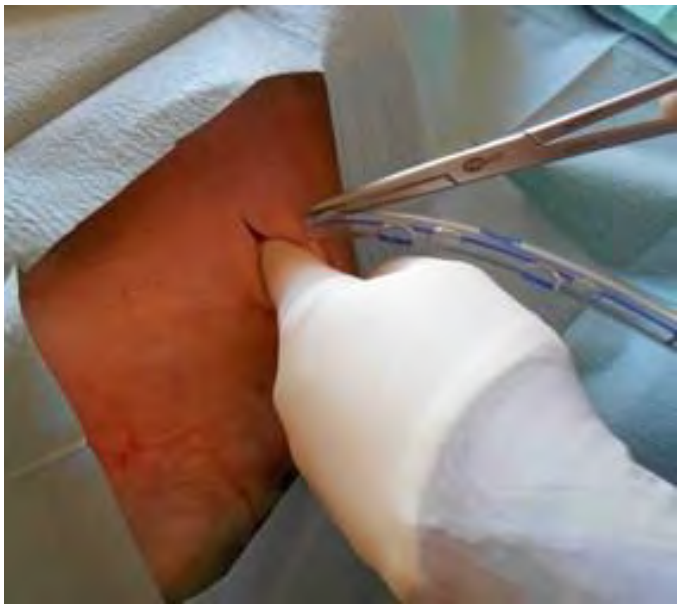


Figure 9: Drain Insertion

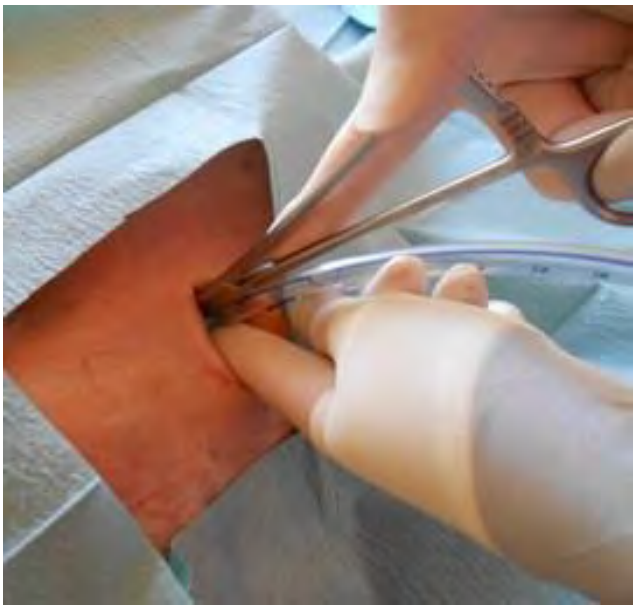


Figure 10: Drain Insertion

Figure 11. Connection to underwater seal

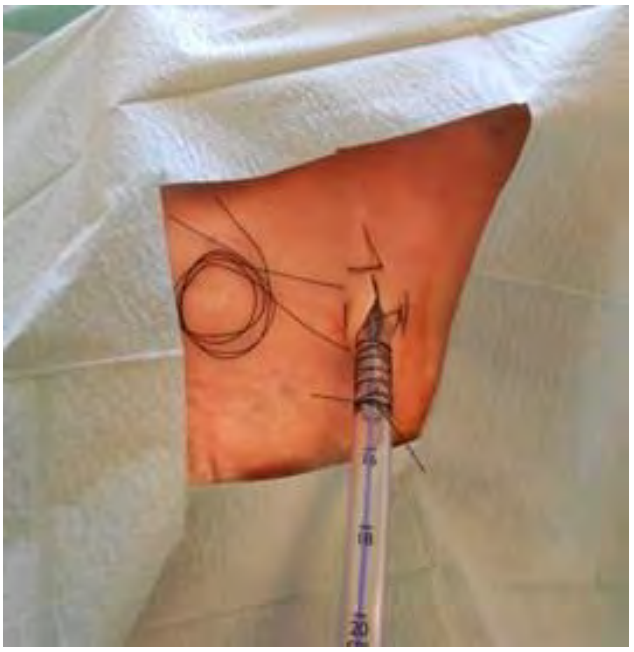


Figure 12. Securing

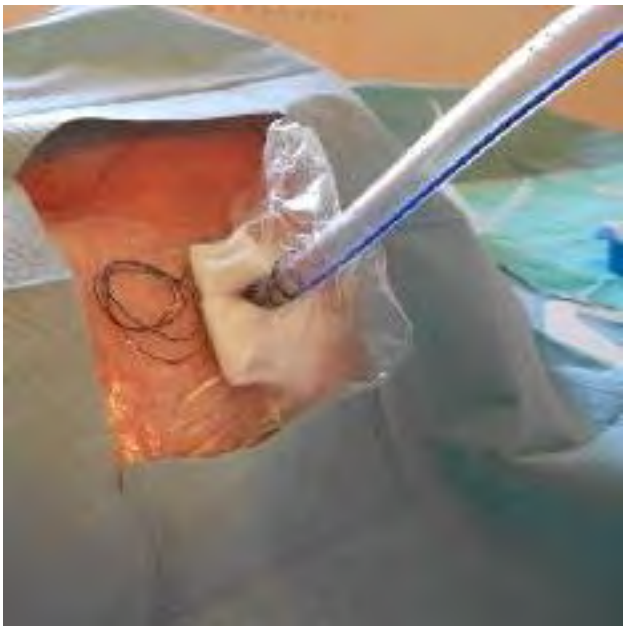


Figure 13. Dressings

Figure 14. Omental Tag

CHEST DRAIN INSERTION AND MANAGEMENT

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

Patient stable
- SpO_2>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

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

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

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 FOR RESUSCITATIVE THORACOTOMY IN ED

The indications for resuscitative thoracotomy in the ED are:

1. 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

2. 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 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 figures 2-5

Bilateral thoracostomies (3-5 cm each) should be performed as described on page 161.

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 gigil 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

Internal Cardiac Massage

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.

Defibrillation

If defibrillation is required use internal paddles with an initial energy level of 10J. 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.

ROSC

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 to 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

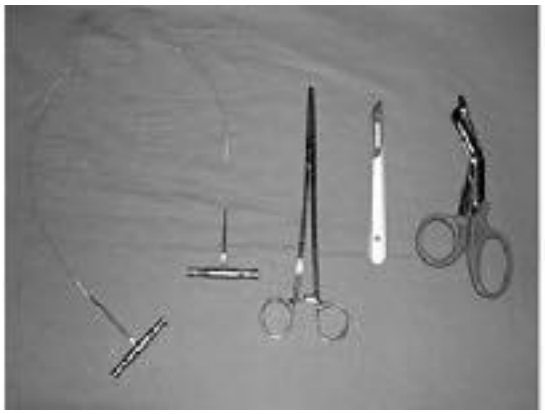


Figure 1: Equipment

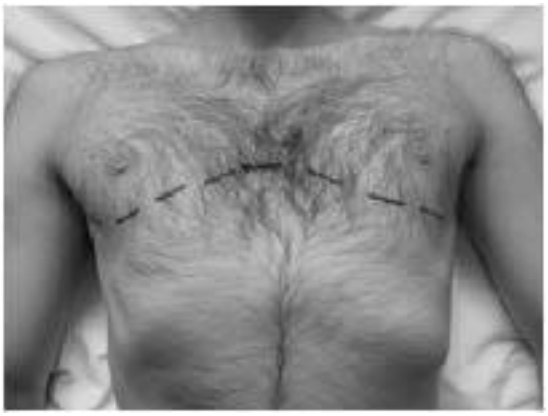


Figure 2: Incision

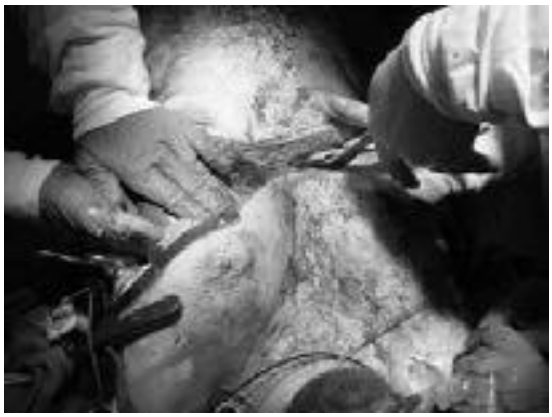


Figure 3: Cutting through the sternum

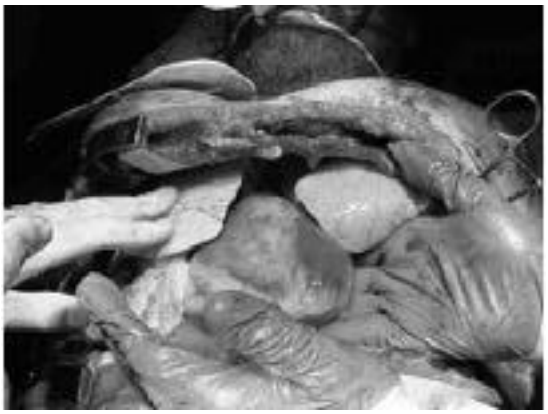


Figure 4: 'Delivering' the heart

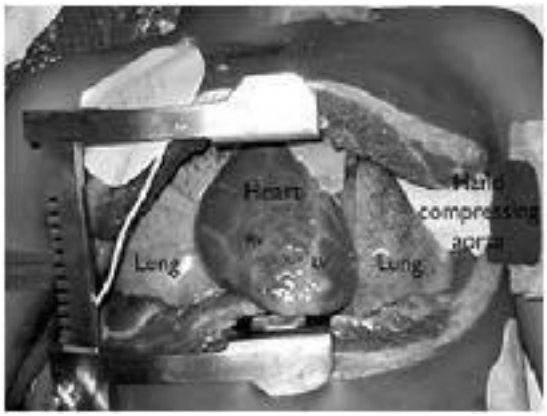


Figure 5: Optimal view with retraction

Invasive Procedure Safety Checklist: CHEST DRAIN

BEFORE THE PROCEDURE

Indication

Pneumothorax

Pleural effusion

Other

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? (including ultrasound gel, dakin) Yes ☐ No ☐

Confirm side of clinical abnormality Yes ☐ No ☐

Correlates clinically 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 the 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 (ABG: PaO2)? 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 these mitigated?

Procedure Date: Time:

Operator:

Observer:

Assistant:

Level of supervision: SpR ☐ Consultant ☐

Equipment & trolley prepared: ☐

SIGN OUT

Sutures, tubing and dressing secured? Yes ☐ No ☐

Patient advised about care and not elevating drain above the chest? Yes ☐ No ☐

Analgesia prescribed? Yes ☐ No ☐

In effusion, confirm no more than 500ml is drained in the first 1 hour or no more than 1500ml in the first 24 hours? Yes ☐ No ☐

Request chest X-ray to confirm position? Yes ☐ No ☐

Verbal handover to Nurse responsible for patient? Yes ☐ No ☐

Signature of responsible clinician completing the form

Patient Identity Sticker:

During Procedure		
Sterile Scrub/Gown and Gloves?	Yes	☐
Chloraprep 2% to skin?	Yes	☐
Local anaesthetic (if required)?	Yes	☐
Large fenestrated drape Used?	Yes	☐
STOP if unable to aspirate Air/fluid while infiltrating LA with green needle	Yes	☐

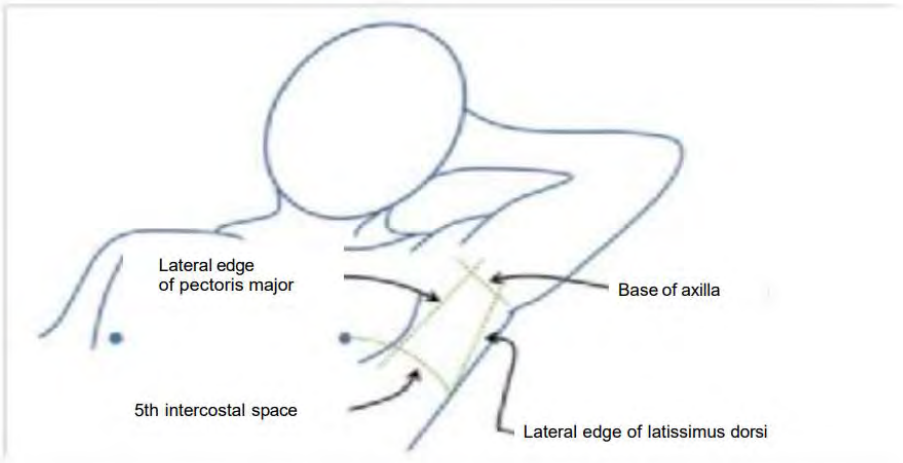
Side L R **Site**_____ **LA used**_____

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



The Faculty of
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intensive care
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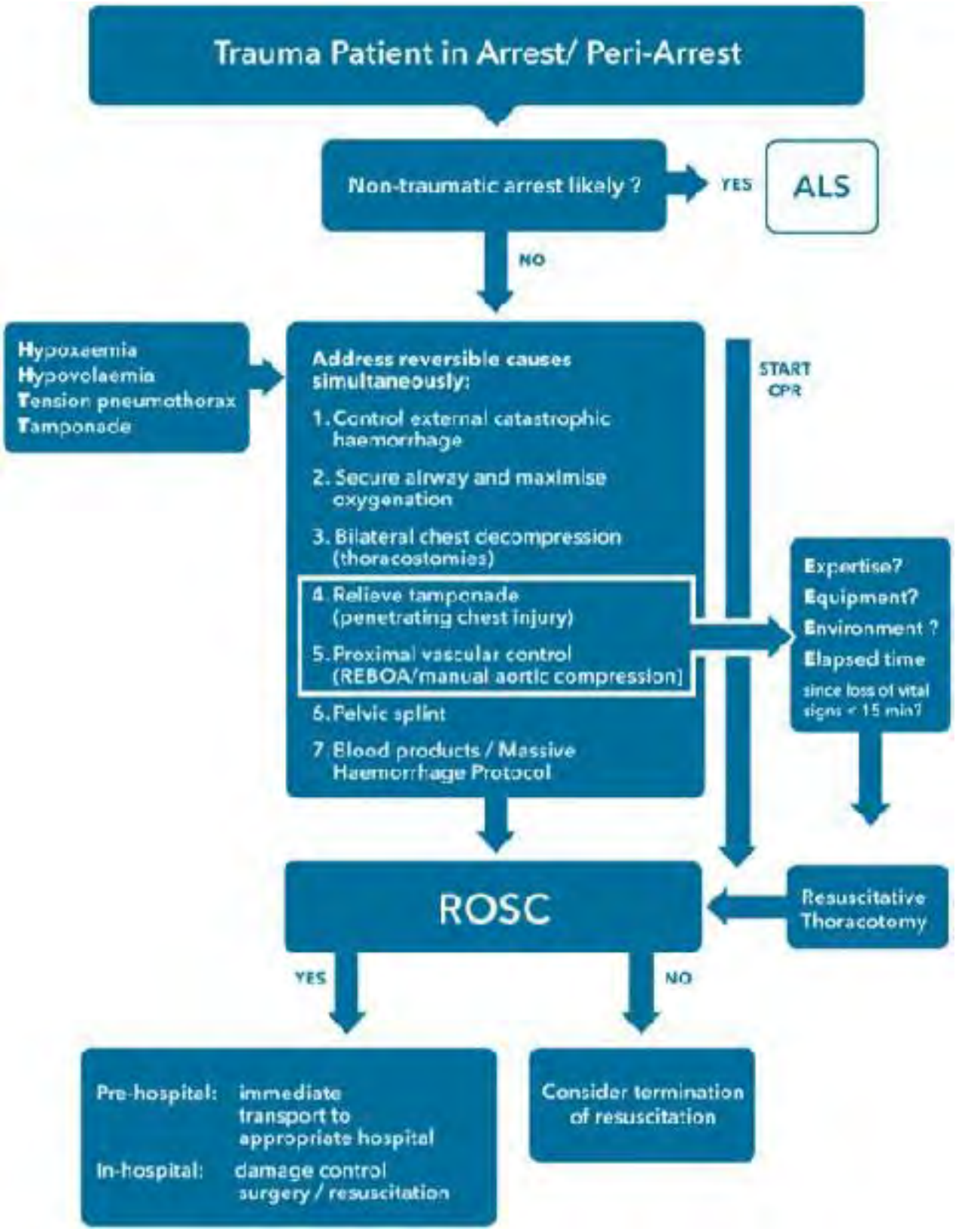
care when it matters

TRAUMATIC CARDIAC ARREST/ PERI-ARREST ALGORITHM

EUROPEAN RESUSCITATION COUNCIL



CHAPTER 6

MAJOR HAEMORRHAGE & VASCULAR INJURIES

MASSIVE TRANSFUSION POLICY

TXA USE IN MAJOR TRAUMA PATIENTS

TRAUMATIC VASCULAR INJURY

MAJOR HAEMORRHAGE

KEY POINTS

- This guideline covers the management of emergency, life threatening haemorrhage in adults and should be initiated by a Consultant or the most senior doctor present.
- A dedicated person responsible for communication should be identified. They should contact x2222 using the term “Major Haemorrhage” stating location and clinical team needed.
- The dedicated person responsible for communication should also contact the transfusion laboratory to confirm they are aware, giving contact number and further details as needed.
- A dedicated porter must be identified.
- Immediate control of obvious bleeding is of paramount importance.
- Fluid resuscitation should allow the blood pressure to be slightly less than normal (permissive hypotension). This promotes thrombus formation while still providing enough perfusion to end organs until control of bleeding is achieved. It should only be maintained for the first two hours or until definitive haemorrhage control is achieved (whichever is sooner). Caution is advised in older patients and a higher Systolic Blood Pressure should be used in polytrauma with Traumatic Brain Injury where the brain injury is the dominant injury.
- Group specific RBCs can be issued without performing an antibody screen as patients will have minimal circulating antibodies. If blood is needed immediately use O RhD negative RBCs for women and O RhD positive RBCs for men.
- Initial resuscitation phase. Shock Packs 1 (4 RBC, 4 FFP) and 2 (4 RBC, 4 FFP, 1 Adult Therapeutic Dose Platelets) are used to streamline the process. Initial resuscitation with Shock Pack 2 should be considered in severe trauma or microvascular bleeding. On-going transfusion needs should be targeted based on the clinical, haematological and biochemical picture, and the use of ROTEM.
- Haemostatic defects in major haemorrhage. These vary depending on the cause, amount of bleeding and the patient’s co-morbidities. Management should be led by the clinical scenario and guided by laboratory and near-patient dynamic clot assessment (ROTEM) results.

- Microvascular bleeding, a fibrinogen of < 1.5 g/L or prothrombin time (PT) and activated partial thromboplastin time (APTT) above the upper limit of the reference range represent coagulopathy. Early administration of FFP (15 mL/kg), platelets and cryoprecipitate (balanced transfusion) should be used to prevent and reverse this.

- Tranexamic acid. Give 1 g over 10 minutes, followed by an infusion of 1 g over 8 hours. In trauma, evidence suggests it should only be started within 3 hours of injury.

- Assess clinical response to treatment using physiological and biochemical parameters. Regular arterial blood gas analysis and laboratory full blood count (FBC), clotting screen and biochemistry will be needed. Consider further ROTEM studies.

- Standard venous thromboprophylaxis should be commenced as soon as possible after haemostasis is secured.

BACKGROUND

The number of severely injured patients continues to increase. Traumatic injury is the leading cause of death for those between 1 and 44 years of age with 50% dying after hospital admission. Of those who reach hospital alive approximately 80% die within the first 24 hours with the most frequent causes of death being neurological injury and haemorrhage. Haemorrhage accounts for 40% of all trauma deaths in the UK and 80% of those who die in the operating room.

Over the last 40 years transfusion has moved from predominantly whole blood transfusion to component therapy administration, this being driven in part by a desire to better utilise this precious resource. As a result, management of haemorrhagic shock changed; instead of whole blood, containing balanced amounts of red blood cells (RBC), clotting factors and platelets, most protocols suggested component therapy. However, blood component ratios were often unbalanced; large amounts of RBC were used, with administration of other components (fresh frozen plasma – FFP, platelets etc.) being guided by in vitro laboratory results. Few studies were conducted to assess the impact of this change.

Over the last decade there has been growing interest in the management of haemorrhagic shock. Perhaps starting in the military, before moving into civilian practice, studies have suggested the benefit of damage control resuscitation (DCR) and a return to the early use of higher ratios of plasma and platelets. This has coincided with the growing acknowledgement and understanding of the coagulopathy that is associated with shock (page 202). However, few robust studies exist, with most being observational or case-controlled studies using historical controls. Despite this, many national and international guidelines are now advocating the use of DCR and more balanced blood component therapy administration.

The use of adjunctive drugs and targeted clotting factors has also changed. Aprotinin (a serine protease inhibitor that maintains platelet function and prevents fibrinolysis) was withdrawn in 2008 due to the increased risk of renal failure and cardiovascular events. As a result of a very large randomised controlled trial in 2010 (CRASH-2), the antifibrinolytic tranexamic acid has gained popularity and is now advocated in the management of haemorrhagic shock. Similarly, while prothrombin complex concentrates (PCC) have gained favour for the rapid reversal of warfarin-associated haemorrhage, the ‘off-licence’ use of recombinant Factor VIIa in haemorrhagic shock is no longer recommended. This has been driven by a meta-analysis in 2009 that showed an increased risk of arterial thrombosis in those who received it.

Ultimately, the key to effective haemorrhage management is its early identification, rapid reversal of cause and aggressive, targeted resuscitation based on current best practice. This requires a dedicated and coordinated approach with clear communication and robust protocols.

GUIDELINE STATEMENT

This Guideline applies to Major Haemorrhage which can be considered pragmatically as a situation where more than 4 units of RBCs are transfused within 1 hour with an ongoing need for transfusion. Other definitions exist, such as the loss of 1-1.5 circulating blood volumes within a 24-hour period. However, many of these are impractical in the acute setting.

PURPOSE OF THIS GUIDELINE

This guideline aims to provide a rapid focused approach to the management of emergency, life-threatening haemorrhage in adults to maximise survival. This is usually only one component of the management of a critically unwell patient, therefore this guideline is intended to supplement current resuscitation guidelines.

SCOPE OF THIS DOCUMENT AND RESPONSIBILITIES

This document is primarily intended for use in the Emergency Department (ED) where acute, life-threatening haemorrhage presents but is also relevant to all medical and surgical teams where massive bleeding is suspected. Where more specific guidelines for the management of major haemorrhage exist e.g. Obstetrics and Gastrointestinal medicine these should be followed.

It is the responsibility of each directorate to provide training for use of this guideline. Drills should be performed every 6 months in clinical areas likely to have a regular use if a real incident has not occurred within this time. Audit and corrective action is described on page 199: Audit Review Arrangements.

This guideline does not cover management during routine surgery, where anticipated blood loss may be equal to, or greater than, one blood volume as the need for ongoing resuscitation and the development of an early coagulopathy should not occur.

