



Leeds Major Trauma Centre Whole body trauma CT (WBTC) in Adult major trauma

These guidelines should be read in conjunction with the following documents

Major trauma: assessment and initial management. National institute for Clinical Excellence. 2016.

Standards of Practice and Guidance for Trauma Radiology in severely injured patients. The Royal College of Radiologists 2011.

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Background

Trauma is the leading cause of death in adults under the age of 45. In England approximately 98% of major trauma is secondary to blunt force trauma, of which road traffic accidents and falls are the most common mechanism. Penetrating trauma such as gunshot wounds and stabbing accounting for 2%.^{1,2}

Provision of trauma services was changed in 2012 following a study by the national audit office into trauma outcomes. This showed that there was “unacceptable variation” in the standard of care trauma patients received inter and intra-regionally. Variations in care negatively impact on patient outcomes, and failings in care can cause unnecessary deaths. Regional trauma networks were developed in order to improve the quality, and reduce the variation, in the care patients received. An additional aim is to save an additional 450-500 lives per year.¹

Each regional trauma network includes a designated major trauma centre (MTC). The MTC for the West Yorkshire Major Trauma Network is Leeds General Infirmary, for both adults and paediatrics. MTCs are hospitals which have a full range of trauma related specialties including neurosurgery, orthopaedics, diagnostic and interventional radiology, and surgery.

In trauma management, rapid identification of life threatening or life changing injuries is essential to improving outcomes. The role of radiology in trauma management is focused on whole body trauma CT (WBCT) to facilitate this. Early CT has been shown to increase survival.^{3,4} CT also helps to determine the Injury Severity Score (ISS), which is important in the classification, management and assessment of outcomes of trauma patients .

This guideline has been developed to aid in decision making, and communication, for CT imaging in adult trauma (over 16 years old). It has been developed based on the Royal College of Radiology standards of practice in trauma, as well as NICE guidelines, and the NHS major trauma contract.

Separate guidelines for imaging in paediatric major trauma are available for patients under 16.



Indications for whole body trauma CT

The decision to refer for a whole body trauma CT (WBCT) should be made by the trauma team leader after the initial clinical assessment

Blunt trauma

Early whole body trauma CT is indicated in initial assessment of blunt trauma patients if significant injury is suspected.

Major Trauma is indicated by:

- RTA:
 - Injury to more than one body region
 - Fatality at scene
 - High speed impact
- Fall
 - Injury to more than one body region
 - Fall from over 3m
- Assault
 - Injury to more than one body region
- Reduced GCS with an unknown mechanism

Penetrating trauma

Early targeted CT is the imaging modality of choice unless there is a need for immediate intervention.

Does the patient need intervention before CT?

Intervention includes chest drain placement, damage control surgery and Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) as a bridge to definitive haemostasis.

In cases of controlled physiological compromise, early CT is still indicated, as early identification of active bleeding points guides surgical and/or radiological intervention

Patients considered too unstable for CT should immediately go for definite care as per the LTHT guidelines. This includes chest drain placement in the ED. REBOA can be considered as part of the UK REBOA Randomised trial.

If there is debate regarding the decision to CT, or doubt regarding mode or approach to treatment, this should be resolved by Consultant-to-Consultant discussion.



Requesting a whole body trauma CT

Decision to refer for CT: This should be made as early as possible (Ideally within 10 minutes of patient arrival)⁵ and documented in the polytrauma proforma booklet.

Requesting:

- 1- Complete polytrauma CT request form on ICE. The printed version is being phased out (see appendix p.14)
- 2- Communicate with Acute CT radiologists. This is often best done by direct face to face communication with them

During office hours (Monday - Friday 0900-1700) contact:

1. LGI CT ext 25207
2. SJUH CT Celia Craven 67160

Out of hours contact:

The On Call Radiology Registrar via switchboard, or the extensions:

1. LGI CT ext 25207
2. SJUH CT Bexley ext 68948

N.B. Providing accurate clinical information and diagnostic questions when requesting significantly helps the reporting radiologists.

3- Contact the CT radiographers, and arrange timing and transfer of the patient.

