

# IMAGING

## HEMS Direct to CT Pathway

1. HEMS teams familiar with Severn MTC may choose to accompany major trauma patients requiring a full trauma scan as per of their arrival procedure.
2. The pathway must be followed to minimise delays between patient arrival, imaging and handover
3. HEMS should identify any patients for the direct to CT pathway and contact the Trauma Team Leader / EM Red Phone
4. The patient remains under the clinical care of the HEMS team until formal handover in the resuscitation bay following imaging.

### **Direct to CT applies to the following emergency attendances:**

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

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

## Before Patient Arrives at Emergency Department

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

**HEMS must contact the Trauma Team Leader (TTL) or ED Red Phone and inform of need for direct access to CT**

- HEMS should confirm that the patient is stable for scan
- Patient name and DOB, accurate ETA and route of transfer must be provided

**The doctor who receives the HEMS pre-alert must:**

- Inform reception staff to book-in patient and order required imaging
- Inform CT radiographer and on-call Radiology Registrar that the direct to CT pathway is in place

## Following Patient Arrival At Emergency Department

HEMS crew/paramedics will proceed direct to CT through the 'far door'.

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

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

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

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

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

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

HEMS will formally handover (ATMIST) the patient to the receiving clinician/TTL in ED Resuscitation bay.

## Whole Body CT Imaging Protocols

1. Whole body multidetector CT (MDCT) is the gold standard for radiological assessment of the severely injured patient
2. When the decision to proceed with MDCT has been made, transfer to the CT suite must not be delayed by inferior imaging modalities such as digital radiography or ultrasound (FAST).
3. North Bristol NHS Trust has a default MDCT whole body protocol for imaging of the head and neck and imaging of the thorax, abdomen and pelvis
4. For trauma units not familiar with multiphase whole body trauma imaging example protocols of alternative MDCT whole body protocols are suggested.

## Background

Whole body multidetector CT (MDCT) is the imaging modality of choice and the gold standard for radiological assessment of the severely injured patient (SIP).

Integration of MDCT in early trauma care significantly increases the probability of survival in multi-trauma patients. When a decision to proceed with MDCT has been made by the trauma team, transfer to the CT suite must not be delayed by inferior imaging modalities such as digital radiography or ultrasound.

MDCT protocols in trauma imaging have moved away from segmental body component imaging towards single pass and multiphase contrast injection scanning to shorten examination time and improve vascular and parenchymal enhancement and imaging.

## North Bristol Trust MDCT Whole Body Protocol

The default MDCT whole body protocol in adult trauma at North Bristol NHS trust is a modified version of the camp Bastion 'military' protocol.

### Head and Neck – Ideally imaged with arms down

- Brain - Unenhanced acquisition (0.625/1.25mm) with bony and soft tissue recons with the 3mm soft tissue recons made immediately available for review.
- C-Spine - Unenhanced spiral acquisition (0.625/1.25mm) from base of skull to T4 with 2mm axial, coronal and sagittal bony recons.

### Thorax, abdomen and pelvis – ideally imaged with arms up

- Lung apices to symphysis pubis (bone and soft tissue algorithms)
- 150mls iodinated contrast, biphasic contrast injection
  - ▶ initially 85mls @ 2mls/sec
  - ▶ followed by 65mls @ 4mls/sec
- Image acquisition at 60 secs post initiation of contrast injection.
  - ▶ If there is high clinical suspicion of significant intracerebral or cervical vascular injury in the SIP then the post-contrast scan volume should start at the level of the circle of Willis. This should be agreed at the time of the scan by the supervising radiologist and TTL.
  - ▶ Additional scan to include the facial bones should be undertaken as part of the C-Spine acquisition in cases where significant facial injury is suspected by the TTL.
  - ▶ Additional delayed phase imaging in the presence of suspected high grade renal, collecting system or bladder imaging should be discussed by the supervising radiologist and trauma team leader (TTL) at the time of scan.
  - ▶ High clinical suspicion of a significant lower limb arterial injury merits extending the scan volume to cover the area of concern.
- Some patients will inevitably be unable to comply with body imaging with arms above their head. Alternative approaches to positioning and protocols for imaging these patients is given as a traffic light aide memoir in Appendix AA (page 293).