THE MANAGEMENT OF MAJOR HAEMORRHAGE

Main Actions (See Flow Chart for the Management of Major Haemorrhage – Page 192)

1. Early identification of patients with uncontrolled bleeding and risk of coagulopathy is required. This may occur before arrival in the Emergency Department.

2. Organisation
   i. The team leader, ideally a Consultant or the most senior doctor present, should clearly communicate with the team that this is a major haemorrhage patient.
   ii. Their role is to coordinate management including identification of a member of staff responsible for communication.
   iii. Member of staff responsible for communication (page 193). They are to;
      - Active the Major Haemorrhage Protocol using x2222 stating 'Major Haemorrage', location and clinical team required
      - Contact transfusion laboratory to confirm they are aware and give contact number and further details as needed
   iv. Transfusion will contact a Consultant Haematologist, as appropriate, so that they are aware of the situation and available for advice.
   v. Intensive care and other personnel needed should be contacted as necessary.

3. Positive patient identification (ID) is essential – 2 ID bands are required. If a temporary emergency number has been used to request blood this should remain in place for administration. All blood component transfusions should comply with Trust Transfusion Policy (available on the NBT intranet).

4. In the critically unwell hypovolaemic patient damage control resuscitation should be considered. This involves a <C>ABC (Catastrophic haemorrhage control, Airway, Breathing, Circulation) approach – see page 200: Resuscitation Concepts.
   i. Arrest bleeding: methods include direct pressure, tourniquets, surgery (plus cell salvage), endoscopic control, reduction and fixation of fractures and interventional radiology.
   ii. Permissive hypotension: fluid resuscitation – aim is to maintain vital organ perfusion whilst awaiting definitive control of bleeding. Maintain radial pulse and consciousness – usually systolic blood pressure of 90-100 mmHg. Caution is advised in older patients. In polytrauma with Traumatic Brain Injury (TBI) if brain injury is the dominant clinic concern then a SBP > 100mmHg should be targeted. If brain injury is not the dominant clinical concern an SBP of 90 – 100mmHg should be targeted as above. Once definitive haemorrhage control is achieved, normotension should be restored. If definitive control is not achieved within 2 hours the default setting should be that the patient's blood pressure is restored towards normal[1].

iii. Balanced resuscitation: avoid worsening of coagulopathy by giving blood in conjunction with blood products (FFP, platelets, cryoprecipitate/fibrinogen concentrate).

5. Request laboratory investigations – Crossmatch, FBC, clotting screen including fibrinogen, biochemistry including calcium. Ensure correct patient ID and immediate dispatch.

6. Request Shock Pack 1 (4 RBCs and 4 FFP). If clinical suspicion of thrombocytopaenia or platelet dysfunction request Shock Pack 2 instead (4 RBCs, 4 FFP and 1 Platelets).

7. Where haemorrhage is likely to exceed replacement from first Shock Pack proceed to request Shock Pack 2 (4 RBCs, 4 FFP and 1 Platelets).

8. Use ROTEM to guide blood product replacement therapy (page 204). Repeat packs and specific components can be requested at any time. If ROTEM is unavailable use of Shock Pack 2 will give balanced blood component support.

9. More FFP may be needed if coagulopathy is present i.e. microvascular oozing or fibrinogen < 1.5 g/L or PT/APTT above reference range. Use a blood warmer.

10. Prevent/correct reversible causes of coagulopathy including hypothermia, acidosis and anticoagulant therapy.

11. Give Tranexamic Acid Injection – Give 1g slow IV injection over 10 minutes followed by 1g IV infusion over 8 hours (within 3 hours of trauma injury for reduced mortality associated with bleeding) (page 209).

12. Assess clinical response to treatment using physiological and biochemical parameters. Arterial blood gases should be performed regularly (every 20-30 mins) to assess Hb, lactate and base excess. Repeat ROTEM and hourly laboratory FBC, clotting studies and biochemistry is recommended.

13. Haematological and biochemical goals;
    i. Hb ≥ 70 g/L once bleeding is controlled (80 – 100g/L in Traumatic Brain Injury)
    ii. Fibrinogen > 1.5 g/L and PT/APTT within the reference range.
    iii. Platelets > 75 x 10^9 /L (100 x 10^9 /L in multiple or central nervous system trauma) or higher if platelet function abnormal. Administration is usually guided by platelet count. In severe trauma or microvascular bleeding a 4:4:1 ratio of RBC: FFP: Platelets is used initially. 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.

iv. Fibrinogen > 1.5 g/L. Use cryoprecipitate (or fibrinogen concentrate if available) if this has not been achieved following FFP. The usual dose for an adult is 2 pooled units.
v. Ionised Calcium > 1 mmol/L, Essential for coagulation, smooth muscle contraction and cardiac stability. Hypocalcaemia caused by consumption and sequestration with citrate (used as an anticoagulant in some blood products). Use 10 mL of 10% calcium chloride (1 g).
vi. Potassium < 5.5 mmol/L. Hyperkalaemia due to intracellular release from RBC lysis. Treat with insulin / glucose (10 units of Insulin in 50mL of 50% glucose)

14. 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.

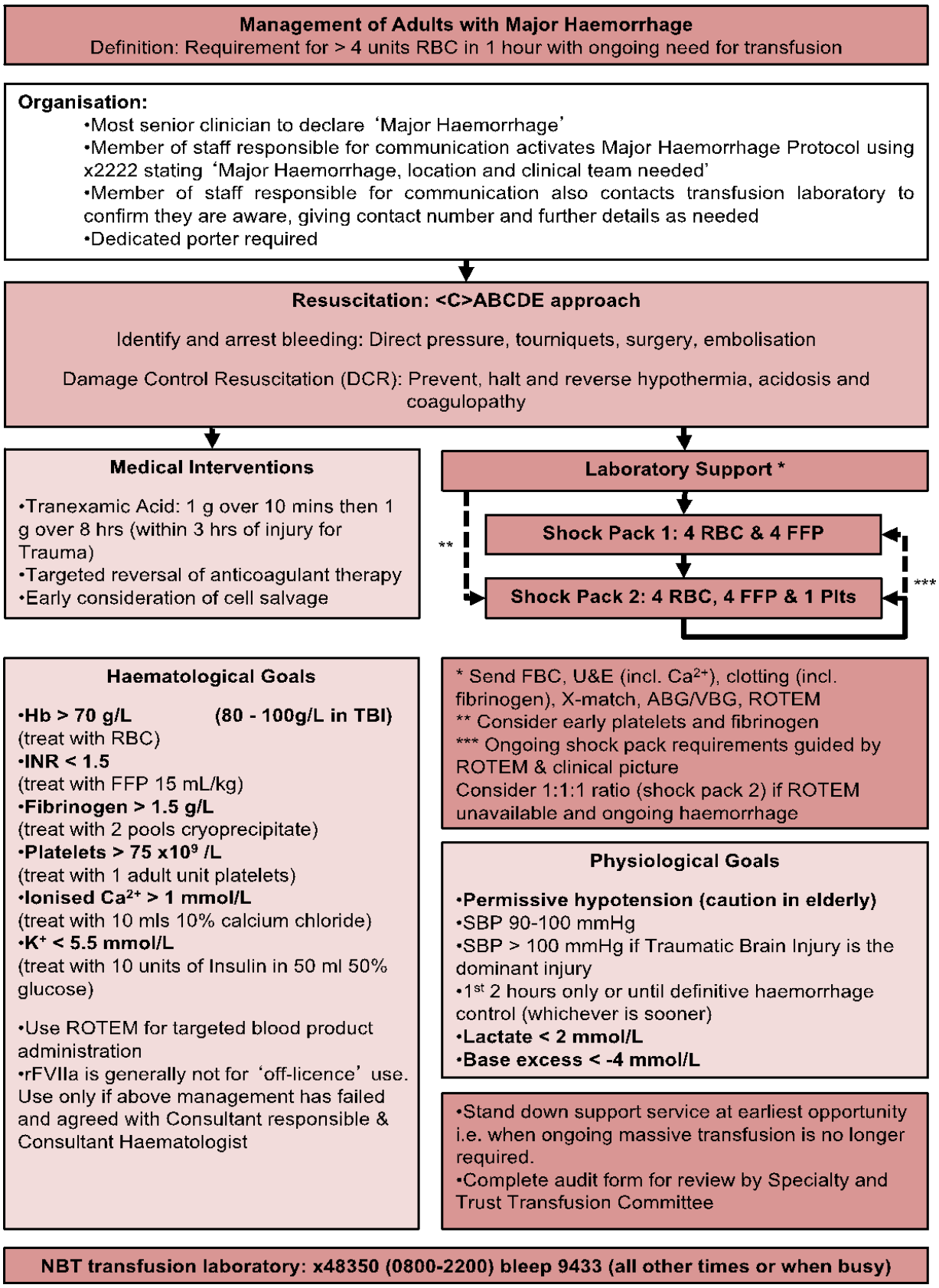
15. Vasopressors should be avoided. However, if hypotension persists as a result of vasodilatation from inflammatory processes (e.g. systemic inflammatory response syndrome – SIRS) vasopressors may be required, but the patient must be adequately fluid resuscitated first.

16. Stand down support services when there is no further immediate need for blood.

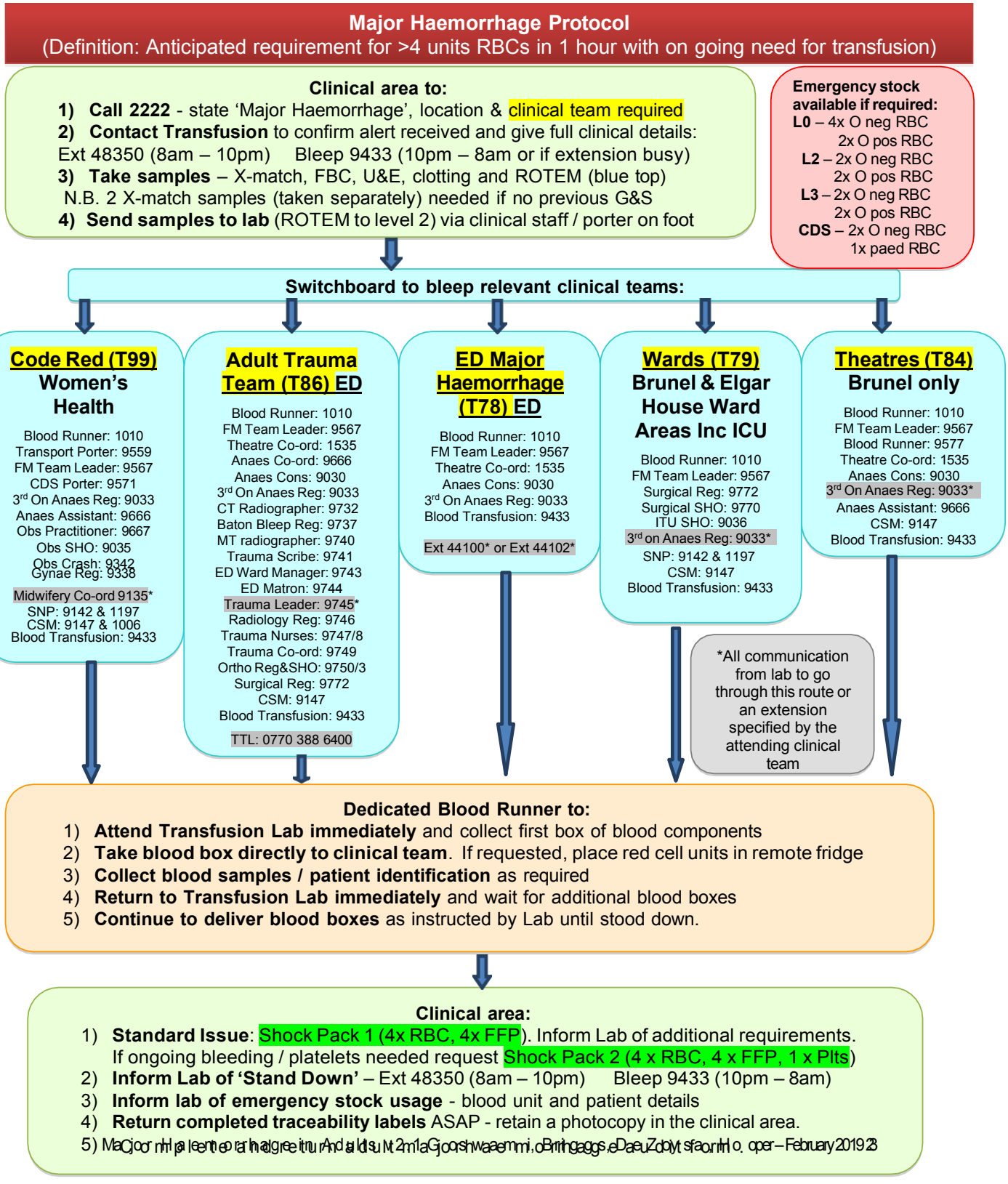
17. Complete audit form. The lead clinician coordinating management should delegate this. (Audit form available on intranet)

18. Standard venous thromboprophylaxis should be commenced as soon as possible.

SUMMARY FLOW CHART FOR THE MANAGEMENT OF MAJOR HAEMORRHAGE



Appendix 5: Major Haemorrhage Flowchart



BLOOD COMPONENT ISSUES, STORAGE AND TRACEABILITY

Red Blood Cells

- Crossmatched blood should be used if it is available or if time allows.
- Use Group O RBCs (O RhD Negative for women, O RhD Positive for men) if extremely urgent until group specific RBCs are available. Inform Transfusion immediately if this has been removed from the blood fridge so that it can be replaced.
- Group specific RBCs 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.
- RBCs 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.
- 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 on page 203.

Fresh Frozen Plasma OctaplasLG, Platelets and Cryoprecipitate

- Group A Neg for HT or 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. 4 units of FFP are routinely kept thawed in Transfusion and immediately available in the event of Major Haemorrhage.
- For patient born after 01/01/1996 pathogen reduced plasma (OctaplasLG) is recommended if it does not delay treatment.
- One unit of platelets is 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

- 1. It is a legal requirement for all blood components to be traceable for 30 years. The Trust Transfusion Policy must be followed.

SUMMARY TABLE OF AVAILABILITY OF BLOOD COMPONENTS AFTER SAMPLE RECEIVED IN LABORATORY

BLOOD COMPONENT		TIME AVAILABLE
Red Blood Cells	Emergency O RhD Negative	ED Blood Fridge 4 units Level 2 Blood Fridge 2 units Level 3 Blood Fridge 2 units CDS Blood Fridge 2 units Further requested from Transfusion Laboratory
	Emergency O RhD Positive	ED Blood Fridge 2 units Level 2 Blood Fridge 2units Level 3 Blood Fridge 2 units Further requested from Transfusion Laboratory
	Crossmatch / group specific	40 mins
FFP	A or AB	4 units thawed and immediately available from Transfusion Laboratory 25 mins (can be provided without a crossmatch sample if needed urgently)
	Group specific	25 mins
Platelets		Immediately when available in Transfusion Laboratory If not, 1 hour after request to NHS Blood & Transfusion (Filton, Bristol)

PHARMACOLOGICAL MANAGEMENT: REVERSAL OF ANTICOAGULANT / ANTIPLATELET DRUGS AND UNDERLYING COAGULOPATHY

Heparin

Severe bleeding associated with IV unfractionated heparin (UFH) should be treated[2] with IV protamine at a dose of 1mg 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 1mg per 100 anti-FXa units of LMWH administered within the previous 8 hours. If no response a second dose of 500 micrograms per 100 units can be tried[2].
Note: Excess protamine will itself induce a coagulopathy[3].

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 (5mg IV) and administering Prothrombin Complex Concentrate (PCC). The dose of PCC ranges from 25 to 50 micrograms/kg, dependent on the INR, and is available from the Transfusion laboratory. Page 207 provides further information regarding the use of PCC in the reversal of oral anticoagulants.

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)[4]. 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[5].
All cases of DOAC-associated Major Haemorrhage should be discussed with a Haematologist. Consider use of activated charcoal, to minimize absorption, if within 3 hours of ingestion[6].

For patients taking Dabigatran suffering life-threatening or intracranial haemorrhage Idarucizumab (Praxbind) can be used. 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 on page 209.
Andexanet Alfa (Recombinant Factor Xa) is a reversal agent for Factor Xa inhibitors. However, although recently licenced for use in the United States, it is not licenced for use in Europe as yet. High-dose PCC (50u / kg) may reverse anticoagulation in patients treated with Factor Xa inhibitors – it is recommended as first-line treatment by the American College of Cardiology.[7, 8]

The table below summarises the reversal strategy and relevant pharmacokinetics of the DOAC agents.[6, 8, 9]

Drug	Reversal strategy	Half-life (hours)	Time until full resolution of effect with normal renal function	Renal excretion
Dabigatran	Discuss with Haematologist Idarucizumab	12-17h	2.5-3.5 days	80-85%
Rivaroxaban	Discuss with Haematologist PCC 50 units / kg	5-9h	1-2 days	35%
Edoxaban		6-11h	1.3-2 days	35%
Apixaban		8-15h	1.5-3 days	25%

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.

See page 211 for further information on the use of tranexamic acid. Platelet transfusion may be used in addition; suggest x2 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.

Tranexamic Acid

Tranexamic acid is a synthetic lysine analogue that inhibits fibrinolysis by competitive inhibition of plasminogen.

The CRASH-2 trial showed that, when used in trauma, it reduced all-cause mortality by 1.5% versus placebo. The protocol for usage was 1g IV over 10 minutes, followed by 1g IV over 8 hours[10]. This observed effect was time-dependent, with the greatest benefit occurring within the first hour following injury. Whilst benefit was observed up to 3 hours post-injury, after 3 hours an increased risk of death due to bleeding was seen[11].

Tranexamic acid has been shown to reduce the risk of transfusion in elective surgery and its role is currently being evaluated by a number of RCTs in traumatic brain injury and upper gastrointestinal bleeding[11].

Tranexamic acid should be administered to all cases of traumatic major haemorrhage and should be strongly considered in major haemorrhage from other causes, particularly where there is point-of-care testing or laboratory evidence of fibrinolysis.

Recombinant Factor VIIa (rFVIIa)

A Cochrane Review examining the use of rFVIIa in non-haemophilia patients failed to demonstrate any benefit for its use in either the prevention or treatment of major haemorrhage. Additionally, safety concerns exist regarding the increased risk of venous and arterial thrombosis[12]. The current product specification makes reference to both these issues and states rFVIIa should not be used outside of its approved indications, i.e. those patients with specific pre-existing haematological conditions[3].

As a result, its routine use in major haemorrhage is not recommended. However, there may be situations where off-label use may be considered. An example may be its use in a potentially salvageable patient with ongoing haemorrhage despite standard attempts to control bleeding and use of best-practice conventional haemostatic measures[2,4].
Use may therefore be a licensed indication or when all other standard treatments have been tried and failed, in a potentially salvageable patient. Requests should by made by the Consultant responsible for the patient and approved by a Consultant Haematologist. The usual dose is 90 mcg/kg (maximum dose 7.2 mg IV). Acidosis (pH < 7.2), hypothermia (temperature < 34˚C), thrombocytopaenia (platelets < 50 x 109 /L) and hypofibrinogenaemia (fibrinogen < 1.5 g/L) should all be corrected prior to administration[4]. The cost will be covered from the Directorate responsible for the patient. Recombinant Factor VIIa is not stored in the laboratory and will have to be ordered from the Haemophilia centre (University Hospitals Bristol).

Aprotonin
Aprotonin is a serine protease inhibitor that acts to inhibit fibrinolysis.
Following suspension of marketing in 2007, the efficacy and safety of aprotonin use was re-examined by the Committee for Medicinal Products for Human Use of the European Medicines Agency in 2013[13]. Currently, aprotonin is only licensed for prophylactic use to reduce blood loss and blood transfusion in adult patients at high risk of major blood loss undergoing isolated coronary artery bypass graft surgery[13]. Its use in major haemorrhage outside of this setting in not recommended.

Calcium
Calcium has a range of vital homeostatic roles. It is essential for effective coagulation and facilitates contraction of cardiac and vascular smooth muscle. Hypocalcaemia during Major Haemorrhage may result from consumption and the administration of large volumes of blood products, which contain citrate as an anticoagulant that can sequester calcium ions.
Ionised calcium levels should be measured regularly (using arterial blood gases) and maintained within the normal range (>1mmol/L) using 10% calcium chloride where necessary[4].

Patients with a Bleeding Diathesis
Contact Haematologist.

Von Willebrands Disease and Renal Failure
Consider Desmopressin 300 nanograms / kg in 50 mL 0.9% Sodium Chloride IV over 30 minutes for patients with Von Willebrand's disease or renal failure.

Liver Disease
Liver disease results in reduced clotting factor production and dysfunctional fibrinogen. A dilutional coagulopathy is likely before the loss of one circulating blood volume.

AUDIT REVIEW ARRANGEMENTS

Each event triggering this protocol should be recorded on an audit form 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 the Emergency Department, the audit form should be completed by 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 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 records 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 DATIX system (by completing an 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.

OTHER RELEVANT POLICIES AND GUIDELINES

Blood Transfusion and the anaesthetist: management of massive haemorrhage. Association of Anaesthetists of Great Britain and Ireland. Anaesthesia 2010; 65:1153-61

Management of severe perioperative bleeding: guidelines from the European Society of Anaesthesiology. European Journal of Anaesthesiology 2013; 30:270-382

RESUSCITATION CONCEPTS

The key to successful resuscitation continues to be the early recognition of the severity of the situation with a systematic, aggressive and coordinated response that aims to halt and reverse the physiological and biochemical effects of shock. Effective resuscitation relies on teamwork and must utilise a horizontal, rather than vertical, approach; interventions must run concurrently and be led by experienced clinicians.
The traditional Airway, Breathing, Circulation (ABC) approach to recognition and treatment of life-threatening emergencies continues to be the mainstay of resuscitation. However, in recent years (since 2006 in the UK military) there has been a paradigm shift from ABC to <C>ABC, where <C> reflects catastrophic haemorrhage control, for those patients with critical hypovolaemic shock[14].

Although not a new concept, damage control resuscitation (DCR) has regained popularity in the last 10 years. The impressive survival statistics from recent conflicts in Iraq and Afghanistan have, in part, been attributed to its implementation. However, it is not only applicable to the military setting. DCR (that encompasses damage control surgery – DCS) is a systematic approach to minimise blood loss and maximise tissue oxygenation in order to optimise outcome and should therefore be considered in those with critical hypovolaemic shock. In short, DCR aims to reverse the lethal triad of acidosis, coagulopathy and hypothermia[15].

There are typically 3 phases:

- DCR I – achievement of definitive haemostasis within 1 hour (by DCS, interventional radiology etc.) with ongoing resuscitation
- DCR II – transfer to ICU for continued correction of coagulopathy, reversal of acidosis and oxygen debt and rewarming
- DCR III – definitive correction of the underlying problem (i.e. theatre for definitive surgery).