1. LGI CT ext 23617
3. SJUH CT Celia Craven ext 66136 (Monday - Friday 0900-1700)
4. SJUH CT Bexley ext 68564 or 68612 (out of hours)

Female patient of child bearing age

- Attempts to establish the pregnancy status of the patient should be performed if this will not delay CT in seriously injured patients
- If a decision is made to scan without confirming pregnancy status this needs to be documented by the senior clinician.
- If pregnant, the health of the mother takes priority over the health of the foetus
- Modifications to pathways should be made, where possible, and guided by Consultant-to-Consultant discussion



Transfer to CT

- This should be as smooth and fast as possible
 - **AIM FOR LESS THAN 15 MINUTES FROM TIME OF REFERRAL**⁶⁻⁸
- Prior to transfer ensure suitable intravenous access. i.e. via the largest cannula possible. This should be placed in the right ante-cubital fossa if possible- IV contrast via a left sided cannula causes streak artifact obscuring the mediastinal vessels
- Significantly injured patients should be catheterised prior to the scan if there are no contraindications and if it will **NOT DELAY** the transfer to CT
 - Clamp the urinary catheter if present.
- Full monitoring must be used (HR, NIBP, Sats & CO₂ if intubated).
- Temporary pelvic stabilisation (pelvic binder) should be applied if significant pelvic fracture is suspected.
- For limb injuries, only immediately limb conserving splinting/manipulation via rapid immobilisation should be performed prior to CT
- All patients **MUST** have an escort to CT. The number and grade/seniority of the escort(s) is the responsibility of the team leader/referring doctor.
- Transfer should be as smooth and as fast as possible. Aim to use either the trauma transfer mattress (when available) or leave the patient on the scoop stretcher. The scan can be performed on the scoop stretcher but ensure that there is as much distance as possible between the top of the patient's head and the metal clip at the top of the stretcher.
- If the patient cannot be transferred on a stretcher or transfer mattress then 4 members of staff must accompany the patient to allow safe log-rolling and sliding.
- The polytrauma request and booklet must accompany the patient to CT to facilitate documentation of the primary provisional report.
- The most senior doctors from specialities (T&O, Vascular Surgery plus anaesthetist if necessary) and one nurse must stay in the control room whilst the patient is being scanned.
- **ALL** other non-CT personnel must wait outside the CT control room to allow the radiographer to perform the scan, and the radiologist to issue a primary provisional report without interruption/distraction.



Blunt trauma default CT protocol: 'Split-dose, single pass protocol (Bastion)

A whole body trauma CT (WBCT) includes imaging of the head, cervical spine, chest, abdomen and pelvis.

The default WBCT protocol is the Split dose, single pass (Bastion) protocol. This can be used for all haemodynamically stable trauma patients.

This protocol includes a biphasic scan of the abdomen, i.e. simultaneous arterial and venous enhancement in one scan. It has been shown to increase the sensitivity of arterial injuries, whilst maintaining the sensitivity of solid organ injury.⁴ Therefore, it provides diagnostic imaging with a reduced radiation dose.^{3,4}

Areas to be scanned:

- Vertex to mid-thigh scanogram to plan scan
 - Consider extending the scanogram to feet if significant lower limb injury is suspected
- Head
 - Non-contrast CT head
- Cervical Spine
 - C spine 1mm axial 2mm coronal & sagittal recons
- Chest, abdomen, and pelvis to mid-thigh Biphasic injection
 - Axial, Coronal, and Sagittal reformats
 - IV Contrast, No oral contrast
- Bony reformats:
 - Spine 1mm axial
 - Spine 2mm sagittal
 - Bony pelvis 3mm coronal
- Consider dedicated limb CT if significant injury is suspected
- If there is any uncertainty/suspicion for active bleeding on review delayed imaging should be performed through the area of concern. If there is any doubt, a delayed CT should be performed.
- Where there is concern for active bleeding or major arterial trauma the case must be discussed immediately with the Trauma surgeons.
- A joint decision Consultant-to-Consultant should be made regarding the need for endovascular intervention.

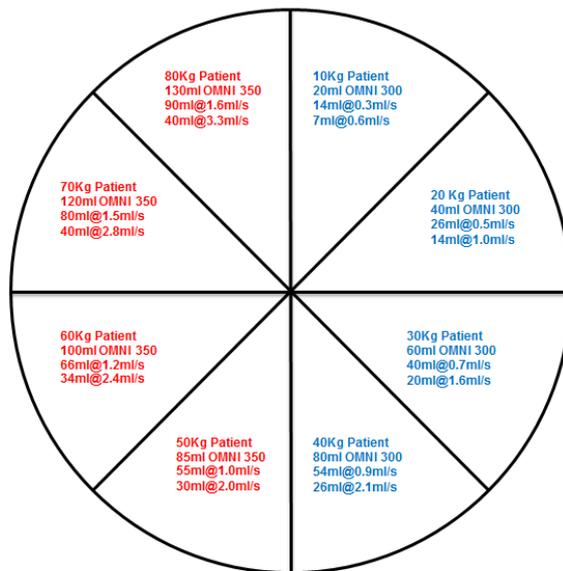


- The clinical primary survey + polytrauma request form + radiology primary report (see pages 11-12) should be scanned onto CRIS by the CT radiographer.