## Alternative Whole Body Protocol for Trauma Units

Alternative MDCT whole body protocols for trauma units not familiar with multiphase whole body trauma imaging should include as a minimum, non-contrast imaging of the head and neck supplemented by arterial phase imaging of the chest, abdomen and pelvis and portal venous phase imaging of the abdomen and pelvis.

An example protocol is given below:

### **Head and Neck**

- Unenhanced acquisition (0.625/1.25mm) brain (bony and soft tissue recons) with 3mm soft tissue recons immediately available for review
- Unenhanced spiral acquisition (0.625/1.25mm) from base of skull to T4 with 2mm axial, coronal and sagittal bony recons

### **Lung apices to symphysis pubis (bone and soft tissue algorithms)**

- 100mls iodinated contrast @ 3.5mls/sec.
- Arterial phase: Commence scan @ 25 seconds post injection – Lung apices to symphysis pubis.
- Portal venous phase: Commence scan at 65 seconds post injection from dome of liver to symphysis pubis.
- Consider delayed scan if suspicion of significant renal collecting system or bladder injury.

An immediate (within 5 minutes) primary radiological survey should be given to the trauma team leader following image review on PACS.

An example proforma for communicating significant life threatening injuries is given below.

**Detailed radiological secondary survey should be completed within 1 hour.**

A consultant-verified report should be made available at the earliest opportunity, definitely within 24 hours and ideally within 1 hour of image acquisition.

## Interventional Radiology

1. The on-call Interventional Radiologist is contactable via switchboard
2. If contrast extravasation / active bleeding is seen on CT the on-call Interventional Radiologist should be contacted
3. Essentially any arterial bleeding can be treated by embolisation
4. Patients who are candidates for intervention will return to the Emergency Department for on-going management whilst awaiting the Interventional Radiologist team.

### Guidance for Discussion With On-Call Interventional Radiologist

If contrast extravasation/ active bleeding is seen on CT by the radiology registrar or general radiologist, or if they are uncertain the case should be discussed with the on-call Interventional Radiologist – contactable by switchboard.

Essentially any arterial bleeding can be treated by embolisation.

- Renal, splenic trauma and abdominal wall bleeding respond very well
- Pelvic bleeding (either fracture related or gynaecological) responds well but often needs more diffuse embolisation. In general, embolisation is not considered the first line for bleeding secondary to pelvic injury: all cases must be discussed with the on call consultant for pelvic surgery before embolisation is considered.
- Liver trauma is more difficult as 70% of blood supply is portal venous, but is worth attempting if there is arterial bleeding seen on CTA.

Upper and lower GI bleeding can also be treated with embolisation but is less commonly trauma related and usually has endoscopy as first line.

Patients who are candidates for intervention will return to the Emergency Department for ongoing management while awaiting the attendance/ mobilisation of the Interventional Radiology team.

## Radiology

**The Emergency Department has a large radiology suite embedded within its design. The suite consists of:**

- 4 plain film imaging rooms
- 2 CT scanners, one within the suite and one within the Resuscitation area
- Ultrasound room

### **Plain Film:**

The plain film imaging rooms contain digital radiography equipment providing rapid imaging for all patients.

### **CT:**

Both scanners are accessible 24/7, with all major trauma patients receiving their CT scans in the resus scanner. There is an onsite CT radiographer 24/7 and an on-call radiographer located within 30 minutes of the hospital.

### **MRI:**

The MRI unit is located on Level 2. These facilities are accessible 24/7. An on-call radiographer is available outside of normal hours and within 30mins.

Monday to Thursday 0730 – 2130

Friday 0730-2000

Saturday and Sunday 0730-1500

### **Interventional Radiology**

Located on Level 2. The Interventional Radiology department has staffing available for 5 labs between 0900-1700, a hybrid theatre and 2 fluoroscopy rooms from 0900-1700 every day.

In addition there is cover from 0800 in one lab and between 1700-2000 there is cover for one lab plus another radiographer for run overs.