The principles of DCR are summarised in the table below[15]:

.Rapid recognition of high risk for trauma-induced coagulopathy (massive transfusion
.Rapid definitive/surgical control of bleeding
.
Avoidance of haemodilution by minimising use of crystalloids
.
Appropriate use of coagulation factor products (FFP) and fibrinogen-containing
Use of antifibrinolytics (Tranexamic Acid)*

**Additional principles that should be considered since the original description was published*

Situation reports (sit reps) should be used during DCR Phase I to keep the team informed of the patient's clinical state: Every 10 minutes the time since initiation of resuscitation, blood products transfused, temperature, visible clotting state and progress with definitive haemorrhage control should be verbalised; every 20-30 minutes an ABG should be performed; every 60 minutes a ROTEM should be performed and blood for FBC, clotting screen and renal function sent to the laboratory.

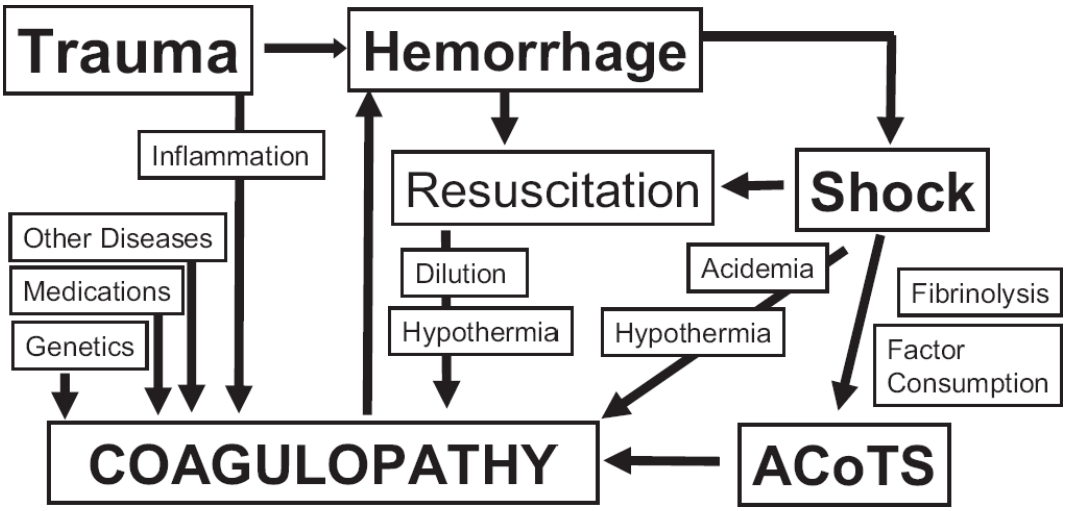
The principle of permissive hypotension is to maintain a blood pressure that is less than normal in order to promote thrombus formation while still providing adequate perfusion to end organs[16]. In the initial phase, intravascular administration of fluids and blood products is restricted to a volume sufficient to maintain a systolic blood pressure of 90-100 mmHg. Without monitoring, a radial pulse and consciousness may be used as markers of adequate organ perfusion. Caution is advised in older patients who may be less able to autoregulate their blood pressure resulting in inadequate organ perfusion. In polytrauma with Traumatic Brain Injury (TBI) if brain injury is the dominant clinic concern then a SBP > 100mmHg should be targeted. If brain injury is not the dominant clinical concern an SBP of 90 – 100mmHg should be targeted as above.

Permissive hypotension should be seen as a temporising measure with organ perfusion being optimal with a normal blood pressure. Blood pressure should therefore be allowed to rise towards normal as soon as definitive haemorrhage control is achieved. If it is not achieved within an hour, very careful consideration needs to be given as to the most appropriate blood pressure for that situation, with a return to normotension being the default setting.

TRAUMA INDUCED COAGULOPATHY

In the last 15 years there have been many publications on the management of major haemorrhage in trauma. Although not of robust research quality, with many being observational studies or case-controlled studies using historical controls, the early use of plasma in resuscitation is considered to reduce mortality.

Trauma induced coagulopathy is the umbrella term for any coagulopathy seen in relation to trauma. It is multifactorial and may be patient specific (i.e. underlying disease states and medication), iatrogenic (i.e. dilutional due to crystalloid or RBC administration) or shock related. Shock perpetuates the lethal triad of hypothermia, acidosis and coagulopathy[17], with hypothermia and acidosis both affecting clotting factor and platelet function. The diagram below summarises the multiple mechanisms that can cause a coagulopathy in trauma.



Acute Coagulopathy of Trauma Shock (ACoTS, also known as Acute Trauma Coagulopathy – ATC) is thought to be a separate entity. Although not fully understood it is likely to be caused by endothelial failure from hypoperfusion. This leads to glycocalyx disruption with activation of Protein C (an endogenous anticoagulant that mainly acts be inactivating clotting factors V and VIII). Additionally, hyperfibrinolysis and platelet dysfunction may occur[17].

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[18,19].

Intra-operative cell salvage should be considered for blood collection[18,19]:

- Where blood loss may exceed 500mls in adult patients
- In patients with increased risk factors for bleeding such as coagulopathy
- In patients with pre-existing anaemia where the surgery is urgent and there is no time for active management of anaemia pre-operatively
- In 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, chlorhexidine, topical clotting agents and orthopaedic cement. Cell salvage can be resumed once these have been washed away. 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[19]. Despite theoretical concern, there is no absolute contraindication to cell salvage in cancer surgery, as there is no conclusive evidence that cell salvage induces metastases or affects cancer prognosis[20].If used in these cases an infusion set with Leucodepletion Filter is recommended[18].

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 suckers during caesarean section[19].

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[2]. Current guidance from the AAGBI 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[19].

POINT OF CARE TESTING

Point-of-care testing available within the Trust includes arterial blood gas analysis and rotational thromboelastometry (ROTEM). ROTEM machines can be found in the operating theatre complex on Level 2 (next to the blood fridge and ABG machine) and in Obstetric Theatres.

Arterial blood gas analysis parameters relevant to Major Haemorrhage include pH, base deficit, lactate, glucose, potassium, ionised calcium and haemoglobin.

ROTEM allows rapid dynamic clot assessment. By mixing a sample of whole blood with different reagents the viscoelastic properties of the clot can be determined including initiation of fibrin formation, clot retraction and ultimately fibrinolysis. 2 reagents are stocked within the Trust; EXTEM and FIBTEM. Both use tissue factor to initiate clot formation (simulating in vivo clot initiation when endothelial damage has occurred) but FIBTEM also utilises a platelet inhibitor to allow quantitative assessment of the functional fibrinogen component. When looked at together blood component therapy can be targeted to the individual's needs.
Its benefits over conventional coagulation tests (PT, APTT and fibrinogen) include[21]:

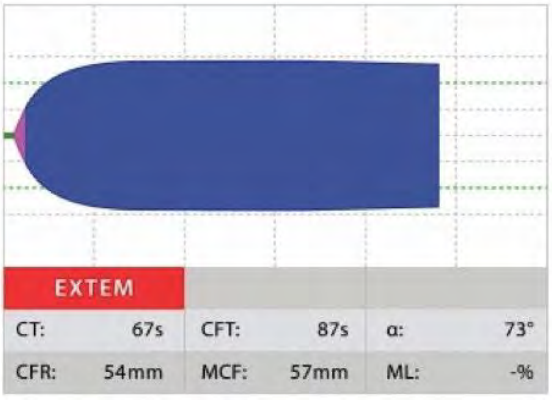
1. A shorter turnaround time (interim results are available in as little as 10-15 minutes)
2. A graphical representation of clot formation against time is displayed allowing interim analysis
3. Whole blood is used permitting analysis of the interaction of clotting factors, platelets and red blood cells
4. All phases of coagulation are assessed; more targeted blood component therapy is therefore possible

A recent NICE guideline (August 2014) only recommended the use of ROTEM (and TEG) in cardiac surgery due to insufficient evidence for its use in other areas[22].
The recent 'ITACTIC' study did not show a benefit of viscoelastic haemostatic assay augmented protocols when compared to conventional coagulation test augmented protocols in patients presenting with signs of haemorrhagic shock.

Current trust guidance is that ROTEM should be considered, in conjunction with conventional coagulation assays, for all cases of major haemorrhage. This guidance may change as further evidence becomes available.

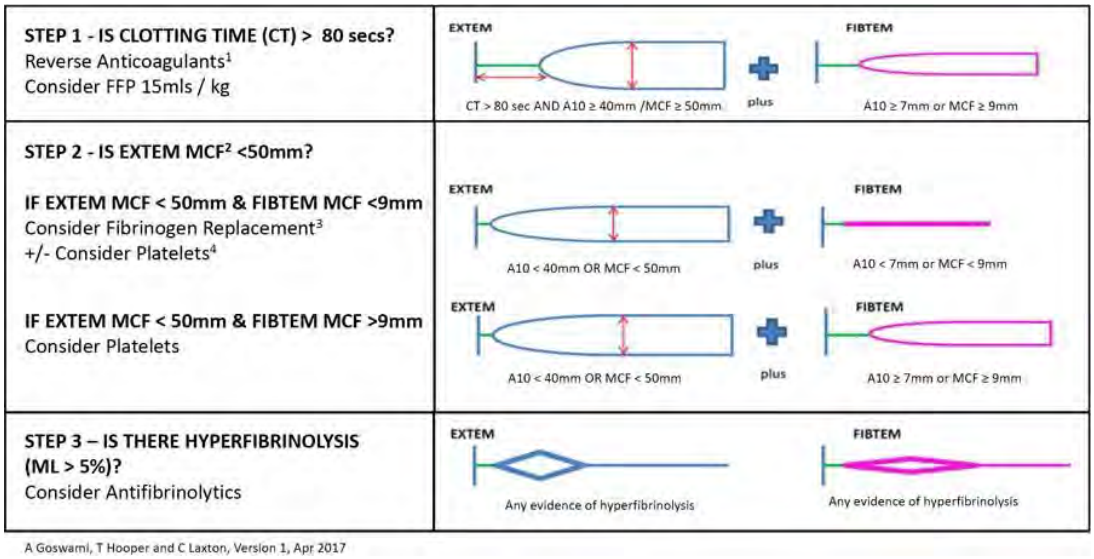
A Guideline for ROTEM Interpretation can be found overleaf [23].

Further information about ROTEM, including the interpretation guideline, can be found in the Critical Care / Anaesthetic Department Guidelines on the Trust intranet.



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.

Parameter	Definition	Range	Unit
Coagulation Activation			
Clotting Time (CT) (synonym r)	Time from test start to 2mm amplitude	EXTEM: 38-79	Seconds (s)
Clot Formation Time (CFT) (synonym = k)	Time from 2 mm amplitude to 20 mm amplitude	EXTEM: 34-159	Seconds (s)
-angle	Angle between baseline and tangent to the clotting curve through the 2 mm point	EXTEM: 63-83	degree (°)
Clot Firmness			
Maximum Clot Firmness (MCF) (synonym MA)	Maximum amplitude reached during the test	EXTEM: 50-72 FIBTEM: 9-25	Millimetres (mm)
A10	Clot firmness (mm amplitude) 10 mins after CT Other time points may be used e.g A15 (15 mins), A30 (30 mins)	EXTEM: 43-65 FIBTEM: 7-23	Millimetres (mm)
Clot Lysis			
Clot Lysis Index at 30 minutes (CLI30)	Ratio of amplitude and MCF, 30 mins after CT Other time points may be used e.g. CLI15 (15 mins), CLI 45 (45 mins)	EXTEM: 94-100	%
Maximum Lysis (ML)	Maximum lysis detected during run time, described as difference between MCF and lowest amplitude after MCF, described in % of MCF.	EXTEM: <15	%



A Goswami, T Hooper and C Laxton, Version 1, Apr 2017

REVERSAL OF ANTI PLATELET AGENTS

The effect of platelet transfusion in the presence of anti-platelet agents is unclear. A systematic review (total 635 patients) examining the treatment of adults on anti-platelet agents with traumatic intracerebral haemorrhage found no evidence to support platelet transfusion. However, all included studies were of low quality (Nishijima 2012).

In vitro experiments suggest that platelet dysfunction caused by aspirin is much easier to correct with platelet transfusion than treatment with clopidogrel or ticagrelor (Vilahur 2006, Hansson 2014, Li 2012). Platelet transfusion to reverse the effects of aspirin however is usually unnecessary as it does not increase bleeding severity for most procedures (Makris 2013). In addition to concerns regarding efficacy, platelet transfusion may increase the incidence of arterial thrombosis in these high-risk patients (Makris 2013). In a pilot study of 14 patients on aspirin and clopidogrel, one patient developed acute coronary syndrome 4 days after receiving two units of platelets to cover urgent surgery (Thiele 2012).

In contrast Tranexamic Acid has been used in three randomised controlled trials in patients taking clopidogrel (with or without aspirin) before coronary artery bypass grafting (total 766 patients). Its use significantly reduced blood transfusion requirements (Shi 2013a, Shi 2013b, Ahn 2012) with no difference in adverse events were reported between the groups. However, the authors advised caution regarding the small numbers and limited follow up (in the two largest studies follow up was for one year).

PROTHROMBIN COMPLEX CONCENTRATE (BERIPLEX P/N) FOR REVERSAL OF ORAL ANTI COAGULATION

Rapid anticoagulation reversal may be required:

- When there is life threatening haemorrhage
- Prior to an emergency invasive procedure

Prothrombin complex concentrate (PCC) is a pooled plasma product, containing Factors II, VII, IX, and X as well as Proteins C and S.
The licensed indication is: "Treatment and perioperative prophylaxis of bleeding in acquired deficiency of the prothrombin complex coagulation factors, such as deficiency caused by treatment with vitamin K antagonists (VKA), or in case of overdose of vitamin K antagonists, when rapid correction of the deficiency is required."
PCC are an accepted, but unlicensed treatment for management of bleeding in patients anticoagulated with Directly Acting Oral Anticoagulants (DOACs).

Requesting
The Blood Transfusion Laboratory will issue Beriplex providing:-

- The indication is within the licensed indications
  - Active bleeding or need to perform an intervention with an INR >2.0
  - Supratherapeutic INR when rapid correction of the INR is required

For off-license indications the case should be discussed with a Haematology SpR or Consultant by the requesting clinical team before Beriplex is issued.

Dosage
The dose of Beriplex and appropriate details should be recorded on a standard transfusion record and filled in the patient's notes.

Warfarin (or other VKA) reversal
25 U/kg if INR 2 – 3.9
35 U/kg if INR 4 - 6
50 U/kg if INR > 6
Maximum single dose for a patient weighing 100kg and over:
INR 2.0-3.9 is 2500 IU
INR 4.0-6.0 is 3500 IU
INR >6 is 5000 IU

DOACs

Rivaroxaban, Apixaban, Edoxaban
These drugs are inhibitors of activated Factor X. The half-life of the drugs is different (in the order of 12 hours), but for all is longer in renal impairment.
There is no specific reversal agent
For life-threatening bleeding consider Beriplex at a dose of 50iu/kg.
Adjunctive therapy will usually include tranexamic acid and may include desmopressin.

Dabigatran
This is an inhibitor of the enzymatic activity of thrombin. For patients taking dabigatran the specific reversal agent idarucizumab (Praxbind) can be administered (stored in ED). The licensed indications are adults treated with dabigatran when rapid reversal of its anticoagulant effects is required for emergency surgery/urgent procedures or in life-threatening or uncontrolled bleeding.
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 a second 5g dose can be considered depending on the clinical situation.

Non-availability of Beriplex
If supply of Beriplex is interrupted the alternative PCC Octaplex should be sourced and offered for clinical use using the dosing guidance for that product.
FRESH FROZEN PLASMA HAS A LIMITED ROLE IN THE MANAGEMENT OF VKA OVERDOSE. If FFP is used instead of a PCC when unavailable, then the recommended dose is 15 ml/kg. FFP is not effective for reversal of DOACs.

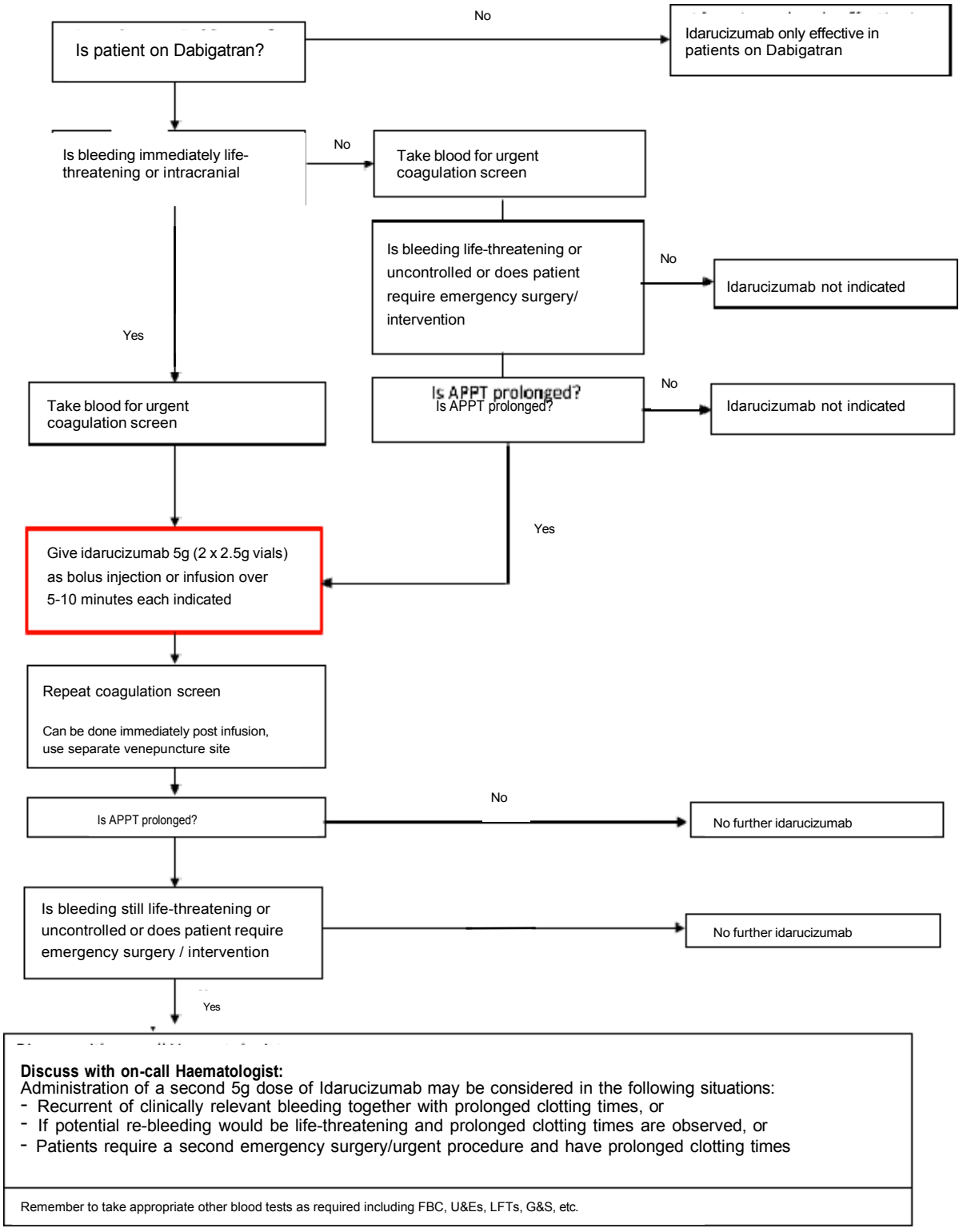
Cautions/side effects:
Care should be taken that blood does not enter the syringe filled with product as fibrin clot may then be administered to the patient.
Hypotension, tachycardia, anginal pain, wheezing, burning/stinging at injection site, chills, flushing, itching, tingling, headache, nausea, vomiting, restlessness and lethargy have been reported following administration. Allergic and anaphylactic reactions have rarely been reported. In a meta-analysis, PCC was associated with a 1.4% risk of thromboembolic events when administered to VKA-treated patients with bleeding complications.

Contraindications and Precautions
See SPC. https://www.medicines.org.uk/emc/product/6354/smpc

Contact numbers: Haematology SpR bleep 1555 or 9441 or via switchboard and ask for the on-call haematologist.

Reconstitution and Administration
See SPC section 6.6. https://www.medicines.org.uk/emc/product/6354/smpc

GUIDANCE ON THE USE OF IDARUCIZUMAB FOR MANAGEMENT OF BLEEDING IN PATIENTS RECEIVING DABIGATRAN



Jason Kendall on behalf of the Thrombosis Committee (February 2016, version 2)

TRANEXAMIC ACID IN SURGERY

Tranexamic acid injection (Cyklokapron®) use in Surgery

Operations with predicted blood loss (greater than 500mLs)

- Tranexamic Acid 1g slow IV injection over 10 mins should be considered in all adult surgical cases with an expected blood loss volume of >500mLs (unless contra-indicated) NICE 2015.
- Consider second dose in patients with 1000mL loss and ongoing blood loss.

Operations requiring Cell Salvage

- Tranexamic Acid 1g slow IV injection over 10 mins should be considered routinely for intra-operative cell salvage (unless contraindicated) NICE 2015.

Trauma and Major Haemorrhage*

- Tranexamic Acid 1g slow IV injection over 10 mins followed by 1g IV infusion over 8 hours (within 3 hours of trauma injury for reduced mortality associated with bleeding) NICE 2012.

VTE

- In conjunction an appropriate VTE risk assessment must be completed and appropriate prophylaxis prescribed

Contra-indications

- Fibrinolytic conditions following disseminated intravascular coagulation
- Seizures
- Allergy to tranexamic acid

Caution**

- Thromboembolic disease
- Oral contraceptive pill (increased thromboembolic risk)
- Relative contraindication use in pregnancy
- Visible haematuria (avoid if risk of ureteric obstruction)
- ↓ eGFR - see renal dosing below

Dosage in Renal Failure and Renal Replacement Therapy (RRT):

Dose in renal impairment		
CrCL (mL/min)	*Dose IV*	Frequency
<10	5mg/kg	24 hourly
10-20	10mg/kg	24 hourly
21-50	10mg/kg	12 hourly
For RRT; CVVHF (on ICU); dose as in CrCl 10-20ml/min, otherwise dose in CrCl<10ml/min.		

Doses are based on Creatinine Clearance (CrCL) rather than eGFR calculated by;

Cockcroft and Gault formula;

$$estimated\ CrCL\ (ml/min) = \frac{(140 - age)\,x\ weight\ x\ c}{Serum\ creatinine}$$

Weight in Kgs, age in years, c = 1.23 for men; 1.04 for women

Online calculator accessible via BNF online > calculators.

*Use of tranexamic acid in trauma patients is unlicensed (off-label).