Technique

- Bastion IV contrast protocol (Biphasic injection protocol^{9,10})
LTH Protocol Code: T BASTION

Bastion wheel for biphasic injection in trauma CT. Surgeon Commander Richard Miles (adjusted for higher concentration contrast)



Contrast:

The wheel calculator for contrast dose/timing is based on patient weight.

Scan Protocol:

2/3 contrast volume injected at slow rate x, and 1/3 volume injected at approximately 2x. Contrast rates are calculated for injection phase to last 70 secs. Scan initiated at 70 seconds.

Bleeding Protocol. (LTH Protocol code: T BLEED FULL)¹⁰

Dual phase imaging (arterial phase chest/abdomen/pelvis, PV abdomen/pelvis to mid-thigh +/- delayed phase) should be performed in haemodynamically unstable patients where bleeding is suspected .

Arterial phase - start scanning at 25 seconds then **Portal Venous phase** scanning after 65 seconds



CT in penetrating trauma

The CT coverage should be tailored according to the site of injury and cover the distal extent of the injury.

The chest and abdomen must be covered in penetrating injury in the location of the diaphragm.

- **The Split dose, single pass (Bastion) protocol remains the default protocol (see blunt trauma protocol page 7-8)**
- If there is any uncertainty/suspicion for active bleeding, delayed imaging should be performed through the area of concern. If there is any doubt, a delayed CT should be performed
- Unstable patients should be scanned using the bleeding protocol (LTH Protocol Code:T BLEED FULL)
- This involves **Arterial phase** - start scanning at 25 seconds then **Portal Venous phase** scanning after 60-65 seconds +/- delayed imaging.
- Where there is concern for active bleeding on review of images, the case must be discussed immediately with the Trauma surgeons,
- A joint decision Consultant-to-Consultant should be made re need for endovascular intervention.
- **The clinical primary survey + polytrauma request form + radiology primary report (see pages 11-12) should be scanned onto CRIS by the CT radiographer.**



Oral Contrast

When should oral contrast be used in trauma?

Using oral contrast is not routine practice for the initial trauma CT.

Repeat CT with oral contrast following the initial diagnostic study may subsequently be required to help detect small bowel injury.

Rectal Contrast

When should rectal contrast be used in trauma?

Using rectal contrast is not routine practice for the initial trauma CT.

If there is concern re large bowel injury on the table rectal contrast can be administered.

Rectal Contrast Technique (Adults):

1000 mls 8% iodinated contrast delivered via a bag under gravity via a ballooned Foley catheter over 30-60 mins

CT Cystography

CT cystography may be needed in severe pelvic trauma and is the best method to assess for suspected bladder injuries. If needed, this is performed after the initial trauma CT. If not present, the trauma team is responsible for inserting a urinary catheter. Please refer to the West Yorkshire Trauma Network guidelines on Pelvic Fractures with Urogenital Trauma for further guidance

Technique CT Cystography

200-300mls 4% contrast is introduced via urinary or suprapubic catheter using a bladder syringe. Repeat the CT through the pelvis. Extravasated bladder contrast is easily recognised.



Radiology Reporting In Hours (Mon-Fri 09:00-17:00)

LGI:

- Requests are accepted and vetted by the 'Body CT' Radiologists at LGI
- The Body CT Radiologist should then pre-alert the Neuro (ext 23780), and MSK (ext 28254) Radiology that a polytrauma will be performed
- The **primary survey report**, whilst the patient is on the table, is performed by the 'Body CT' Radiologist
 - It should be documented in the polytrauma booklet (see proforma in appendix p.14)
 - **THIS SHOULD BE COMPLETED WITHIN 5 MINUTES OF THE SCAN BEING COMPLETED**⁸
 - Decisions regarding further scanning or immediate interventions should be made at this point
- A **full report** by Neuro, Body, and MSK Radiologists should then be completed.
 - **THE FULL VERIFIED REPORT SHOULD BE AVAILABLE ON THE RESULTS SERVER WITHIN 60 MINUTES.**⁸
- Important clinical findings should be relayed in person or by phone to the lead clinician, or by contacting ED Consultant on 20170 or ED Nurse in Charge on 28908.

SJUH:

- Requests are accepted and vetted by the Acute CT Radiologists
- The **primary survey report**, whilst the patient is on the table, is performed by the Acute CT Radiologist
 - It should be documented in the polytrauma booklet (see proforma in appendix p.14)
 - **THIS SHOULD BE COMPLETED WITHIN 5 MINUTES OF THE SCAN BEING COMPLETED.**⁸
 - Decisions regarding further scanning or immediate interventions should be made at this point
- A **full report** should then be completed.
 - **THE FULL VERIFIED REPORT SHOULD BE AVAILABLE ON THE RESULTS SERVER WITHIN 60 MINUTES.**⁸
- Important clinical findings should be relayed in person or by phone to the lead clinician, or by contacting ED Consultant or ED Nurse in Charge.