From 2000-0800 there is on-call cover from home. At weekends on-call cover from 2000 Friday through until 0800 on Monday morning is available from home. A radiographer is always available within 30 minutes.



## References

1. Huber-Wagner S, Lefering R, Qvick LM, et al. Effect of whole-body CT during trauma resuscitation on survival: a retrospective, multicentre study. *Lancet* 2009;373:1455e61.
2. Nguyen D, Platon A, Shanmuganathan K, et al. Evaluation of a singlepass continuous whole-body 16-MDCT protocol for patients with polytrauma. *AJR Am J Roentgenol* 2009;192:3e10.
3. Loupatatzis C, Schindera S, Gralla J, et al. Whole-body computed tomography for multiple traumas using a triphasic injection protocol. *Eur Radiol* 2008;18:1206e14.
4. The Royal College of Radiologists: Standards of Practice and Guidance for Trauma Radiology in Severely Injured Patients [https://www.rcr.ac.uk/system/files/publication/field\\_publication\\_files/bfcr155\\_traumaradiol.pdf](https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr155_traumaradiol.pdf)
5. The Royal College of Radiologists: Standards for Providing a 24-hour interventional radiology service [https://www.rcr.ac.uk/system/files/publication/field\\_publication\\_files/bfcr171\\_24hr\\_ir.pdf](https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr171_24hr_ir.pdf)
6. NICE: Major Trauma: Assessment and Initial Management – Interventional Radiology (Section 1.5.40 – 1.5.43) <http://www.nice.org.uk/guidance/ng39/chapter/Recommendations#interventional-radiology>



## Appendix Z - Radiological Primary Survey Checklist

<b>PATIENT NAME:</b>				<b>MRN:</b>				
<b>DATE:</b>				<b>Time on SCANNER:</b>				
<b>RADIOLOGIST:</b>				<b>SPR 1 2 3 4 5 6 CONSULTANT</b>				
AIRWAY				BREATHING				
ET Tube Placement	N/A	Incorrect	Correct	Drain Placement	N/A	Incorrect	Correct	
Foreign Body		Yes	No	Pneumothorax		Yes	No	
Airway Obstruction		Yes	No	Haemothorax		Yes	No	
Major Air Leak		Yes	No	<b>COMMENTS:</b>				
<b>COMMENTS:</b>								
CIRCULATION								
CHEST			ABDOMEN			PELVIS		
Contrast Extravasation	Yes	No	Contrast Extravasation	Yes	No	Contrast Extravasation	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	If renal injury, consider additional delayed phase study		
Pericardial Fluid	Yes	No	Renal Injury	Yes	No			
<b>COMMENTS:</b>								
DISABILITY				X-RAYS				
Intracranial Bleed	Yes	No	<b>CXR:</b>					
Mass Effect	Yes	No						
C Spine Fracture	Yes	No						
T-L Spine Fracture	Yes	No						
<b>COMMENTS:</b>				<b>Pelvis:</b>				
<b>COMMENTS:</b>				<b>Other:</b>				
<p>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.</p> <p><b>Clinicians Contacted</b> Name / Specialty / Grade:</p> <p>Time Complete:</p>								

**Appendix AA - Whole Body CT Protocols**

**Image Quality**

<p><b>Stable</b></p> <p><b>GCS 15</b></p> <p><b>Able to follow commands &amp; raise arms above head</b></p>	<p><b>Stable</b></p> <p><b>Ventilated</b></p> <p><b>Unable to raise arms above head</b></p>	<p><b>Unstable</b></p>
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<p>Non contrast head &amp; C-spine in headrest</p> <p>Patient moved from headrest</p> <p>Biphasic lung apices to lesser trochanters</p> <p>Patient arms up</p>	<p>Non contrast head &amp; C-spine in headrest</p> <p>Patient remains in headrest</p> <p>Biphasic lung apices to lesser trochanters</p> <p>Patient arms across abdomen</p>	<p>Non contrast head only on footrest</p> <p>Patient remains on footrest</p> <p>Biphasic base of skull to lesser trochanters</p> <p>Patient arms across abdomen</p>
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**Patient Dose**