**Monitor for potential visual disturbance and if necessary discontinue treatment.

References:
NICE guidelines. Blood Transfusion [NG24] Published Nov 2015 Section 1.1.5- 1.18. Available at www.nice.org.uk
NICE advice [ESUOM1]. Significant haemorrhage following trauma: tranexamic acid. Oct 2012. Available at www.nice.org.uk
SPC Cyklokapron Injection. Pfizer Ltd. Last updated Mar 2016. Available at www.medicines.org.uk
The Renal Drug Database. Available at www.renaldrugdatabase.com

v. 01 Raised by: Dr Mark Pyke, Consultant Anaesthetist; Jane Styles, Blood Conservation Co-ordinator and Kate Leonardo, Pharmacist. Approved by: Medicines Governance Group July 2016 Review Date: July 2018

TXA USE IN TRAUMA PATIENTS

KEY POINTS

- Tranexamic Acid (TXA) is indicated in the majority of seriously injured patients and all patients with suspicion of, or clinical signs of major haemorrhage. It should also be used in patients with a suspected isolated traumatic brain injury (TBI).

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

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

- Contraindications include established disseminated intravascular coagulopathy (but obviously not trauma induced coagulopathy), known allergy and history of convulsions (a relative contraindication).

BACKGROUND

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

The 2010 Clinical Randomization of an Antifibrinolytic in Significant Haemorrhage 2 (CRASH-2) showed that TXA was associated with a 1.5% absolute reduction in mortality compared to placebo with no increase in the risk of vascular occlusive events.

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

The 2019 Crash-3 trial (Effects of tranexamic acid on death, disability, vascular occlusive events and other morbidities in patients acute traumatic brain injury) showed that TXA was associated with a reduction in death in patients with mild and moderate TBI.

Many patients arriving at hospitals in the Severn Major Trauma Network will have received TXA in the prehospital setting (now carried as standard on all ambulances and HEMS). 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 (physiological markers include systolic blood pressure of < 90mmHg and 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 Trust within 8 hours of injury, TXA should be administered if not already received.
- Guidance for the prehospital and in-hospital administration of TXA in those patients with suspected TBI are shown below

TXA IN HEAD INJURY

Pre-Hospital

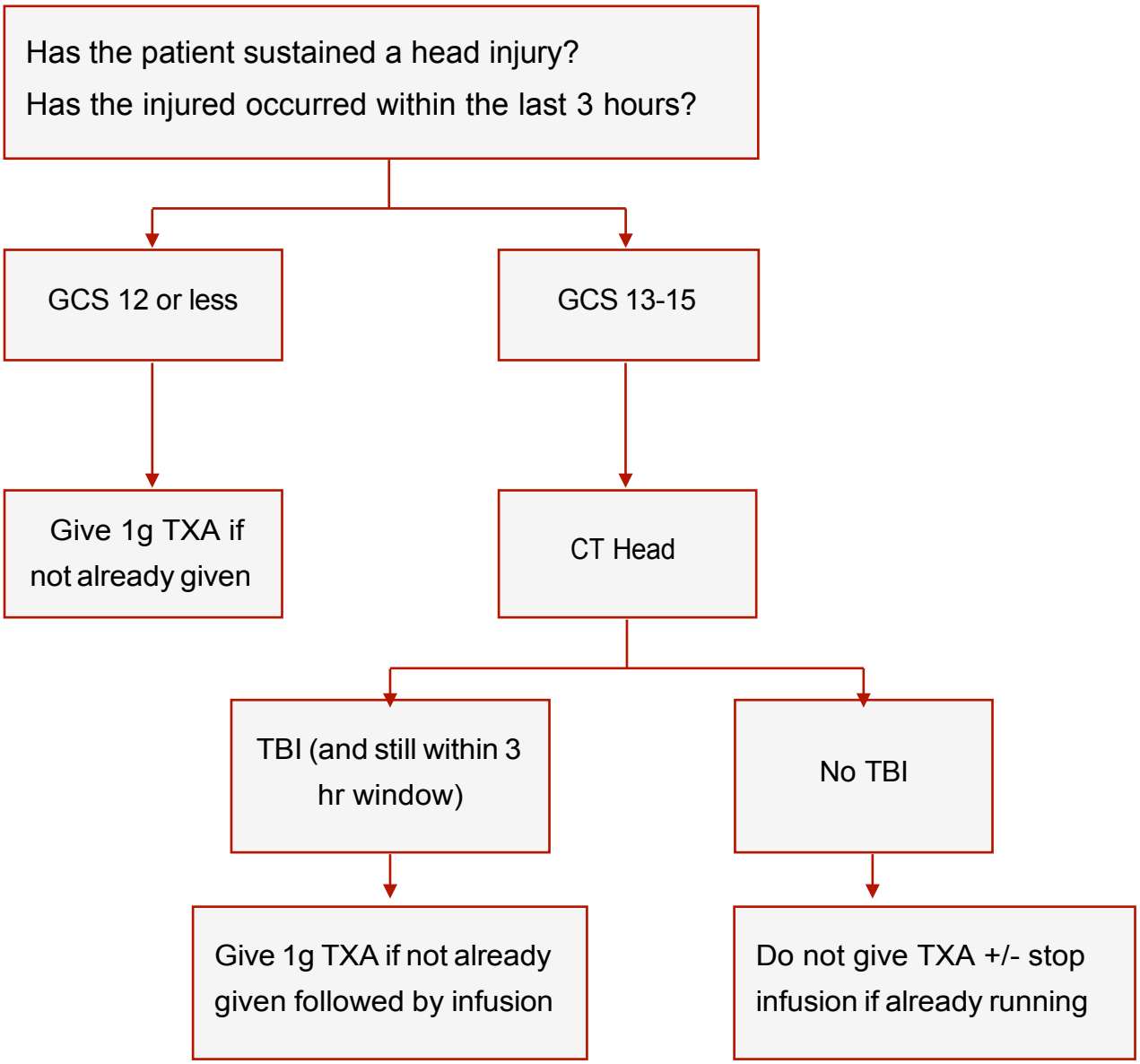
QUESTIONS

Has the patient sustained a head injury?
Has the injury occurred within the last 3 hours?
Is the GCS 12 or less?

TREATMENT

If yes to all 3 questions administer 1g TXA as soon as possible

In-Hospital



DOSE AND ADMINISTRATION

- Initial loading dose: TXA 1g diluted in 100mls 0.9% Saline administered by intravenous infusion over 10 minutes (infusion pump rate of 600ml/hour or a slow bolus over 10 minutes).

- Second dose: TXA 1g diluted in 400mls 0.9% Saline infused over 8 hours (infusion pump rate of 50mls/hour).

CONTRAINDICATIONS AND CAUTIONS

Caution should be taken when using TXA in patients with:

- Known allergy to TXA
- Established DIC (e.g. related to sepsis but obviously not hypofibrinogenaemia or coagulopathy associated with trauma)
- History of seizures (this is a relative contraindication as TXA can cause seizures in high doses)

TRAUMATIC VASCULAR INJURY

KEY POINTS

- If injury mechanism, assessment or investigations raise concerns of significant vascular injury or ischaemia the on-call vascular consultant should be contacted via switchboard.

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

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

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

- 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.

- Local hospitals in the trauma network who feel they do not have the expertise to cover paediatric vascular trauma may contact us to discuss if specified Vascular, Plastics and Paediatric trauma cases may be transferred here if transfer is required

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

INDICATIONS TO CONTACT THE ON CALL VASCULAR CONSULTANT

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.

DIAGNOSIS OF VASCULAR INJURY

History

Important components of the history include:

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

Examination

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

Extensive soft tissue swelling may make evaluation difficult, but a diminished or reduced distal pulse is due to arterial occlusion until proven otherwise.

DIAGNOSIS OF VASCULAR INJURY INVESTIGATIONS

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

Normal Vascular Examination and Ankle Brachial Pressure Index (ABPI) of >0.9

No further vascular input required

Abnormal Vascular Examination or an ABPI of <0.9

Arterial imaging required: CT angiography within 30 minutes of arrival in the ED

Vessel Injury and Distal Circulation Compromise

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.

Hard Signs of Arterial Injury

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).

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:

1. 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).

2. The network on call vascular surgeon should be contacted early via the NBT switchboard and will either:
   i. **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
   ii. **Attend in person**: Unless there is a vascular surgeon on site
   iii. **Transfer Patient**: This only becomes an option once the haemorrhage is controlled, and the patient is haemodynamically stable.

HAEMORRHAGE CONTROL IN VASCULAR EXTREMITY INJURY

This does not include junctional haemorrhage – see below

Initial Control on Non-Junctional Extremity Haemorrhage

A stepwise approach should be used:

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

2. 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.

3. 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.

4. 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 ON 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.

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

2. **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.

3. **Damage control surgical intervention in the ED maybe required:** these measures may include resuscitative thoracotomy, pelvic packing or REBOA.

4. **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.

5. **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).

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).

CHAPTER 7

TRAUMATIC BRAIN INJURY & SPINAL INJURY

TRAUMATIC BRAIN INJURY

SPINAL INJURY

TRAUMATIC BRAIN INJURY

KEY POINTS

- Moderate and severe head injury has around a 5% mortality. Early neuroprotective measures can significantly improve outcomes.
- Early CT head and cervical spine are indicated in the majority of patients with GCS <14.
- 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.
- 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.
- RSI technique in head injury should maintain oxygen saturations >94%, minimise pharyngeal and laryngeal stimulation and avoid unplanned hyperventilation.
- Following RSI, ventilation, volume management and packaging must be carefully considered but rapidly initiated with specific attention to optimisation of cerebral perfusion pressure.
- Emergency control of clinically suspected raised ICP or impeding herniation can be attempted with boluses of 3ml/kg of 5% saline.
- Levetiracetam (Keppra) is now the first line anticonvulsant for patients with significant head injury.
- Patients already taking anticonvulsants who sustain a head injury should have their anticonvulsant therapy discussed with a neurosurgeon. Patients with complex medications to be discussed with neurologist with specialist epilepsy knowledge.

BACKGROUND

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.

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.

This guideline is based on NICE CG176: Head Injury.

INDICATIONS FOR IMAGING AND NEUROSURGICAL INVOLVEMENT

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.

ADULT GLASGOW COMA SCALE		
	Score	
Eye Opening	4	Spontaneously
	3	To verbal command
	2	To pain
	1	No response
Verbal Response	5	Orientated
	4	Confused
	3	Inappropriate words
	2	Incomprehensible sounds
	1	No response
Motor Response	6	Obeys
	5	Localises pain
	4	Flexion – withdrawal
	3	Flexion – abnormal (decorticate)
	2	Extension (decerebrate)
	1	No response

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 current anticoagulant therapy such as warfarin or a DOAC

For patients who have sustained a head injury with no other indications for a CT head scan and who have been receiving anticoagulant therapy, 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 235 for guidance on when intubation and ventilation is indicated prior to a patient with head injury being transferred.

The Retrieve Adult Critical Care Transfer Service provides triage and coordination of all adult critical care transfer referrals 24/7 and should be contacted whenever a critical care transfer is required. See ‘Inter-Hospital Transfer of Major Trauma’ guideline.

ADMISSION AND OBSERVATION

Admission

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
- SpO_2

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.

There 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.

DISCHARGE AND FOLLOW UP

Do not discharge patients presenting with head injury until they have achieved GCS equal to 15, or normal consciousness in infants and young children as assessed by the paediatric version of the GCS. Patients admitted after a head injury may be discharged after resolution of all significant symptoms and signs.

All patients with any degree of head injury should only be transferred to their home if it is certain that there is somebody suitable at home to supervise the patient.

Give verbal and printed discharge advice to patients with any degree of head injury who are discharged from an Emergency Department or an observation ward, and their families and carers. They should be aware of risk factors that indicate the need to return to the Emergency Department.

INITIAL MANAGEMENT OF THE PATIENT WITH TRAUMATIC BRAIN INJURY

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 (PaO_2 <13 kPa on oxygen) or hypercapnia ($PaCO_2$ >6kPa)
- Spontaneous hyperventilation causing $PaCO_2$ <4kPa
- Irregular respirations

If transferring from a trauma unit to the 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:

- PaO_2 >13 kPa
- $PaCO_2$ 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 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.

Analgesia:
Effective multimodal analgesia is associated with better outcomes in head injured patients. Pain can lead to an increase in intracranial pressure and should be managed effectively.
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:
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 CO_2 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 CO_2 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:

1. **Adequate induction agent**

Use of adequate dose of Fentanyl and Ketamine where allowed by the patient's cardiovascular status.
Use 1mg/kg of Rocuronium
Reparalyse frequently
Avoid touching the posterior pharyngeal wall during intubation

2. **Minimal tube movement. Hold the tube when the patient is moved.**

VENTILATION

Ventilate to low normocapnia (end-tidal CO2 of 4.0KPa). This equates to a $PaCO_2$ of approximately 4.5KPa in normal individuals. This minimises the risk of cerebral vasodilation (high $PaCO_2$) and cerebral vasoconstriction (low $PaCO_2$).
High levels of PEEP can increase ICP. Use of more than 5 cmH_2O 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.

PACKAGING

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 / IMPEDING 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.

ANTICONVULSANTS FOR TRAUMATIC BRAIN INJURY

Patient Not Taking Anticonvulsants Prior to Injury

In patients who were not taking anticonvulsants prior to injury, where no witnessed seizure has occurred since injury:

1. Start levetiracetam 1g twice daily
   - No loading dose needed
   - Initial dose intravenously
   - Give subsequent doses via NG/PO if absorbing feed, otherwise continue IV

2. 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:

1. Give loading dose levetiracetam 20mg/kg
2. 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-base 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. Patients with complex medications should be discussed with a neurologist with specialist epilepsy knowledge.

REFERRAL TO NBT NEUROSURGICAL TEAM

Major trauma patients with cranial and spinal injuries can be referred to NBT neurosurgery by completing the referral form at https://www.referapatient.org/new-referral
This form is for EMERGENCY or URGENT specialist referrals only (Cranial & Spinal).

- For Emergency referrals, you may also contact the on-call Neurosurgery Registrar (SpR) through Hospital Switchboard on **0117 9505050** (Ext 45726). This number must not be used for general enquiries.
- The SpR may be on another call or scrubbed in theatre. It may be quicker to alert the SpR via referapatient®. The response may not be immediate as the registrar may be on another call or scrubbed in theatre. If you have not had a response after a reasonable amount of time, then please call switchboard.
- If your referral is critical and you are unable to reach the Neurosurgery SpR, contact the on-call Consultant Neurosurgeon via switchboard **01179505050.**

To make a referral you will need to provide:

- Patient details including 10-digit NHS Number
- Your and your consultant's Trust or nhs.net email
- URGENT transfer of scans via IEP
- Brief history and examination findings
- Your clinical management questions

Sending scans

Transfer of scans can take time. Therefore, please contact your PACS transfer team for urgent transfer of all relevant imaging via the Image Exchange Portal (IEP). If it is an emergency case, please specify 'Clinical Emergency' or 'Blue Light Scan Transfer" on your request. Ensure that the report is attached.

Referral Outcome

The decision/outcome of your referral will be sent back, at the earliest opportunity, to your email address as a PDF file. You can print this letter and file it in the patient's notes or upload to your electronic patient record system.

If you provide your mobile phone number (this will not be visible to anyone including our team), you will be alerted by SMS when the response letter has been sent to you.

Transfer of Care

Remember to handover the patient to a colleague on referapatient.org at the end of your shift. If you do not, you will continue getting clinical emails and will be responsible for the actions.

SPINAL INJURY

KEY POINTS

- 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.

- 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.

- In the conscious, co-operative patient, the need for cervical spine imaging can be excluded 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.

- 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.

SPINAL CLEARANCE

Introduction:

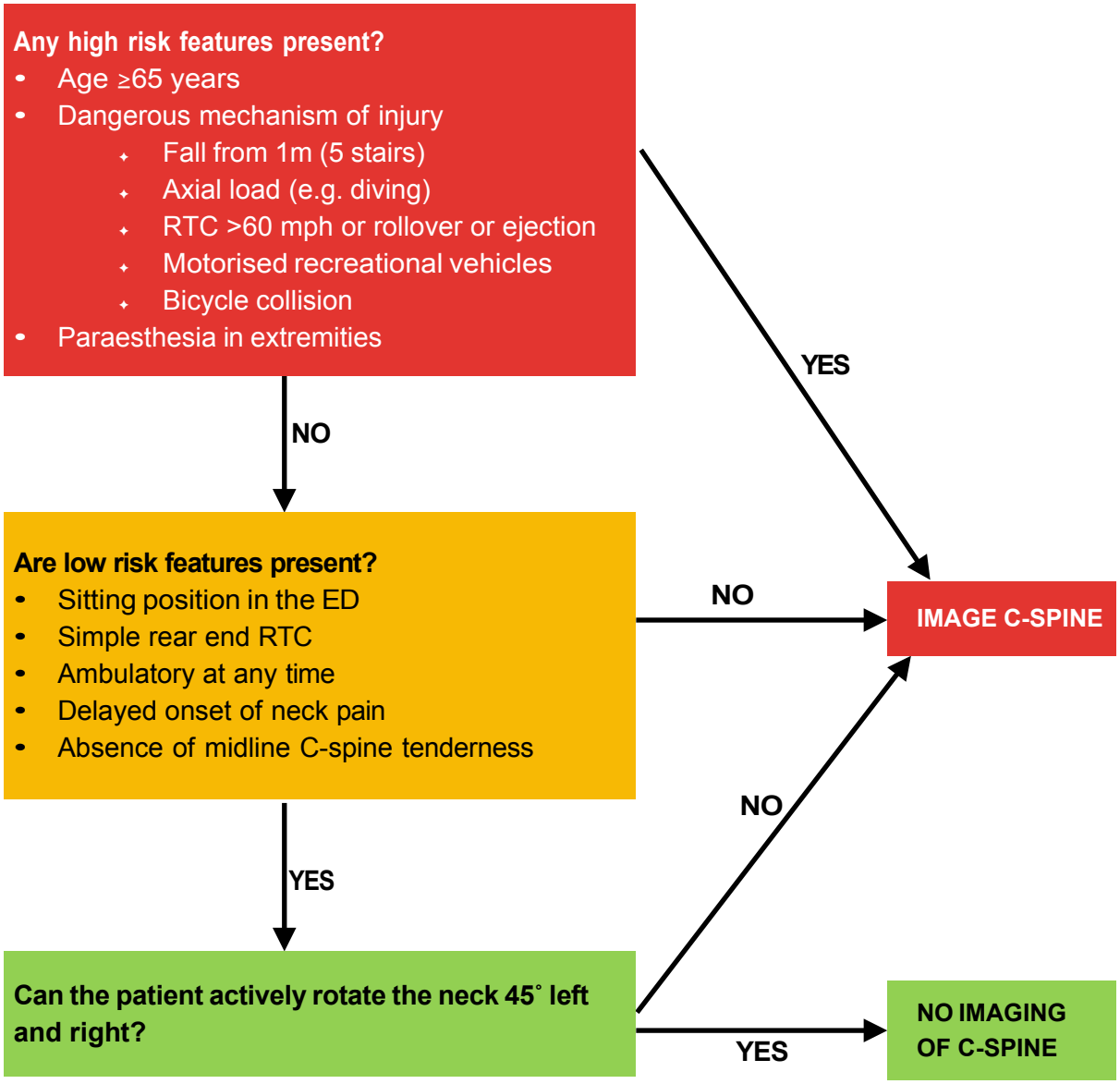
C-spine injuries occur in 2.0-6.6% of blunt trauma patients. Co-existing head injury increases the incidence of C-spine injury to 10%. Injury to the cervical spinal cord in the absence of fracture occurs in 0.07-0.7% of trauma admissions.

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.

Conscious, cooperative Patient:

In the conscious, co-operative patient: the Canadian C-spine rule can be used to exclude the need for imaging.



Still, I. *et al*. The Canadian C-spine rule for radiography in alert and stable trauma patients. *JAMA* 2001; 286:1841-1848

Removal of Cervical Spine Collars

In all patients, cervical collars should be removed as soon as practically possible (Grade III evidence). All extradition collars must be replaced with hospital approved rigid collars within 24 hours of arrival.

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 and principles of manual in-line stabilisation applied 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 may have a role in the conscious patient 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.

Fracture Exclusion

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 neuro-surgeon or 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:

- Hard collars (such as Aspen, 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 or concerns.

TRAUMATIC SPINAL CORD INJURY

ACTIONS ON CONFIRMATION OF SPINAL CORD INJURY

ASIA Score: Patients with traumatic spinal cord injury must have ASIA score performed as soon as possible in the Emergency Department, if patient is clinically assessable. It should be documented if an ASIA score was not performed.

Surgery: Patients with traumatic spinal cord injury requiring surgery should have surgery within 4 hours of injury in MTC if required.

At Trauma Unit: The Trauma Team Leader should contact the specialist Neurosurgical or Spinal Surgeon on call at North Bristol NHS Trust unless local service provision is available (Taunton 24/7 Spine surgeons and Gloucester 8am-8pm Monday-Friday).

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, 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.

Duke of Cornwall Spinal Treatment Centre 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 the Duke of Cornwall Spinal Treatment Centre 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.

See page 252 for further information on referral to the Duke of Cornwall Spinal Treatment Centre.

INITIAL ASSESSMENT AND MANAGEMENT OF SPINAL CORD INJUR

Initial resuscitation should be according to standard trauma principles. The management of a spinal cord injury should be agreed between spinal surgeons and the Duke of Cornwall Spinal Treatment Centre. See page 252 for further information on contacting the spinal cord injury centre.

Airway and Cervical Spine Control

In the conscious patient the patient should be encouraged to keep their neck still in a position of comfort. In the unconscious patient, 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 SaO_2 - maintain at 95 – 98% saturations.
- 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.

Circulation

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 (80-85mmHg ideal). Discuss on referral to the Duke of Cornwall Spinal Treatment Centre.
- Maintain a urine output of ≥0.5mls/kg/hour (patients should have a urinary catheter inserted as soon as possible in the emergency department).
- 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 cardio-vascularly 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 (page 254), should be completed:

- As soon as possible in the Emergency Department (and 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 – patient's 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, Salisbury
Tel: 01722 336 262

Referral to the Spinal Cord Injury Centre:

The Neurosurgical / Spinal Surgeon team is responsible for contacting Duke of Cornwall Spinal Treatment Centre as soon as possible.

- The appropriate location for medical management (including surgery) should be discussed.
- Immediate management plan should be discussed and documented
- Complete the referral paperwork (page 256)
- 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 (page 256)
- 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.

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.

Transfer to the Spinal Cord Injury Centre:

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 page 261

SPINAL CORD INJURY ALGORITHM

Inclusion Criteria
Clinical diagnosis of spinal cord injury resulting in full or partial, para or tetraplegia as a result of traumatic & non traumatic insult (tumour, complete and incomplete cauda equina, abscess and infection, haematoma).

Admission to NBT

Exclusion Criteria
Injury to the vertebral spine without cord injury.

Assessment & Provisional SCI Diagnosis
Neurological assessment, triage/management of associated injuries, respiratory evaluation and neuro-protection therapy

Useful Contact Numbers
Neurosurgical Spinal ANP
Bleep 1192 /1153
Orthopaedic Spinal NP
07798581139
Trauma Network Team NP
Bleep 1630/1623
Neuro Physio Lead
Bleep 1394

ASIA Score within 24 hours and again at 72 hours. Helpful to do this prior to call if possible.