Radiology Reporting Out of Hours

LGI and SJUH:

- Requests are accepted and vetted by the on-call Radiology Registrar at the respective site
- The primary survey report, whilst the patient is on the table, is performed by the on-call Radiology Registrar.
 - It should be documented in the polytrauma booklet (see proforma in appendix p.14)
 - **THIS SHOULD BE COMPLETED WITHIN 5 MINUTES OF THE SCAN BEING COMPLETED**⁸
 - Decisions regarding further scanning or immediate interventions should be made at this point
- A full report should be then be completed.
 - **THE FULL PROVISIONAL ON-CALL REPORT SHOULD BE AVAILABLE ON THE RESULTS SERVER WITHIN 60 MINUTES.**⁸
- Important clinical findings should be relayed in person or by phone to the lead clinician, or by contacting ED Consultant or ED Nurse in Charge.
- Any difficulties in image interpretation should be discussed with the on call Diagnostic Radiology Consultant.
- CT signs of active bleeding should be discussed directly with the Trauma Surgeons. Consider involving the on-call Consultant Vascular Radiologist early in such cases.
- A verified Consultant Radiologist report should be completed **within 24 hours.**
 - Any significant changes from the provisional report should be directly communicated to the clinical team



References

1. Major trauma care in England. National Audit Office. 2010. <https://www.nao.org.uk/wp-content/uploads/2010/02/0910213.pdf>
2. The National Confidential Enquiry into Patient Outcome and Death (2007). Trauma: 2 Who cares?
3. Huber-Wagner S et al. Effect of whole-body CT during trauma resuscitation on survival: a retrospective, multicentre study. *Lancet* 2009; 25: 1455–61. doi: [http://dx.doi.org/10.1016/S0140-6736\(09\)60232-4](http://dx.doi.org/10.1016/S0140-6736(09)60232-4)
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6. NHS standard contract for major trauma service (all ages). NHS England. 2013. <https://www.england.nhs.uk/wp-content/uploads/2014/04/d15-major-trauma-0414.pdf>
7. Major trauma: assessment and initial management. National institute for Clinical Excellence. 2016. <https://www.nice.org.uk/guidance/NG39bastion>
8. Standards of Practice and Guidance for Trauma Radiology in severely injured patients. The Royal College of Radiologists 2011.
9. RNJ Graham. Battlefield radiology. *Br J Radiol*. 2012 Dec; 85(1020): 1556–1565.
10. Leeds teaching Hospitals CT protocols booklet



Appendix: Sample Polytrauma CT Request Form

Leeds General Infirmary		The Leeds Teaching Hospitals 	
		NHS Trust	
Polytrauma CT Request Form			
WQN1361			
Patient's Name		Date of Birth.....	
Patient's Address.....		Sex	
.....			
.....			
Consultant			
Indication			
RTA	Injury to more than one body region	<input type="checkbox"/>	
	Fatality at scene	<input type="checkbox"/>	
	High speed impact	<input type="checkbox"/>	
Fall	Injury to more than one body region	<input type="checkbox"/>	
	Fall from over 3m	<input type="checkbox"/>	
Assault	Injury to more than one body region	<input type="checkbox"/>	
Reduced GCS with unknown mechanism of injury		<input type="checkbox"/>	
Other (please specify)	<input type="text"/>		
Current GCS	<input type="text"/>		
Haemodynamically	Stable <input type="checkbox"/>	Unstable	<input type="checkbox"/>
Clinical Regions of Concern			
	Head <input type="checkbox"/>	Abdo Pelvis	<input type="checkbox"/>
	C spine <input type="checkbox"/>	All	<input type="checkbox"/>
	Thorax <input type="checkbox"/>	None	<input type="checkbox"/>
Clinical questions to be answered:	<input type="text"/>		
Possibility of pregnancy	<input type="checkbox"/>	Catheterised	<input type="checkbox"/>
Referring Doctor	<input type="text"/>	IV access	<input type="checkbox"/>
Signature	<input type="text"/>	Date	<input type="text"/>

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Appendix: Sample Primary Survey Report

Patient name:	
Date of scan:	
Reporting radiologist:	

Purpose: To guide initial management only. Formal detailed report will follow on results server.

AIRWAY			
ET placement	N/A	Satisfactory	Unsatisfactory
Airway obstruction		Yes	No

BREATHING			
Pneumothorax		Yes	No
Contusion		Yes	No
Laceration		Yes	No
Chest drain placement	N/A	Satisfactory	Unsatisfactory

CIRCULATION (BLEEDING)			
Thoracic		Yes	No
Abdominal		Yes	No
Pelvic		Yes	No
Soft tissue		Yes	No

DISABILITY			
	Intracranial bleed/oedema	Yes	No
	Major spinal injury	Yes	No