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 SCI level. 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.

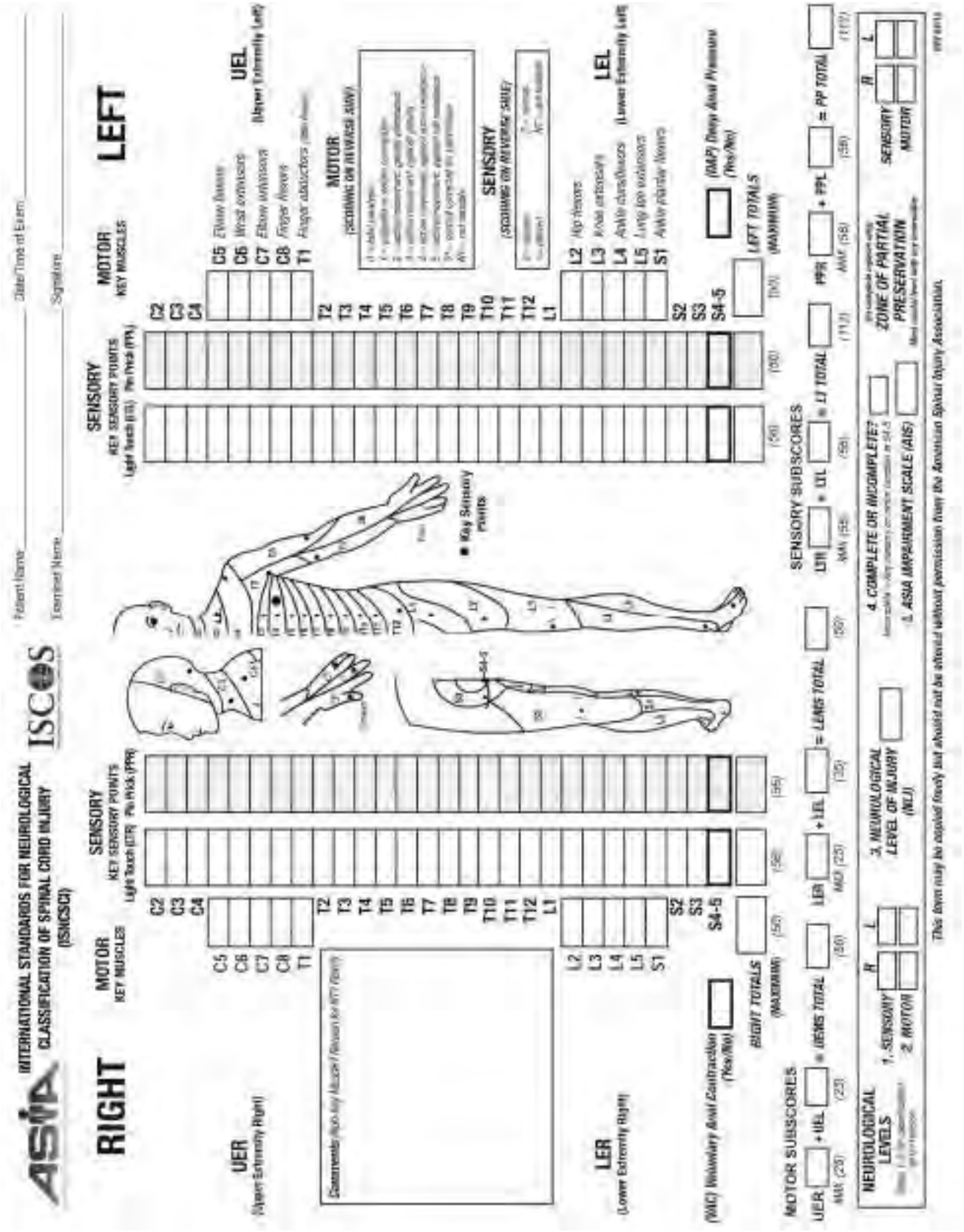
Traumatic SCI Transfers
Transfer to SCIC or local hospital repatriation to be organised as per the trauma pathway guidelines

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

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

ASIA CLASSIFICATION



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 pattern

5 = normal active movement, full ROM against gravity and full resistance in the muscle specific pattern tested

5* = normal active movement, full ROM against gravity and full resistance in the muscle specific pattern tested in a patient who has a demonstrated deficiency due to pain inhibition that would otherwise have graded a 5

NT = not testable (i.e. immobilised, severe pain with first movement, amputation) Cannot be graded unless there is evidence of full ROM

Sensory Grading

0 = absent

1 = altered light touch/pinprick 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 function more than 3 levels below the motor level on each side should be tested to more accurately classify the injury (differentiate between AIS B and C).

Movement	Root level
Shoulder: Scapular protraction (serratus anterior) and elevation (trapezius)	C5
Elbow: Supination	C6
Elbow: Extension	C7
Wrist: Flexion	C7
Finger: Flexion at proximal interphalangeal joint (PIP)	C8
Thumb: Palmar abduction (thenar eminence)	T1
Finger: Abduction of middle finger	T1
Finger: Flexion at distal interphalangeal joint (DIP)	C8
Thumb: Opposition (abductor pollicis brevis)	T1
Finger: Abduction of little finger	T1
Hip: Adduction	L2
Hip: External rotation	L3
Hip: Extension (hamstrings)	L4
Knee: Flexion	L5
Ankle: Inversion and eversion	L4
Toe: MP and IP flexion	S1
Hallux and Toe: Abduction (abductor hallucis)	L5
Hallux: Adduction	S1

ASIA Impairment Scale (AIS)

A = Complete. No sensory or motor function is preserved in the sacral segments S4-5.

B = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 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 caudal sacral segments for voluntary anal contraction (VAC) OR the patient meets the criteria for sacral sparing with incomplete motor function. This includes key muscle functions below the single NLI level, but the majority of key muscle functions below the single NLI have a muscle grade < 3.

D = Motor Incomplete. Motor incomplete. At least half (half or more) of key muscles below the single NLI have a muscle grade ≥ 3.

E = Normal. Sensory and motor function are normal in all segments, and the patient had prior deficits, then the examiner must document evidence (eg, medical records) of prior deficits and then grade the impairment as AIS E.

Using ND: To document the sensory motor and NLI levels, the ASIA motor score (sum of 10 key muscles on each side) and sensory scores (PP and LT) are used to assess sensory and motor function and are recorded on the standard ISCOS worksheet.

ASIA
INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY
ISCOS

Steps in Classification

The following order is used to determine the AIS:

1. Determine sensory levels for right and left sides.
The sensory level is the most caudal segment with normal function for both modalities (light touch and pin prick).

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 the supine exam), provided the key muscle functions proximal to the specified level are graded as normal (5 or 5*). Note: in regions where there is no myotome to test, the motor level is presumed to be the segment rostral to the last normal myotome, if the adjacent segment is also normal.

3. Determine the neurological level of injury (NLI).
This is the most caudal segment with intact sensation and antigravity (≥3/5) muscle function strength, provided that there is normal function rostrally. The NLI is the most caudal segment with normal function. If sensory and motor levels differ, the more rostral level is used.

4. Determine whether the injury is Complete or Incomplete.
Presence of sacral sparing (voluntary anal contraction OR any sensory or motor function in the lowest sacral segments S4-5) = No AND all levels below the neurological level are absent = Yes. With injury is Complete.
Otherwise, injury is Incomplete.

5. Determine ASIA Impairment Scale (AIS) Grade:
Is injury Complete? If YES, AIS=A (no need to proceed with more examinations)

NO ↓

Is injury Motor Complete? If YES, AIS=B
(Voluntary anal contraction OR motor function more than three levels below the motor level on either side of the body)

NO ↓

Are at least half (half or more) of the key muscles below the neurological level of injury graded 3 or better?

NO ↓ AIS=C. YES ↓ AIS=D

If sensation and motor function is normal in all segments, AIS=E
(Note: AIS E does not imply that there was no spinal cord injury, but rather that there is no longer any objective neurological impairment. Spinal cord injury may initially present with transient spinal shock.)

SPINAL CORD INJURY CARE PATHWAY

Part 1: Patient Information	
Patient Name:	
Date of Birth:	
Hospital Number:	
Address:	
Consultant Neurosurgeon / Orthopaedic Surgeon / Other Responsible for SCI Care:	

Part 2: Admission Details				
Date and Time of Injury				
Mechanism of Injury	Traumatic SCI		Non Traumatic SCI	
Date	**Provisional / Actual Spinal Cord Injury Diagnosis**			

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

1st	Within 4hrs of admission by assessing Dr	ASIA Completed		Date	Sign
2nd	Within 24hrs of admission	ASIA Completed		Date	Sign
3rd	Within 72hrs of admission	ASIA Completed		Date	Sign
4th	Further neurological changes	ASIA Completed		Date	Sign
5th	Further neurological changes	ASIA Completed		Date	Sign
6th	Further neurological changes	ASIA Completed		Date	Sign
7th	Further neurological changes	ASIA Completed		Date	Sign

REFERRAL TO SPINAL CORD INJURY CENTRE

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) http://www.nscisb.nhs.uk				
Form completed by:	Name	Date	Time	Signature

Part 2: Please Record the Plan from SCIC		
		Deviation from SCIC plan:
Ventilation		Y□ N□
Circulation	MAP Target: Duration:	Y□ N□
Position:		Y□ N□
DVT		Y□ N□
Skin		Y□ N□
Gastric Protection	□ NBM/ □ NG Free drainage/ □ NG feed	Y□ N□
Bladder	□ Indwelling catheter/ □ Suprapubic catheter □ Self-Intermittent catheterisation	Y□ N□
Bowel	Commence NBT neurogenic bowel pathway: □ Reflexic pathway / □ Areflexic pathway	Y□ N□
Autonomic Dysreflexia	At risk of AD? Y□ (if SCI at or above T6) / N □	Y□ N□
Mental Health	Mental health referral advised? Yes □ / No □	Y□ N□

Document deviation and reasoning if any:

Section 2. SCIC Outreach visits – visits by specialist spine practitioners		
Date	Advice given	Sign

TRANSFER TO SPINAL CORD INJURY CENTRE CHECKLIST

Transfer to SCIC Checklist	Yes	No	NA
Does this patient need a HDU or ITU bed?			
Immobilisation of the spine is adequate and secure			
Long bone fracture immobilisation			
Airway is clear and can be maintained during transfer Intubate if PaCO2 is >*5.5* KPa or if respiratory failure is likely to develop during a prolonged transfer			
Supplemental O_2 is being administered and ventilation is adequate whether spontaneous or assisted. Voluntary vital capacity should exceed > 15 ml/kg: elective ventilation if incipient or frank respiratory failure			
Chest drainage if pneumothorax or haemothorax before transfer			
IV is patent and infusing at desired rate			
Naso-gastric tube is in situ, draining freely.			
Indwelling urinary catheter is in situ and draining freely			
Skin is protected from injury and apparatus or debris which may cause pressure ulcers is cleared away			
Level of spinal cord injury is documented			
Other injuries – thorax, abdomen, pelvis etc. are documented and stabilised			
Any head injury documented and monitored			
Copy of medical records, drug charts and test results			
X-rays or radiology images have been transferred using: Image Exchange Portal □ Decrypted CD □			
Nurse to Nurse handover			
Family/relatives aware of transfer			

Repatriation to another Hospital:	**Yes**	**No**	**NA**
Copy of Medical records, drug charts and test results including SCI care documents.			
Nurse to Nurse handover			
Transfer letter			
Outpatients Appointment? Date_____ Time_____			
Planning for home	**Yes**	**No**	**NA**
TTA completed and dispensed			
Family aware of discharge			
Transport Booked			
Package of Care set up			

CHAPTER 8

ABDOMEN & PELVIS

ASSESSMENT AND MANAGEMENT OF MAJOR ABDOMINAL TRAUMA

KEY POINTS

- All patients with suspected abdominal injuries who remain cardiovascularly unstable in spite of full resuscitative measures should undergo immediate emergency damage control laparotomy.
- 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.
- In the presence of a pelvic fracture, a binder should be in place before laparotomy is performed.
- Damage control surgery or interventional radiology procedure should be undertaken concurrently with haemostatic resuscitation.
- 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.
- If high-grade liver injuries are present on CT, consider contacting the on-call hepatobiliary surgeon at University Hospital Bristol.
- 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.

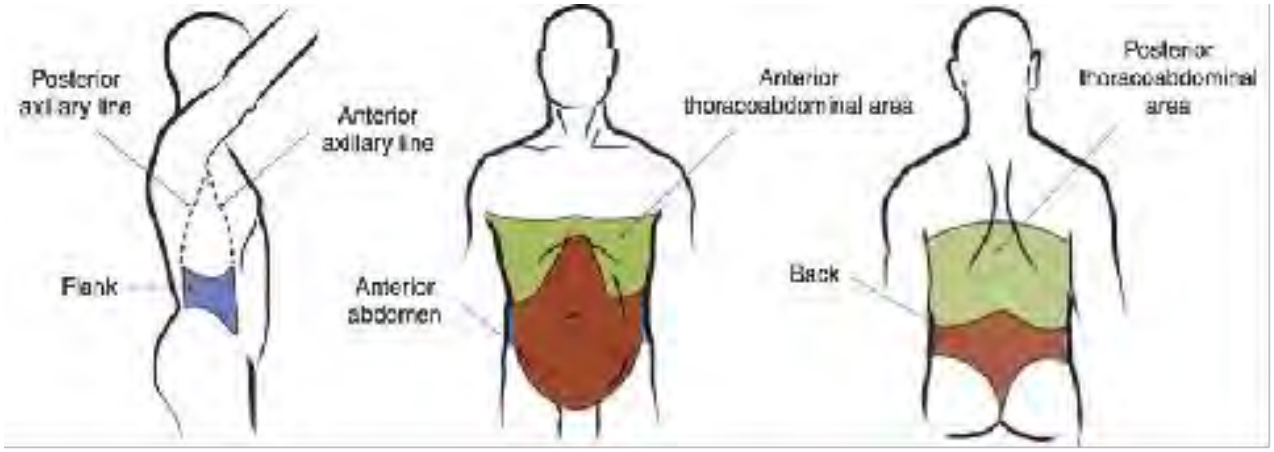
OPERATIVE MANAGEMENT OF ABDOMINAL TRAUMA

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 crepitation (association with hepatic/splenic injury)

When the need for damage control surgery is suspected the trauma team leader should contact the on-call GI surgical consultant directly, as soon as possible – preferable prior to patient arrival or the trauma CT.
When 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, with an AbTHERA or other negative pressure wound closure system. DCS is performed 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.

Control of intra-abdominal haemorrhage should be the first priority to minimize the need for transfusion, followed by control of gastrointestinal contamination. Injuries to the gastrointestinal tract should be evaluated, the primary aim is contamination control. This is often best achieved by rapid stapling and resection of damaged area of the GI tract, without immediate anastomosis or complex repair. Formal repair in a systematic manner or reconstitution of intestinal continuity should be a plan for the second or subsequent look laparotomies in all but the simplest of cases..

Please refer to NBT Damage Control Laparotomy protocol for detailed theatre team management 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 other senior surgeons, the TTL or ICU consultant to ascertain whether continuing surgical intervention is appropriate.

DIAGNOSTIC LAPAROSCOPY

Absolute contraindications to laparoscopy, requiring damage control laparotomy are haemodynamic instability, evisceration, diffuse peritonitis and/or impalement as above.

The role for diagnostic laparoscopy in trauma is increasing in selected cases and where used can help avoid full laparotomy (in up-to 45% of cases - and thereby reducing the length of stay, morbidity and cost). Particularly for inspecting the diaphragm in thoraco-abdominal wounds and evaluating the depth of wound tracts and identifying visceral injury in patients with equivocal or limited peritoneal penetration. The use of therapeutic trauma laparoscopy is limited to isolated diaphragmatic injuries, or clearly isolated and single intestinal injuries.

Therefore, **consider** diagnostic laparoscopy in the haemodynamically stable patient for assessment of:

- Penetrating abdominal trauma (to assess whether the peritoneum has been breached +/- management of limited subsequent injury)
- Suspected diaphragmatic injury in thoraco-abdominal trauma
- Isolated liver trauma with initial non-operative management with suspected bile leak requiring washout.

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 there 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.

Any planned non-operative management (including interventional radiology) of solid organ trauma MUST be discussed directly with the GI consultant on call – ideally directly between the TTL and consultant surgeon.

LIVER INJURIES

The initial management of patients with blunt hepatic trauma should be mandated by their haemodynamic (and contamination) 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 / V injuries are universally hemodynamically unstable, mandating intervention, but can still be successfully managed non-operatively with successful interventional radiology.

If high-grade liver injuries are present on CT please contact the on-call hepatobiliary surgeon at University Hospitals Bristol, if interventional radiology fails or damage control laparotomy is required.

Operative Management

Control of hepatic haemorrhage is approached in a step-wise fashion initially using simple measures and progressing to more aggressive techniques, as needed.

- Initial control of bleeding is performed with manual compression, perihepatic packing or portal clamping.
- Ongoing mild-to-moderate bleeding from the parenchyma can be controlled using topical haemostatic agents, electrosurgical techniques, and ligation of the parenchymal vessels.
- For more severe injuries, liver suturing techniques or hepatic artery ligation may be needed.

If these techniques fail, the segment of liver may need to be resected (although this is preferably part of a later procedure rather than the primary trauma laparotomy). If there is difficulty in controlling bleeding, please contact the hepatobiliary surgeon on call at University Hospital Bristol.

Non-operative Management

Non-operative management Is the treatment of choice for haemodynamically stable, or resuscitation responsive, 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 of the abdomen have higher failure rates with non-operative management, and these patients should undergo arteriography and possible liver embolisation followed by continued observation and serial haemoglobin determination. Angiography with embolisation should be considered in a haemodynamically stable patient with hepatic injuries with evidence of active extravasation (a contrast blush) on abdominal CT scan.

In general, the principals of non-operative observation are:

Initial 48 hours:

- ICU admission mandated for a minimum of 24-48 hours for those with injuries classified as grade III or above. Central ward bay on the trauma ward is suitable for grade I/II injuries.
- Bed rest (with exception of toileting)
- Continuous monitoring until stable for grade III & above (otherwise 1-2 hourly observations on the trauma ward bay).
- 6 hourly Hb monitoring until stable (twice a day for grade I/II injuries)
- Formal anticoagulation reversal if safe (take an individualised approach)
- Mechanical VTE prophylaxis

Subsequent inpatient stay:

- Ambulation and light activity
- Daily Hb monitoring
- Consider VTE chemoprophylaxis as soon as possible in stable patients
- Minimum stay of 3 days (for isolated liver injuries), 7 days for grade IV / V injuries – as secondary haemorrhage / need for operative intervention generally occurs days 5-7.

Diagnostic laparoscopy has been successfully utilized for further assessment of isolated liver injuries in paediatric trauma patients who were initially managed non-operatively. This could be considered in caution with adults with injuries that fail to show improvement, especially if bile washout is required..

LIVER INJURIES FOLLOW UP CARE

A length of stay between 3-7 days depending on grade of injury would be appropriate for patients with isolated hepatic trauma.

All patients whether managed operative or non-operatively should be provided with a patient information leaflet including safety netting advice on discharge with recommendation to return to hospital if they experience abdominal pain, light-headedness, nausea or vomiting

It is a common recommendation that patients avoid strenuous activities for 3-4 months (particularly higher grade injuries), in recognition that the majority of liver lesions heal in 4 months. An alternative is to use follow up CT or USS at 6 weeks and if significant healing is seen then activity could resume at this time. If liver injury is still evident on first follow up scan a second scan at 3 months in indicated. Liver pathology remaining beyond 3-4 months on imaging should be referred to the hepatobiliary service at University Hospital Bristol.

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 embolization – the decision for which must involve the Consultant GI surgeon on call.

Operative Management

The decision to perform splenectomy versus splenic salvage (splenorrhaphy or partial splenectomy) is made based upon the grade of injury, presence of associated injuries, patient's overall 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, surgical or IR, 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 co-morbidities who may not tolerate a significant or recurrent episode of hypotension or a second surgical procedure.
Splenectomy is also 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, are hypothermic, acidotic, coagulopathic, and will likely only poorly tolerate recurrent haemorrhage.

Embolisation

Angiography and angioembolisation of the spleen, 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. Direct angiography is indicated if signs of persistent haemorrhage in patients under observation, even in the absence of a contrast blush on CT angiogram

Splenic embolisation is associated with risks including re-bleeding, pseudoaneurysm formation at the arterial puncture site, splenic infarction, splenic/sub-diaphragmatic abscess, inadvertent embolisation of other organs 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.

Non-interventional Management

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.

Relative contraindications to non-operative management, are patients with MORE THAN ONE of these risk factors and should be considered for early laparotomy and splenectomy (however intensive monitoring and a higher index of suspicion may be more appropriate). The most recent data shows failure of non-operative management to have a detrimental effect on mortality and LOS

Risk Factors:

- Over the age of 55
- A high injury severity score
- More severe splenic injury (III – V)
- Portal hypertension
- Large volume haemoperitoneum
- Traumatic brain injury
- Refusal of blood transfusion in the setting of pre-existing anaemia
- Altered neurological status precluding serial abdominal examination

Hemodynamically stable patients with low-grade (I to III) blunt or penetrating splenic, and selected higher grade blunt, injuries may be initially observed safely.

In general, the principals of non-operative observation are:

Initial 48 hours:

- ICU admission mandated for a minimum of 24-48 hours for those with injuries classified as grade III or above. Central ward bay on the trauma ward is suitable for grade I/II injuries.
- Bed rest (with exception of toileting)
- Continuous monitoring until stable for grade III & above (otherwise 1-2 hourly observations on the trauma ward bay).
- 6 hourly Hb monitoring until stable (twice a day for grade I/II injuries)
- Formal anticoagulation reversal if safe (take an individualised approach)
- Mechanical VTE prophylaxis

Subsequent inpatient stay

- Ambulation and light activity can begin in a number of days equal to the grade of injury plus one (e.g. day 4 for a grade III injury)
- Daily Hb monitoring
- Consider VTE chemoprophylaxis as soon as possible in stable patients
- Minimum stay of 3 days (for isolated grade I/II),

Note that the majority of patients who fail non-operative management do so in the first 24 hours, while 96% will within the first 4 days. 7 days observation is advised for grade IV/V injuries – as 50% have a need for operative intervention which drops after 7 days.

Post Splenectomy Vaccination:

Immunization is recommended for asplenic patients, ideally these should occur at 14 days following splenectomy for maximal immunologic benefit. This may not be feasible in all trauma patients given sporadic follow-up in this patient population. Therefore, if doubts exist splenectomy patients should be immunised at the time of discharge, regardless of the postoperative day if they have not a clear plan in place for 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.

SPLENIC INJURIES FOLLOW UP CARE

The mortality of late splenic rupture is considerably higher than acute rupture (15% compared to 1%). For that reason, timing of discharge and post discharge advice for patient with non-operative management is crucial.

All patients whether managed operative or non-operatively should be provided with a patient information leaflet including safety netting advice on discharge with recommendation to return to hospital if they experience abdominal pain, light-headedness, nausea or vomiting.

Patients who have undergone splenectomy can return to normal activity after 3 weeks. For those managed non-operatively it is a common recommendation that patients avoid strenuous activities for 3-6 months (particularly higher grade injuries). A follow up USS at 12 weeks with healing complete, allows normal activity to resume. If splenic injury is still evident on first follow up scan, further scans at 3 months intervals is indicated.

BOWEL INJURIES

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 is an indication for laparoscopy or laparotomy.

Operative Management of Bowel Injuries

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.

In damage control surgery (DCS), repair of gastrointestinal injury should be delayed until after haemodynamic stabilization, (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.

Evaluation of duodenal injury requires mobilizing 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.*

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.

For high grade injuries to the upper GI tract, including all oesophageal perforations, please contact the Oesophago-gastric surgical team, second on call, at UH Bristol.

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.

If there is evidence of large bowel injury, the involved region of the colon should be fully mobilized to allow inspection of the colon circumferentially.
Patients who are haemodynamically stable with limited extra-GI injuries should undergo definitive management of their bowel injuries at initial exploration.

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

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 on-call 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 stabilization, definitive resection and reconstruction (Whipple) can be performed by the hepatobiliary team at UH Bristol.

RENAL INJURY

History and examination: the mechanism of injury may suggest a renal injury (rapid deceleration injury or direct blow to flank). Most renal injury in the 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 contralateral 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

RENAL INJURY MANAGEMENT

Management should be in collaboration with the consultant Urologist on-call

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 reassess 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.

RENAL INJURY 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.

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 page 215.

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 (AbThera trademark KCl) – please see the separate TACS SOP. 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, over the liver and into the pelvis. 2 sponge layers are applied, in the midline wound, with the aim to closely medialize the two wound edges, 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, rarely 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. The primary aim of every re-look laparotomy is primary closure of the abdomen – NEVER just a change of VAC dressing. If an abdomen is left open the aim is to close it within 10 days / 4th re-look. 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 or Phasix mesh

Management of the open abdomen should ALWAYS be consultant lead. The leads for the open abdomen at NBT - Mr James Hopkins or Miss Anne Pullyblank, are always 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 or Phasix mesh to bridge the fascial defect will aid changing to conventional Vacuum assisted dressing. 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 and can be referred to one of the leads for complex abdominal wall reconstruction at NBT, Mr James Hopkins, Mr C Wong or Mr I Tonga.

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.

Tetanus:

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

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:

_____

_____

_____

_____

_____

_____

_____

Team Brief

1. Trauma Team Leader to state:

- ☐ Age
- ☐ Time of injury
- ☐ Mechanism
- ☐ Injuries
- ☐ Signs/symptoms
- ☐ Treatment given
- ☐ Blood products/tranexamic acid given
- ☐ Co-morbidity
- ☐ Allergies

2. Abbreviated WHO checklist:

- ☐ Team members
- ☐ Patient ID
- ☐ Antibiotics
- ☐ Blood bank informed of transfer to theatre

3. Surgeon to state:

- ☐ Surgical plan
- ☐ Specialist kit required
- ☐ Patient positioning (both arms out and nipples to knees exposed)

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.

	SITREP 1: 10 mins	SITREP 2: 20 mins	SITREP 3: 30 mins	SITREP 4: 40 mins	SITREP 5: 50 mins
Time since start of procedure					
Anaesthetist states:					
1. Cardiovascular stability					
2. Clotting (ROTEM +/-lab results)					
3. TOTAL blood products given					
4. ABG (every 20 mins)					
Surgeon states:					
1. Surgical progress (vascular control, need for packing)					
2. Any new findings/ problems					
3. Surgical plan					

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:

Abdominal Trauma

Uncontrollable haemorrhage. Patient peri-arrest

Patient stable

Direct to theatre. No CT

CT

Significant abdominal trauma / patient becomes unstable.

Bowel injury, free air, free fluid

Vessel injury, solid organ injury, haematoma

Injury not requiring immediate intervention.

Proceed with DCS principles

Patient stable

Discuss with interventional radiology and GI / vascular surgery consultant

Significant injury

Minor injury

Management:
- Laparotomy with damage control surgery principles - haemorrhage & contamination control
- ICU for restoration of physiology prior to definitive procedure(s)

Management options:
- Laparotomy
- Diagnostic laparoscopy
- Active observation

Management options:
- Interventional radiology
- Laparotomy
- Active observation

Management: Active observation on ITU

Management: Active observation on ward

If patient becomes unstable:

Consider need for additional imaging
Consider need for further discussion with IR

Further management options:
- Laparotomy
- Interventional radiology
- Control of extra-abdominal injuries and haemorrhage

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

Grade I – Minor contusion without duct injury or superficial laceration without duct injury

Grade II – Major contusion without duct injury or tissue loss, or major laceration without duct injury or tissue loss

Grade III – Distal transection or parenchymal/duct injury

Grade IV – Proximal transection or parenchymal injury involving ampulla

Grade V – Massive disruption of the pancreatic head

KIDNEY INJURY GRADING

Grade I – Subcapsular, non-expanding contusion/haematoma without parenchymal laceration

Grade II – Non-expanding perirenal haematoma or cortical laceration <1cm deep without urinary extravasation

Grade III – Cortical laceration >1cm without urinary extravasation

Grade IV – Laceration: through corticomedullary junction into collecting system **or** Vascular: segmental renal artery or renal vein injury with contained haematoma or partial vessel laceration, or vessel thrombosis

Grade V – Laceration: shattered kidney **or** Vascular: renal pedicle or avulsion

PELVIC AND ACETABULAR FRACTURE MANAGEMENT

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

1. British Orthopaedic Association Audit Standards for Trauma 'The Management of Patients with Pelvic Fracture', January 2018

2. British Orthopaedic Association Audit Standards for Trauma "The Management of Urological Trauma Associated with Pelvic Fracture", August 2016

3. NICE Guideline NG37: Fractures (complex): assessment and management, February 2016

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

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

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

- 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.

- 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.

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

- 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.

- 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.

- 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.

- The only indication for IR selective embolization 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 pre-hospital 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.

Vascular 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 FRACTURES

- 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 embolization 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).

DECISION MAKING IN UNSTABLE PATIENTS

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 catheterization, 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.

OPEN PELVIC FRACTURES

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:

1. Immediately for highly contaminated wounds (agricultural, aquatic, sewage) or when there is an associated vascular compromise.
2. 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:

1. Antibiotic prophylaxis for infection
2. Pelvic stabilisation by external fixation.

ACETABULAR FRACTURES

Combined Acetabular and Pelvic Injury

It's 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 NBT.

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 enoxaparin 40mg s/c od (or other LMWHeparin) 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.

DOCUMENTATION

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 (p323).

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 on page 305.

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 on page 305. 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.

PELVIC AND ACETABULAR REFERRAL FORM

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

Date of INJURY	
Date of REFERRAL	
NAME of patient	
Date of birth (Age)	
HOSPITAL & WARD	
Mechanism of injury	
Type of injury	
Neurovascular complications	YES / NO If YES, please give details:
Urethral injuries Perineal injuries Rectal/vaginal injuries	YES / NO If YES, please give details: YES / NO YES / NO
Catheter in situ	YES / NO
Associated Injuries Past Medical History	
Treatment to date:	
CT Performed	YES / NO [All referrals must have fine cut CT]
Relevant imaging	Pelvic #: AP pelvis, Inlet & Outlet views YES / NO / NA Acetabular #: AP pelvis & Judet views YES / NO / NA
Referring consultant	
Contact telephone numbers (Office and mobile)	Office Mobile

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.

PELVIC FRACTURE CHECKLIST

Date of planned procedure:

In addition to 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

Surname: First Name: Affix Pa>ent Label Here DoB: NHS Number:	Ward: Date: Time: Date of Injury: NBT Admission Date: Referring Hospital: Clinical Summary: Name, Grade, Role & Signature:

	Complete	Initial and Date
Neurological Examination		
Rectal / Vaginal / Perineal Examination		
Genito-urinary injury (ascending urethrogram)		
AP Pelvis Radiograph		
*Acetabular fractures – pre-op Judet views		
* Pelvic ring injury – inlet / outlet views		
CT scan pelvis / acetabulum / lumbar spine		
Blood tests: FBC, U&E, clotting, group and save		
4 units of RBC cross matched for theatre		
Thromboprophylaxis and gastric protection		
Antibiotic propylaxis (teicoplanin and gentamicin)		
NSAIDs stopped		
Duplex scans both legs if delay from injury >3 days		
MRSA swabs taken		
Consent and marked		
Signature		

Post-Op

	Complete	Initial and Date
Neurovascular status of lower limbs		
FBC, U&E within 24hrs of operation		
AP film within 24 hours		
Fine cut CT scan within 3 days (excluding THR)		
Duplex ultrasound both legs 7-10 days		
Thromboprophylaxis		
Heterotrophic ossification prophylaxis (Y/N)		
Weight bearing instruction		
Dictate discharge summary by surgeon		
Physio plan in place		
Transfer back agreed with base hospital		
Follow-up arrange (6/52 pelvic clinic)		
Planned treatment for associated injuries		
Signature		

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.

CHAPTER 9

EXTREMITIES

OPEN FRACTURES

KEY POINTS

- Initial assessment and management should be undertaken in accordance with BOAST 4 & NICE NG37 standards.

- Administer antibiotics and analgesia as soon as possible, ideally within 3 hours of injury and in the pre-hospital setting if at all feasible.

- 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.

- **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 the major trauma centre at Southmead should be at consultant-to-consultant level.

- 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.

- In exceptional circumstances where surgical management of an open fracture must be delayed, appropriate management comprises debridement, stabilisation and dressing.

MANAGEMENT OF OPEN FRACTURES

Immediate Management: Initial assessment and management should be undertaken in accordance with the BOAST 4 standards.

Clinical Assessment:
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 systemically assessed, particularly after reduction or application of splintage.

- 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 AND ANALGESIA

Antibiotics (Flucoxacillin 1g and Gentamicin 3mg/kg or Teicoplanin 400mg and Gentamicin 3mg/kg if penicillin allergic) should be administered within 3 hours and in the pre-hospital 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.

Splintage:

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, preferably CT scan of the limb with should be undertaken in all patients.
- **CT Angiography should be undertaken for all open lower limb fractures and should ideally be included with the Trauma Scan whenever possible (unless this will delay emergency, life saving 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.
- 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 skeletal stabilisation and definitive vascular reconstruction
- Compartment syndrome also requires immediate surgery, with 4 compartment decompression via 2 incisions (see separate guideline)
- Urgent surgery is also needed in some multiply injured patients with open fractures or if the wound is heavily contaminated by marine, agricultural or sewage matter.
- 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
- The wound, soft tissue and bone excision (debridement) is performed by senior plastic and orthopaedic surgeons working together on scheduled trauma operating lists within normal working hours and within 24 hours of the injury unless there is marine, agricultural or sewage contamination, or vascular compromise
- 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:

- 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
- a limb is deemed unsalvageable after orthoplastic 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 MTC

Centres that cannot provide combined plastic and orthopaedic surgical care for severe open tibial fractures must transfer 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, dressing 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 9505050**) or the orthopaedic consultant on-call.

COMPARTMENT SYNDROME

KEY POINTS

- All patients with a significant limb injury should be assessed specifically for compartment syndrome.

- Compartment syndrome is a clinical diagnosis – symptoms and signs are outlined opposite

- If the clinical picture is unclear, compartment pressures may be measured

- 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

- Acute compartment syndrome is a surgical emergency with surgical release performed within 1 hour of definitive diagnosis

- Following surgical decompression, the patient should be referred to the on-call plastic surgical team at Southmead Hospital.

DIAGNOSIS OF COMPARTMENT SYNDROME

All patients with a significant limb injury should be assessed specifically for 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

Later signs:

- Paraesthesia
- Diminished or absent pulses
- Delayed capillary refill
- Cool skin with pallor/mottling
- Neurological changes (evolving sensory/motor deficit)

In obtunded patients, or where the clinical picture is unclear compartment pressures may be measured (either a single or continuous measurement).

- If the absolute compartment pressure is greater than 40 mmHg, with clinical symptoms, urgent surgical decompression should be considered unless there are other life-threatening conditions that 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's 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
- Level of pain
- Conscious level
- Response to analgesia
- Any regional anaesthesia given
- Neurovascular status of the limb

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

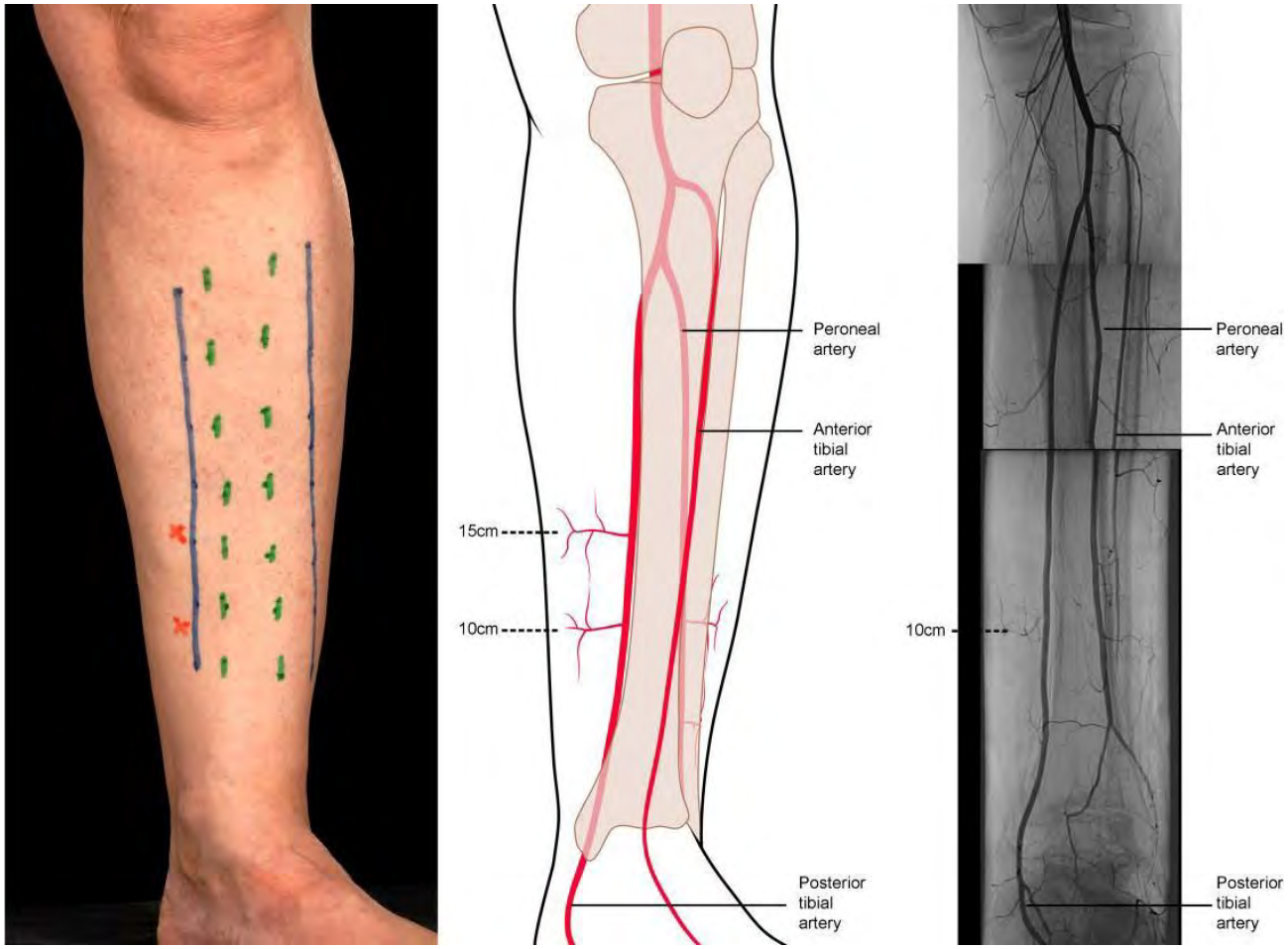
Acute compartment syndrome is a surgical emergency. Once definitively diagnosed, surgical release should be performed urgently (within 1 hour). Surgical treatment should not be delayed for any reason, including starvation status or bed availability.

Immediate treatment:

- All circumferential dressing should be removed
- Elevate the limb to heart level
- Avoid all regional anaesthesia and patient controlled analgesia
- Oxygen
- Optimise blood pressure
- 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.

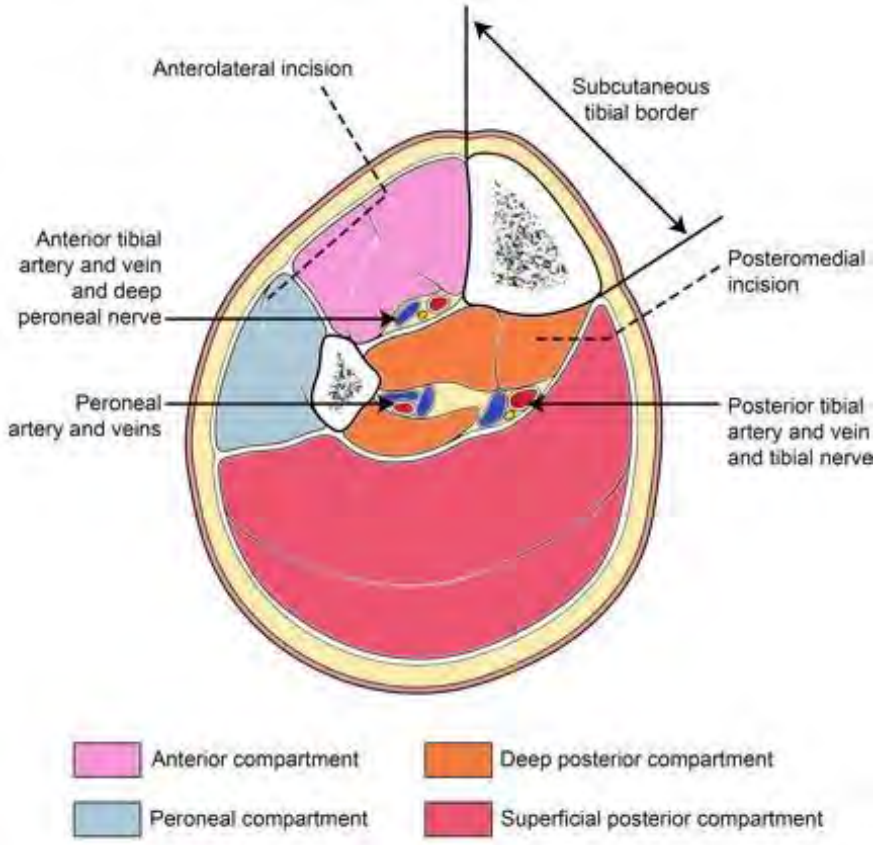
SURGICAL TREATMENT

Surgical treatment of lower leg compartment syndrome should be via a dual incision 4 compartment fasciotomy (as per BOAST/ BAPRAS guidelines)
https://www.boa.ac.uk/wp-content/uploads/2014/05/BOAST-4-The-Management-of-Sever-Open-Lower-Limb-Fractures.pdf



(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. In this patient, the anterior tibial artery had been disrupted following an open dislocation of the ankle; hence the poor flow evident in this vessel in the distal 1/3 of the leg. The distances of the perforators from the tip of the medial malleolus are approximate and vary between patients. It is essential to preserve the perforators and avoid incisions crossing the line between them.



- 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 for transfer and coverage of fasciotomy wounds. The plastics SHO and registrar are available on bleeps via switchboard, or by email **nbn-tr.bristolplastics@nhs.net.** Please ensure that wound photographs have been taken to aid in operative planning.

- If the patient still requires definitive fixation, they should be referred to the orthopaedic team who will liaise with the plastic surgeons.

- 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.

- Monitor renal function due to risk from rhabdomyolysis or reperfusion syndrome.

TERTIARY SURVEY

Primary Survey

On arrival to the department a major trauma patient is assessed fully by the trauma team and undergoes a primary survey. The aim of this is to assess the patient in a systematic way following the ABCDE approach to trauma care identifying their life-threatening injuries and treatment priorities.

- Airway maintenance with restriction of cervical spine motion
- Breathing and ventilation
- Circulation with haemorrhage control
- Disability (assessment of neurologic status)
- Exposure/Environmental control

Secondary Survey

The secondary survey is only undertaken once the primary survey has been completed, resuscitation is underway, and the patient is stabilised. Secondary survey involves taking a history, a head-to-toe physical examination and completing necessary imaging and blood tests.

Trauma Tertiary Survey (TTS)

The TTS is a comprehensive review of all investigations, injuries, and interventions, followed by a thorough clinical examination of the patient. This is ideally performed within the first 24hrs of admission once initial resuscitation and subsequent surgical interventions have been completed. The aim is to identify unrecorded injures and ongoing clinical needs.

All admitted major trauma patients who meet the TARN candidate criteria require a trauma tertiary survey.

The TTS should be performed by an SHO or registrar from the patient's home team or ICU, or by a trained major trauma practitioner.

The TTS should be carried out within 24 hours of the patient's admission to hospital. If the patient is intubated or otherwise unable to communicate at the initial tertiary survey, it should be repeated once the patient is conscious and able to partake in the TTS examination.

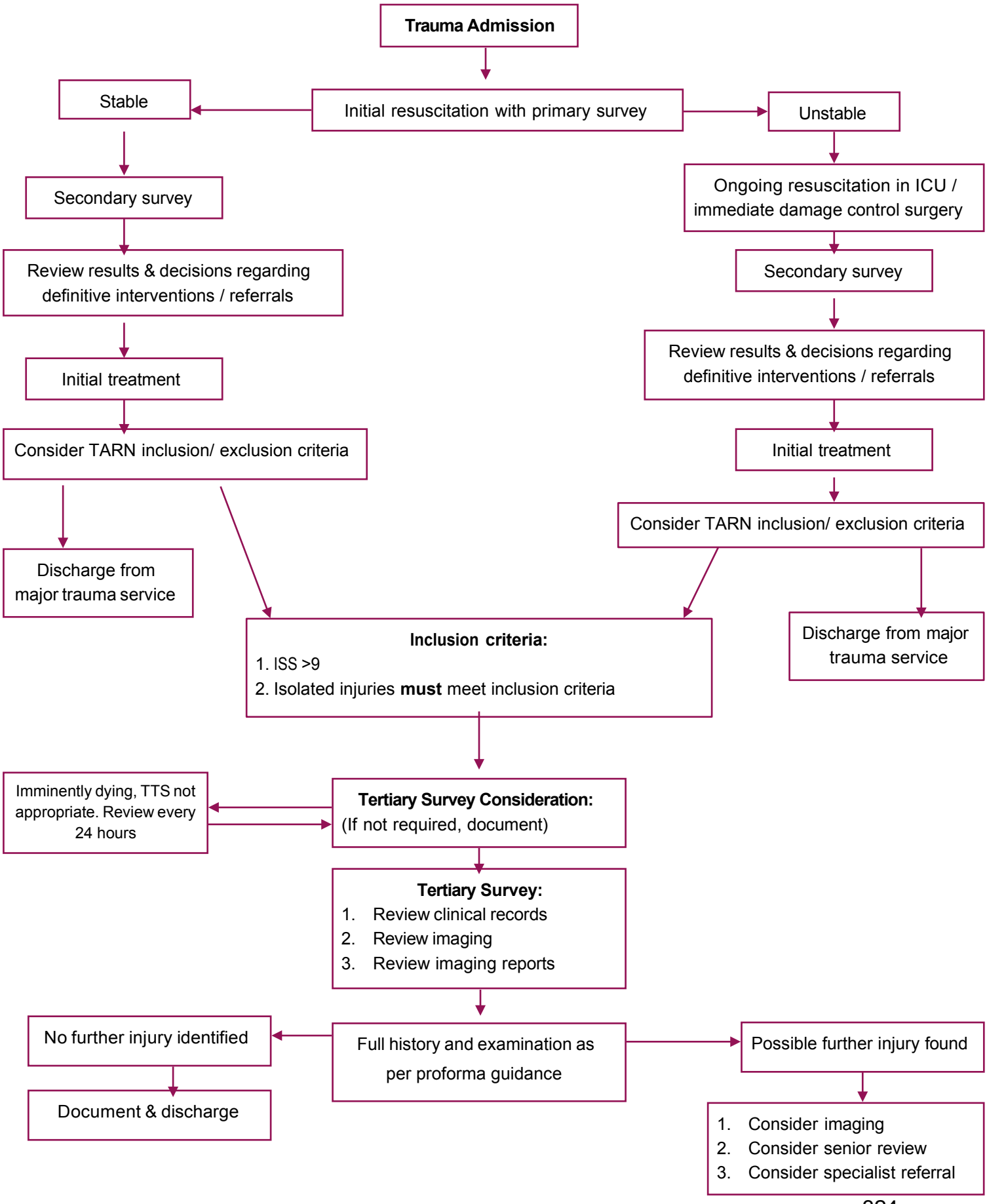
The TTS should be documented in the Trauma Tertiary Survey proforma. It should also be documented in the patient's clinical notes to highlight that a TTS has been performed and include any new findings with planned investigations / interventions which have resulted from the TTS.

Further Resources

A video of a secondary survey being performed in NBT emergency department which covers much of the examination components used for a tertiary survey.
Either follow the link below or use your phone camera to open the QR code:
https://m.youtube.com/watch?feature=youtu.be&v=c6DV8YulIA8

The Trauma Audit and Research Network: https://www.tarn.ac.uk/

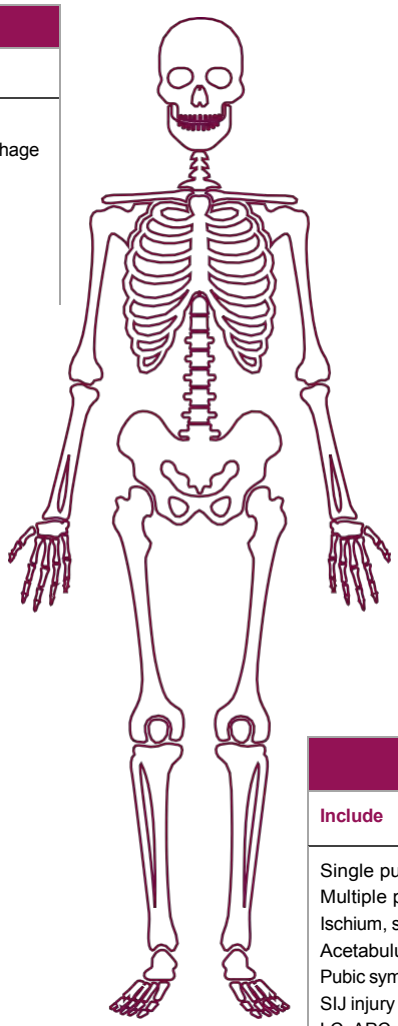
TRAUMA TERTIARY SURVEY WITHIN THE MAJOR TRAUMA PATHWAY



TARN INCLUSION AND EXCLUSION CRITERIA

Include	Exclude
Skull # Traumatic haemorrhage Brain contusion Brain laceration / penetration Vascular injury Nerve injury Diffuse axonal injury	Scalp injuries Spontaneous haemorrhage Loss of consciousness

Include	Exclude
Unstable # Orbital blow out # Le Fort I,II, III Pan-facial # ECA injury CN II / VII injury Eye avulsion Retinal detachment Globe rupture	Minor skin injury Closed / stable # All other eye injuries All other ear injuries



Include	Exclude
Injury to major vessels Organ injury Hyoid fracture	Minor skin injury Nerve injury

Include	Exclude
CN X injury Vascular injury Organ injury Sternum # Rib # Flail chest Haemo / pneumothorax Haemo / pneumomediastinum	Minor skin injuries

Include	Exclude
CN X Injury Organ Injury Retroperitoneal haemorrhage	Minor skin injury

Include	Exclude
Single pubic rami # <65 yrs Multiple pubic rami # Ischium, sacrum, coccyx, ileum Acetabulum Pubic symphysis injury SIJ injury LC, APC, open book, vertical shear # Malgaigne #	Single pubic rami # >65 yrs

Include	Exclude
Vertebral # / dislocation Disc or nerve root injury Brachial plexus injury	Spinal strain (whiplash) Ligament injury

FEMUR	
Include	**Exclude**
Hip fracture <65 yrs Head, shaft, distal, sub troch #, any age Femoral nerve / vessel injury	Hip # >65 yrs

UPPER LIMB / LOWER LEG	
Include	**Exclude**
Open # / dislocation Total crush arm / leg / hand / foot Traumatic amputation arm / leg / hand / foot # / dislocation multiple limbs Transected vessels / sciatic nerve injury	Closed # / dislocation 1 limb Hand / foot / digit # Minor skin injury Muscle / tendon / ligament injury / sprain All other nerve injuries

OTHER INJURIES	
Include	**Exclude**
Electrocution Full thickness frostbite Asphyxia Drowning Major degloving injury Skin lac / penetrating skin injury blood loss >20%	Bruises Abrasions Minor skin lacerations Minor penetrating injuries to skin Hypothermia

BURNS	
Include	**Exclude**
Full thickness burn any % >10% TBSA burn Inhalation injury	<10% partial thickness / superficial burn

TERTIARY SURVEY EXAMINATION

Head and Face

- Assess for lacerations, bruising and swelling from all angles of the head and face. (take care to check in long hair for injuries that may be missed on the scalp)
- Examine the skull for any deformities or depressions
- Palpate the facial bones for tenderness, deformities and depressions
- Eyes:
  - Inspect eyes and eyelids for evidence of blunt or penetrating injuries, foreign bodies, subconjunctival haemorrhage, hyphema, contact lenses, irregular iris (not exhaustive list)
  - Examine pupils: size, equality and reaction to light
  - Examination with ophthalmoscope to assess injury on the back of the eye
- Ears:
  - Look externally for signs of injury and for blood and fluid in the external ear
  - Internal ear examination with an otoscope to assess the ear drum
- Mouth: Look inside the mouth for injuries including broken and missing teeth
- Nose: Deformities, bleeding, nasal septal haematoma, CSF leak
- Jaw: Pain, trismus, malocclusion
- Neurology: cranial nerve examination

Neck

- Establish if the patient is under spinal precautions before examining the neck
- Look for any lacerations, bruising, swelling, subcutaneous emphysema or obvious malalignment
- Examine for point tenderness of the C-spine
- If not under spinal precautions, examine forward and lateral flexion, extension and rotation
- Assess the trachea to see if it is central
- Palpate carotid pulses individually; listen for a bruit

Chest

- Inspect the chest, look for: bruising, lacerations, penetrating wounds
- Observe chest movements, look for: asymmetrical chest expansion, paradoxical movements, flail segments
- Be sure to look in the axilla
- Palpate clavicles and chest wall for tenderness
- Auscultate the lung fields and heart

Abdomen

- Inspect the abdomen, the perineum and external genitalia, look for: bruising, lacerations, distension, blood at the meatus/introitus
- Palpate the abdomen, including renal angles
- Auscultate bowel sounds
- Consider if rectal examination is required (best performed when patient is rolled for examination of the back)

Pelvis

- Inspect the pelvis, look for bruising, grazing over the iliac crest
- Note pain on moving

Limbs

- Inspect all limbs and joints
- Palpate bones, joints and soft tissues
- Neurological examination (tone, power, reflexes, soft touch, sharp touch, co-ordination, proprioception)

Back

- If the spine has not been cleared the patient will need to be log rolled
- Inspect entire back and buttocks
- Palpate and percuss the spine for tenderness
- Palpate the paraspinal muscles, scapulae and the sacroiliac joints for tenderness
- Inspect the anus; perform a rectal examination at this time if required

TRAUMA TERTIARY SURVEY AND MANAGEMENT SUMMARY

Ward:	Surname:
Date of injury:	First Name:
Mechanism of injury:	Affix Patient Label Here DoB: NHS Number:
Primary team and named consultant:	
Additional teams involved in patient's care:	
Date and time of tertiary survey:	

Review clinical records, radiology images and reports and blood results
Treatment so far

	Date & Time	Reported/ Reviewed
Trauma CT		
CXR		
Binder off pelvis		
Cystogram/ Urethrogram		

Blood results	O/A		
Hb			
Plts			
WCC			
INR			
Cr			
eGFR			
Lactate			

	Yes	No	Additional actions required
Adequate symptom control			
Glycaemic control adequate			
Nutritional plan documented			
VTE prophylaxis plan			

Tertiary Survey Examination

Head + Neck

Scalp Lacerations/ tenderness/ swelling/ bruising

Ears Bleeding/ bruising/ lacerations

Oral Cavity Dentures/ lacerations/ loose teeth

Nose Septal haematoma/ bleeding/ tenderness

Eyes Haemorrhage/ blurred vision/ proptosis/ pain

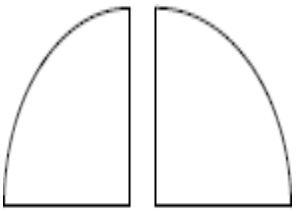
Spine:

Cervical: Thoracic:

Chest:

Airway: Chest Expansion:

Lung Fields:

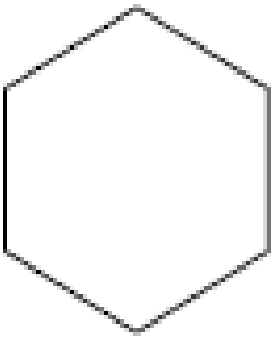


HS: 1 + 2 +

CRT:

NEWS	Time:
HR	
BP	
RR	
SpO2	
Temp	

Abdomen & Pelvis:



Bowels open: Y/N

Catheter: Y/N

Urethral bleeding:

Y/N PR: Y/N

Outcome – PV: Y/N

Outcome –

Neuro:

AMT4:

Age Y/N DOB Y/N
Place Y/N Year Y/N

GCS:

E

4

V

5

M

6

Pupils:

PERRLA: Y/N

Size: RIGHT: LEFT:

Comments

Tertiary Survey Examination continued MSK

RUL
Hand:

Wrist:

Elbow:

Shoulder:

Pulses:

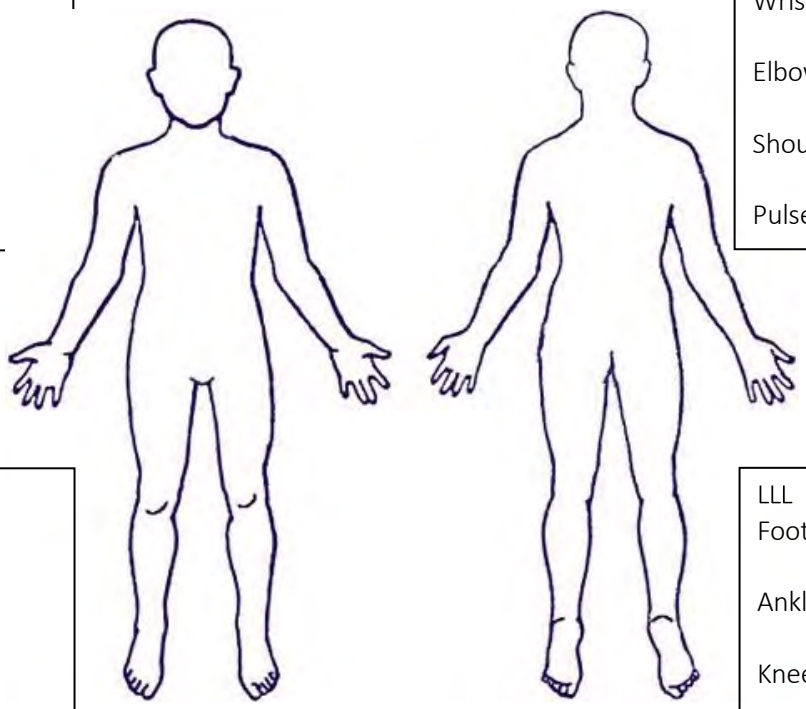
LUL
Hand:

Wrist:

Elbow:

Shoulder:

Pulses:



RLL
Foot:

Ankle:

Knee:

Hip:

Pulses:

LLL
Foot:

Ankle:

Knee:

Hip:

Pulses:

NEUROLOGICAL EXAMINATION						
UPPER LIMB		R	L	LOWER LIMB	R	L
Power	C4			L2		
	C5			L3		
	C6			L4		
	C7			L5		
	C8			S1		
	T1					
Sensation	C4			L2		
	C5			L3		
	C6			L4		
	C7			L5		
	C8			S1		
	T1					
Reflexes	Biceps			Patella		
	Triceps			Ankle		
	Hoffmans			Clonus		
				Plantars		
Tone						

CRANIAL NERVES	
I- Olfactory	
II- Optic	
III- Oculomotor	
IIII- Trochlear	
IV- Trigeminal	
VI- Abducens	
VII- Facial	
VIII-Vestibulocochlear	
IX- Glossopharyngeal	
X- Vagus	
XI- Accessory	
XII- Hypoglossal	

Tertiary Survey findings and plan

Additional finding identified for TTS

1.

2.

3.

4.

5

Plan to be carried out by home team

1.

2.

3.

4.

5.

Repeat tertiary survey required?

Date of repeat tertiary survey

Print name:

Role:

Signature:

CHAPTER 10

RADIOLOGY

WHOLE BODY CT IMAGING PROTOCOL

INTERVENTIONAL RADIOLOGY

SOUTHMEAD RADIOLOGY DEPARTMENT

WHOLE BODY CT IMAGING PROTOCOL

KEY POINTS

- Whole body multidetector CT (MDCT) is the gold standard for radiological assessment of the severely injured patient
- 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).
- 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
- For trauma units not familiar with multiphasic whole body trauma imaging example protocols of alternative MDCT whole body protocols are suggested.

WHOLE BODY CT IMAGING IN ADULT TRAUMA

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[1]. 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[2,3].

North Bristol Trust MDCT Whole Body Protocol:

The default MDCT whole body protocol in adult trauma for SIPs at North Bristol NHS trust is a modified version of the camp Bastion 'military' protocol.

The decision regarding appropriate imaging of adult trauma patients who do not meet criteria for major trauma (including 'silver' trauma and delayed presentation) should have targeted imaging following review by a senior clinician.

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 on page 340.

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 15 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 page 339. This provisional report is stored with patient's clinical documentation.

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.

MAJOR TRAUMA AT NBT BETWEEN 00:00 AND 08:00

Major trauma between 0000 and 0800

- Currently CT reporting is outsourced to Medica between 0000 and 0800.
- A standard operating procedure (SOP) has been agreed between Medica and North Bristol NHS Trust (NightHawk Service Standard Operating Procedure – Major Trauma (MTC)) for the vetting and reporting of acute CT within these hours.

The reporting radiologist will provide a primary verbal report following a preliminary review of the study. Medica will only provide the primary verbal report where the lead clinician has a dedicated direct dial handset to take the call.

RADIOLOGICAL PRIMARY SURVEY CHECKLIST

PATIENT NAME:	MRN:
DATE:	Time on SCANNER:
RADIOLOGIST:	SPR 1 2 3 4 5 6 CONSULTANT

AIRWAY

ET Tube Placement	N/A	Incorrect	Correct
Foreign Body		Yes	No
Airway Obstruction		Yes	No
Major Air Leak		Yes	No

COMMENTS:

BREATHING

Drain Placement	N/A	Incorrect	Correct
Pneumothorax		Yes	No
Haemothorax		Yes	No

COMMENTS:

CIRCULATION

CHEST			ABDOMEN			PELVIS		
Contrast Extrasation	Yes	No	Contrast Extrasation	Yes	No	Contrast Extrasation	Yes	No
Great Vessel Injury	Yes	No	Free Fluid	Yes	No	Free Fluid	Yes	No
Mediastinal Haematoma	Yes	No	Liver Injury	Yes	No	Pelvic Fracture	Yes	No
Mediastinal Gas	Yes	No	Splenic Injury	Yes	No			
Pericardial Fluid	Yes	No	Renal Injury	Yes	No	If renal injury, consider additional delayed phase study		

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:

WHOLE BODY CT PROTOCOLS

IMAGE QUALITY

Non contrast head & C-spine in headrest Patient moved from headrest Biphasic lung apices to lesser trochanters Patient arms up	Non contrast head & C-spine in headrest Patient remains in headrest Biphasic lung apices to lesser trochanters Patient arms across abdomen	Non contrast head only on footrest Patient remains on footrest Biphasic base of skull to lesser trochanters Patient arms across abdomen

PATIENT DOSE

INTERVENTIONAL RADIOLOGY

KEY POINTS

- The on-call Consultant Interventional Radiologist is contactable via switchboard
- If contrast extravasation / active bleeding is seen on CT the on-call Interventional Radiologist should be contacted
- Essentially any arterial bleeding can be treated by embolisation
- Patients who are candidates for intervention will return to the Emergency Department for on-going management whilst awaiting the Interventional Radiology 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, hepatic and splenic trauma and abdominal wall bleeding all respond very well. This should also be discussed with the GI consultant on call.
- Pelvic bleeding responds well. This also requires discussion with the Pelvic Orthopaedic team.

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.

All patients requiring interventional radiology (IR) for major trauma pathology should be transferred to NBT for their definitive treatment.

SOUTHMEAD RADIOLOGY DEPARTMENT

Southmead 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 are two+ onsite CT radiographers 24/7.

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
There is a Consultant Interventional Radiology on call cover 24/7 (contactable via switchboard who hold the rota).

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.

CHAPTER 11

REHABILITATION

SPECIALIST DIETETIC MANAGEMENT

AMPUTEE REFERRAL PATHWAY

REFERRAL GUIDELINES TO REHABILITATION SERVICES

SPECIALIST DIETETIC MANAGEMENT AND NUTRITIONAL SUPPORT

KEY POINTS

- Feeding should be started early: within 48 hours of admission.
- Nutritional requirements should be calculated using validated predictive equations.
- There should be regular monitoring of biochemistry and timely appropriate supplementation when required.
- Potential changes to feeding plan should be discussed with the dietitian.

NUTRITION ON ICU FOR MAJOR TRAUMA PATIENTS

Critically ill major trauma patients are at increased risk of malnutrition due to hypermetabolism. The metabolic response to injury leads to extensive catabolism, hyperglycaemia, profound negative nitrogen balance, changes in serum trace elements and fluid retention. Appropriate and timely nutrition support is therefore imperative in placing the patient in the best position to progress with rehab and achieve the best possible outcome.

Early Nutrition

- If oral intake is not possible, enteral nutrition should be initiated within 48 hours of admission to ICU[1].
- Place fine bore NG tube (12fr) unless contraindicated e.g. #BOS. (Avoid the use of Ryles tubes unless indicated for other clinical reason – they should not be used for feeding). A nasal bridle should also be sited to secure the NGT in place, providing there are no contraindications.
- Refer to NBT ICU Nutrition Guideline to start appropriate feed and rate until Dietetic review at earliest opportunity page 352.
  Policy: NBT Enteral Nutrition Policy, Intensive Care Nutrition Guideline

Requirements

Calculated by Dietitians

- Ventilated patients: Penn State equations[2].
- Non-ventilated patients: Penn State equation for non-ventilated patients[3]. Condition-specific predictive equations may be used where appropriate in accordance with Dietetic clinical judgement.

Micronutrients

- Major trauma patients should be monitored for vitamin, mineral and trace element deficiencies and these should be supplemented as appropriate.

- Feed prescriptions may not be nutritionally complete, particularly at the start of treatment where hypocaloric feeding is indicated. This can be exacerbated by non-nutritive energy sources such as propofol displacing feed to ensure patients are not overfed. Forceval soluble one tablet OD should therefore be prescribed for the first 10 days. The Dietitian will review ongoing need depending on the adequacy of the feed.

- Long stay patients should have long stay ICU blood set checked at 2 weeks and repeated thereafter at team's discretion if deficiencies are evident. (This includes Zn, Cu, Se and Vitamin D).

- Patients with an admission longer than 30 days may have a higher risk of Vitamin D deficiency, which evidence suggests may be associated with reduced immunity, healing and low mood[4]. Therefore prophylactic Vitamin D supplementation should be considered where appropriate, particularly if a prolonged period of inpatient rehab is likely.

- Hypophosphataemia is associated with mortality in ICU patients and is an independent risk factor for the development of infection and sepsis, therefore particular attention should be made to achieving results within the reference range[5]. Phosphate levels below the recommended reference range should be supplemented as below:

Phosphate mM	IV polyfuser (50mmol/500ml)	ml	ml/hr	Duration (hours)
<0.5		400	33	12
<0.65		300	25	12
	If <72 hours of feed, decrease feed to 30ml/hr until phosphate 1.0-1.4 mM			
<0.8		200	17	12
0.8-1.0 or if previous day <0.80	Phosphate sandoz		1 tablet TDS	
CRRT	Adjust daily supplement to maintain phosphate at 1.0 - 1.4 mM			
New infusion	Recheck phosphate level before commencing			

Adapted from NBT ICU Nutrition Guideline

Policy: NBT Enteral Nutrition Policy, Refeeding Guidelines, Intensive Care Nutrition Guideline

Overcoming Delayed Gastric Emptying

- If gastric residual volume ≥250mls or a large vomit: Start Metoclopramide 10mg IV TDS (24 hours).
- If ongoing large aspirates despite Metoclopramide: Consider NJ feeding tube and contact the Dietitian as soon as possible for placement. If needing to wait >1 day for NJ tube placement; start Erythromycin 250mg QDS IV.

Policy: Enteral Nutrition Policy

TPN

- TPN should be considered in those who have confirmed ileus or where enteral access is contraindicated or unobtainable for >72 hours. The patient's clinical condition and nutritional status should be assessed and starting TPN earlier than 72 hours may be appropriate in some cases. Consider whether IV Pabrinex, other micronutrients and IV fluids are required prior to TPN starting, particularly if the patient is at risk of refeeding syndrome.

- If the multidisciplinary team have made the decision that TPN is clinically indicated, then the dietitian covering the ICU pod or ward should be bleeped as soon as possible to arrange an appropriate prescription. Referrals for TPN should be made prior to 11am on weekdays to allow prescriptions to reach pharmacy before 12pm.

- If the decision to commence TPN is made over the weekend, then out of hours TPN is available on ICU only. The TPN calculator on the Trust intranet should be used to determine the safest infusion rate.

Policy: NBT Parental Nutrition Policy

ICU Step Down

- The transition from catabolic to anabolic state occurs weeks to months after major trauma and this is where the transfer to positive nitrogen balance, and therefore muscle restoration and weight gain, can be achieved. It is important to ensure the continuation of adequate nutrition to support this and therefore NG tubes should not be routinely removed on step down to the ward environment. The Dietitian will regularly review and advise on when oral intake is sufficient enough for alternative feeding routes to be stopped.

- Longer term feeding plans should be considered for patients with slow recovery of conscious level or those predicted to have poor recovery of swallow. Earlier PEG placement should be considered within the MDT 6-8 weeks post-injury if the patient is still reliant on NG feeding due to poor swallow or inadequate oral intake.

- Weekly MUST screening and weight monitoring is essential in order to assess if nutritional intake is adequate in supporting rehab.

INTENSIVE CARE UNIT NUTRITION GUIDELINE

Introduction

This guideline applies to all patients admitted to Southmead ICU. Follow the enteral feeding process diagram on page 353 for all patients.

Aims and rationale

Days 1-2

Support physiological adaptation to critical illness by:

- Correcting micronutrient deficit to optimise metabolic and anti-oxidant systems.
- Provide minimal EN macronutrients to maintain GI function and immunity.

Days 3-6

Hypocaloric, high nitrogen feeding:

- Energy expenditure: Provide <60% if obese, <80% if other to avoid substrate intolerance.
- Nitrogen: 0.2-0.32g/kg/day to optimise wound healing and acute-phase protein response.

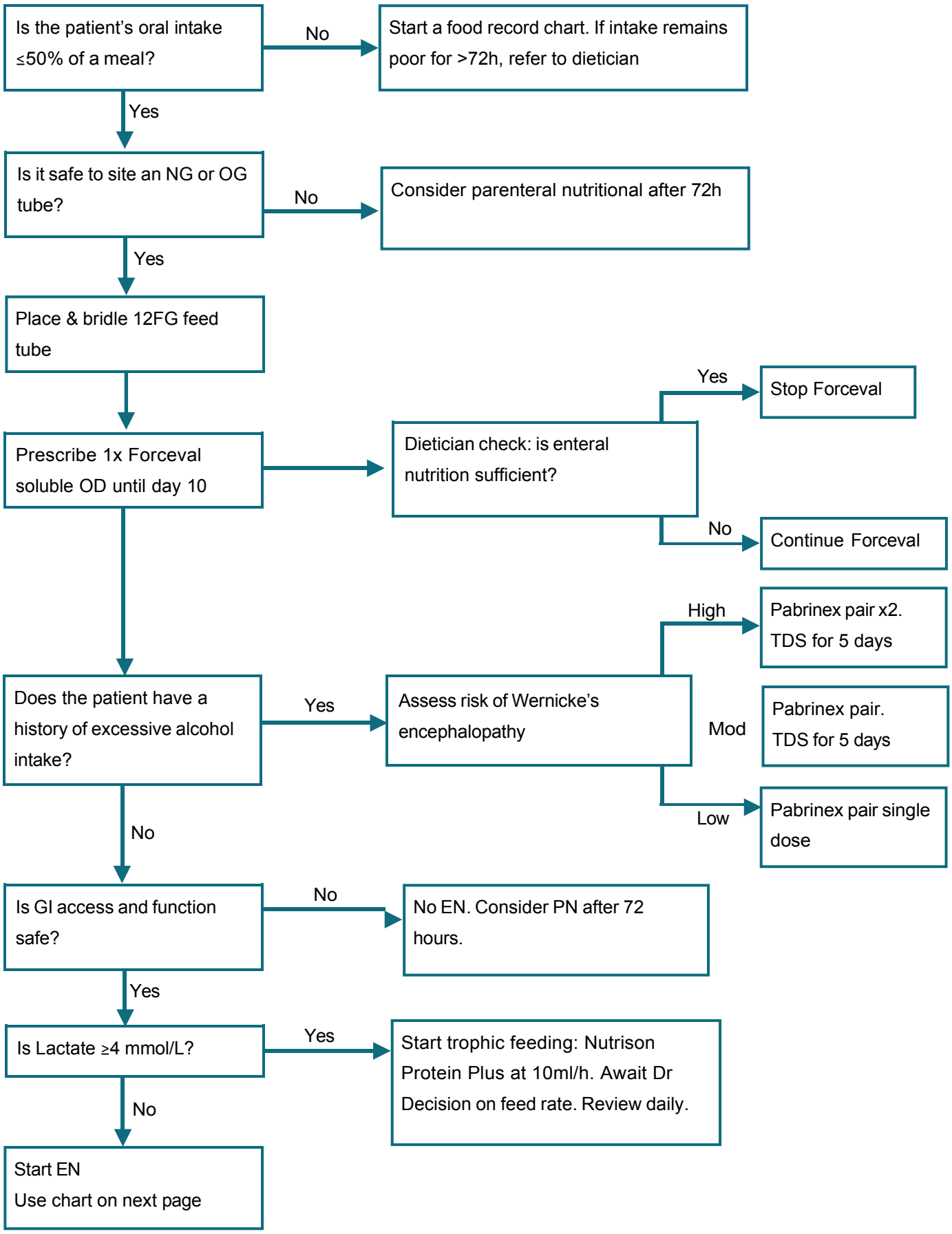
Day 7 onwards

Meet full requirement.

- Energy: Dietitian judges when to meet energy expenditure as substrate tolerance permits.
- Nitrogen and bolus feed/ food: Time to optimise activity-induced anabolism.

Enteral feeding decision tree

Following admission to ICU, the flow chart should be followed for all patients (excluding PACE admissions).



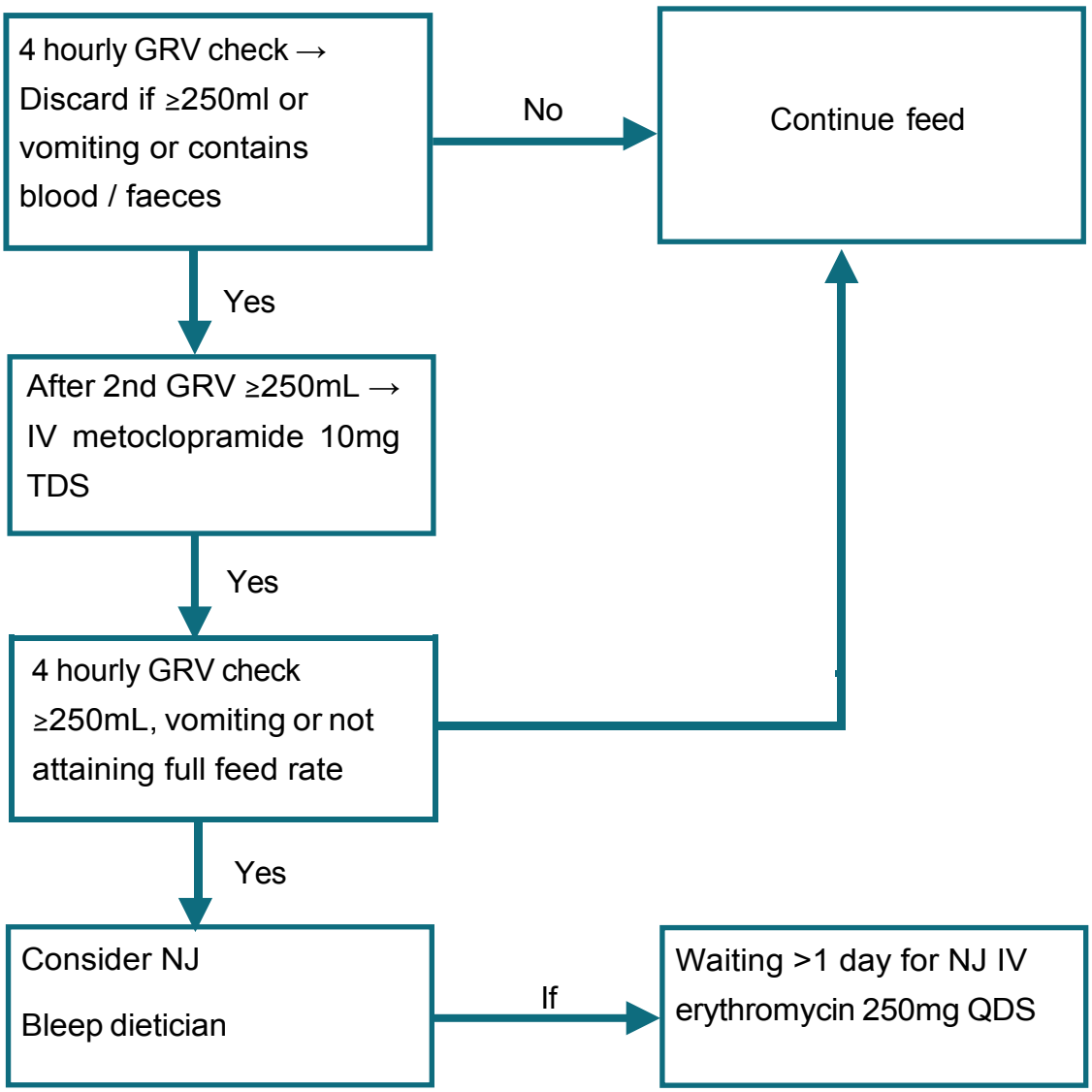
NUTRITION ACTION PLAN

The following decision tool is designed to summarise responsibilities of nursing and medical staff following admission along with providing an aide-memoire for enteral feeding rates and phosphate replacement.

<table>
<tr><th colspan="2"></th><th>Screen</th><th colspan="4">Action</th><th>Daily WR Review</th></tr>
<tr><td rowspan="10">ADMISSION</td><td rowspan="2">NURSE</td><td>Insufficient food</td><td colspan="4">Place 12FG NGT if necessary and possible</td><td rowspan="2">Confirm tube position</td></tr>
<tr><td>NGT in situ</td><td colspan="4">Bridle: Ensure clip 0.5cm from septum</td></tr>
<tr><td rowspan="8">DOCTOR</td><td>All patients</td><td colspan="2">Forceval soluble</td><td colspan="2">1 tablet OD NG until day 10</td><td>Dietician may cancel</td></tr>
<tr><td rowspan="4">Wernicke’s risk</td><td></td><td>High</td><td>Possible</td><td>Low</td><td rowspan="4">Symptom > dose review</td></tr>
<tr><td>Pabrinex 1 pair</td><td>2 TDS</td><td>1 TDS</td><td>1 OD</td></tr>
<tr><td>Duration</td><td>5 Days</td><td>5 Days</td><td>One off</td></tr>
<tr><td>Burn, CRRT</td><td colspan="4">1 pair Pabrinex IV OD & 10mL Additrace IV OD</td><td>Dietician will review</td></tr>
<tr><td>No GI access / poor function</td><td colspan="4">No enteral nutrition</td><td>Consider TPN after 72h</td></tr>
<tr><td>Lactate >4.0</td><td colspan="4">10mL/h Nutrison Protein Plus until WR decision</td><td>Feed rate decision</td></tr>
</table>

DAILY	NURSE	Start NG feed		Most patients	Fluid restricted or K+ >5.0 & no CRRT		Check 4 hourly gastric residual volume
		mL/hr	Nutrition (N)	N: Protein Plus	N: Concentration		Feed full rate unless*
			Day 1 & 2	30	20		<250mL bile/feed: → Return
			Then: full feed	Dietician regime or use actual weight (kg)			
			40kg	40	27		↓
			50kg	45	30		≥250mL or blood / faecal / vomit → discard
			60kg	50	32		
			70kg +	55	35		↓
	DOCTOR	**Phosphate mM**	IV polyfusor	ml	ml/hr	Duration (hours)	If 2nd >250mL or vomit → metoclopramide 10mg IV TDS
		<0.5*		400	33	12	↓
		<0.65*		300	25	12	24h: *unresolved → Feed 30mL/h
			*If <72h of feed then decrease feed to 30ml/h until phosphate >1.0mM				& ↓
		<0.8		200	17	12	Request NJ via dieticians: → Bleep 1127 or 1621 If >24h delay for NJ: → add Erythromycin 250mg IV QDS
		0.8 - 1.0 or if previous day <0.8	Phosphate sandoz	1 tablet TDS			
		CRRT	Adjust daily supplement to maintain PO4 at 1.0 - 1.4				
		New infusion	Recheck phosphate level before commencing				*Version 5.0, Feb 2021*

MANAGEMENT OF GASTRIC ASPIRATES



TOTAL PARENTERAL NUTRITION (TPN)

In hours

If the multidisciplinary team have made the clinical decision that TPN is required, bleep the pod dietician

Out of hours

If the multidisciplinary team have made the clinical decision that TPN is required over the weekend:

- Complete the TPN calculator to determine safest infusion rate (calculator on NBT intranet)

AMPUTEE REFERRAL PATHWAY

KEY POINTS

- All patients with traumatic amputations should be referred to the Bristol Centre for Enablement
- All patients need a referral form signed by their consultant or registrar (electronic form in the J drive)
- If unsure whether a referral form has been sent, contact the prosthetic secretaries – Joanne Sargent ext 04610 / Helen Ford ext 04609
- Advice and support from the counselling service is available for inpatients
- The centre provides advice and treatment options for post amputation phantom pain

AMPUTEE 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.

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.

REFERRAL GUIDELINES TO REHABILITATION SERVICES

KEY POINTS

- Major Trauma Networks (MTN) are required to identify all patients that have on going rehabilitation needs.

- MTN are required to have clear and agreed pathways established to ensure the needs of patients requiring on going rehabilitation and / or support with return to work are met.

- 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.

- 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)

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. [1]

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 patients 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 SMTODN. 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 SMTODN, 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.[2] 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 SMTODN 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.

KEY STANDARDS

All Major Trauma Networks are required to comply with and are audited against the standards agreed with NHS England[3] and need to comply with the NHS England Standard Contract for Major Trauma Services[4].

All Specialist rehabilitation services are expected to comply with the standards laid down by the British Society of Rehabilitation Medicine [5] 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) [6].

- 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.

SERVICES FOR PATIENTS WITH CATEGORY A AND B NEEDS FOLLOWING A TRAUMATIC BRAIN INJURY

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 SMTODN 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 [7]. 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
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 using the web based Badgernet service (https://nww.badgernet.nhs.uk/live/neuro/web). Refers will require a login to be created. Please contact the one of the account managers (Helen.Marshall2@nbt.nhs.uk) (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 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)
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.

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 in-reach 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

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 Caroline Jones, NHS England Complex Rehabilitation Case Manager, (Caroline.Jones73@nhs.net; mob 07881534624)

SERVICES FOR PATIENTS WITH SPINAL CORD INJURIES

Overview:

Services for patients with a spinal cord injury are commissioned by NHS England [8]. Guidance on initial management as well 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.
Spinal Treatment Centre
Salisbury District Hospital
Salisbury
Wiltshire
SP2 8BJ
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 nww.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 aim to be in contact with the referring team within 48hours to request all basic information and completion of the outreach assessment form. They will be available for telephone advice and will offer the patient an 'AttendAnywhere' virtual consultation, advise on management and consider patients suitability for inpatient rehabilitation at the SCIC.

The Acute Outreach Team can be contacted as below:-

- Danilo Galila 01722 336262 Ext. 2451 email: danilo.galila@salisbury.nhs.uk
- Maddie Turner 01722 336262 Ext. 2108 email: Maddie.turner@salisbury.nhs.uk
- Paul McQuaid 01722 336262 Ext 4073 email: paul.mcquaid@nhs.net
- shc-tr.Acuteoutreach@nhs.net

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 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 SMTODN 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 Shigong Guo, Consultant in Rehabilitation Medicine (shigong.guo@nbt.nhs.uk)
Senna Cook (Senna.Cook@nbt.nhs.uk) Counsellor
Marie- Claire Fitzpatrick(marie-claire.fitzpatrick@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

SERVICES FOR PATIENTS WHO HAVE MUSCULOSKELETAL INJURIES

Under development

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..

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 although they do have a limited number ESD places funded.
Referrals should be made to:

Head Injury Therapy Unit
Frenchay Beckspool Building
Frenchay Park Road
Bristol
BS16 1LE

Telephone: 0117 3406522
HITUadmin@nhs.net
HITU@nbt.nhs.uk

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

For patients in Bath, North East Somerset and Wiltshire referrals should be made to: -

Neuro and Stroke Services, Bath and North East Somerset,
St Martins Hospital,
Clara Cross Lane,
Bath
BA2 5RP
Tele 01225 831544 Email : BATHNES.neurostrokeservice@virgincare.co.uk

CHAPTER 12

CONTACT NUMBERS AND REFERENCES

CONTACT NUMBERS

Retrieve	0300 030 2222
WATCh	0300 0300 789
Southmead Hospital Switchboard	0117 9505050
NBT ED Red Phone	1179506862
NBT Trauma Team Leader Mobile	07703886400 (Bleep 9745)
NBT General Surgical SpR On Call	Bleep 9772
NBT Orthopaedic SpR On Call	Bleep 9750
NBT Neurosurgical SpR	Ext. 45726
NBT Plastics SHO	Bleep 1311
BRI Maxfacs SHO (via BRI switch)	Bleep 6099
NBT Anaesthetics Consultant	Bleep 9030
NBT Anaesthetics 3rd On Call	Bleep: 9034
NBT ICU SpR (for trauma)	Bleep 9039
NBT Haematology SpR	Bleep 9433
NBT Blood Transfusion	Ext. 48350 Bleep 9433
NBT Radiology SpR	Bleep 9746
NBT Radiographer	Bleep 9740
NBT PACS	01174 143508
NBT Pelvic Team Secretary	01174141623 / 01174141625
South West Organ Donor Referral Line	03000 20 30 40
Bristol Centre for Enablement General Number	0300 3000110
Salisbury Switchboard	0172 233 6262
BRI Switchboard	0117 923 0000
University of Bristol Dental Hospital	0117 342 9525
Royal United Hospital Bath Switchboard	01225 428331
Great Western Hospital Swindon Switchboard	01793 604020
Musgrove Park Taunton Switchboard	01823 333444
Gloucestershire Royal Hospital Switchboard	0300 422 2222
Yeovil Distinct Hospital Switchboard	01935 475122

REFERRALS

Southmead Major Trauma Centre:

NBT Trauma Team Leader Mobile: 07703886400
NBT Trauma Team Leader Bleep: 9745

Retrieve:

All adult critical care transfer referrals should be made to Retrieve via their single point of contact telephone number (0300 030 2222) and electronic referral platform.

Further information on the referral process can be found at www.retrieve.nhs.uk/refer

Referral to BRI Maxillofacial Surgical Team:

Based at the BRI, but can assess patients at NBT

1st on-call: Maxfacs SHO
First point of contact
On-site (BRI) and available 24/7 on bleep 6099

2nd on-call: Maxfacs SpR
Available via switchboard

3rd on-call: Maxfacs Consultant
Available via switchboard

Contact through BRI switchboard. Rota is with switchboard of NBT, UHB and Weston, and RUH.
Maxillofacial surgery MDT is every Wednesday afternoon. All referrals to this clinic go through the maxfacs SHO.

Referral to BRI Thoracic Surgical Team:

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

Non-urgent referrals
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 Thoracic Surgical Consultant via the BRI switchboard. This route is only appropriate if urgent surgery may be required out-of-hours (i.e. overnight).

Referral to NBT Neurosurgical Team:

Major trauma patients with cranial or spinal injuries requiring emergency or urgent referral to NBT neurosurgery can be referred at https://www.referapatient.org/new-referral

For Emergency referrals, you can also contact the on-call Neurosurgery Registrar (SpR) through Hospital Switchboard on 0117 9505050 (Ext 45726). This number must not be used for general enquiries.

Referral to Salisbury SCI Centre:

The Severn Trauma Network is linked with Duke of Cornwall Spinal Treatment Centre, Salisbury District Hospital, Salisbury
Tel: 01722 336 262

The Neurosurgical / Spinal Surgeon team is responsible for contacting Duke of Cornwall Spinal Treatment Centre as soon as possible.

- The appropriate location for medical management (including surgery) should be discussed.
- Immediate management plan should be discussed and documented
- Complete the referral paperwork (page 257)
- 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 (page 256)

Referral to Southmead Pelvic Team:

Patients with pelvic trauma should be referred to the Southmead Orthopaedic Department as soon as possible

The 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 or Consultant can be contacted through Southmead Hospital switchboard (0117 9505050).

A **referral form** outlining the pertinent information required when referring a pelvic and acetabular fracture can be found on page 305. It is expected that initial imaging will be completed in the referring hospital.

Referral of Patients with Open Fractures:

All open lower limb fractures should be transferred to Southmead MTC via the major trauma pathway from ED to ED.

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

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 9505050) or the orthopaedic consultant on-call.

INDEX OF GUIDELINES AND REFERENCES

About Severn Major Trauma Network
Reviewers: Rowena Johnson
Last review: July 2021

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Reviewers: Aimee White, Rowena Johnson, Ben Walton
Last review: September 2021

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Reviewers: Rowena Johnson, Aimee White, Ben Walton
Last review: September 2021

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Reviewers: Scott Grier
Last Review: May 2021

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Pre-Hospital Handover
Reviewers: Rowena Johnson
Last review: April 2021

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Reviewers: Nicholas Adams
Last review: April 2021

The Trauma Team
Reviewers: Tim Godfrey
Last review: February 2021

Emergency Department and Critical Care Drug Bags
Reviewers: Rowena Johnson
Last review: March 2021

Death and Breaking Bad News in the Emergency Department
Reviewers: Ian Thomas
Last review: October 2020

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Reviewers: Paddy Morgan, Tom Renninson
Last review: July 2021

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Reviewers: Ben Walton, Rowena Johnson
Last review: August 2021

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Reviewers: Jacqueline Cox
Last review: August 2021

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Thoracic Injuries

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Reviewers: Amit Goswami, Anna Briggs, Tim Hooper, Nirosha De Zoysa
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Reviewers: Bill Neary
Last review: November 2021

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Reviewers: Neil Upadhyay, Jules Blackham
Last review: May 2021

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Reviewers: James Hopkins, Matt Doe, Anne Pullyblank
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Reviewers: Tim Chesser

Last review: March 2021

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Reviewers: Deborah Cleary
Last review: May 2021

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Reviewers: Natalie Sturtridge, Katie Williams, Kaylee Sayer, Stephen Taylor, Rowan Clemente
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Reviewers: Deborah Cleary
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Referral Guidelines to Rehabilitation Services

Reviewers: Steve Novak
Last review: October 2021