

Sussex Trauma Network
Guidelines about:

Interventional Radiology in Trauma



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Interventional Radiology in Trauma

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1 Executive Summary

- Protocol-driven Interventional Radiology must be available for seriously injured patients treated within this network (from RCR Standard 2).
- Where there is a difference between adult and paediatric guidelines in this document, it will be specified. Paediatric guidelines take precedence for patient under 16 years of age.
- Interventional Radiology (IR) facilities should be co-located (same hospital campus) with the Emergency Department (from RCR Standard 14).
- IR trauma teams should be in place within 60 minutes of the patient's admission or within 30 minutes of referral (RCR Standard 17).
- IR for trauma should only be performed in facilities with available on-site surgical expertise in case rescue surgery is required.
- The suitability of treatment by IR will usually be indicated by results of a CT Traumagram (Whole Body CT).
- Treatment by IR should be considered in the context of active arterial bleeding or significant haematoma from trauma-related solid organ (liver, kidney or spleen) or pelvic injury.
- Decisions about management of such cases should be made after discussion of options by a group of consultants including trauma team leader, interventional radiologist and consultant from relevant specialty or specialties.
- Patient initially seen in a Trauma Unit (TU) may need secondary transfer to a Major Trauma Centre (MTC) following the relevant network [Patient Pathways](#).
- Paediatric patients who require interventional radiology should be treated in a dedicated tertiary referral centre by an expert in interventional radiology with appropriate skills where possible.
- All patients undergoing IR for trauma should have a period of admission non-radiology specialty.
- Patients undergoing IR for trauma should be included in the TARN audit data submissions for the hospital(s) involved.
- IR decisions and procedures should be fully documented.

2 Introduction

Use of nonoperative management such as interventional radiology in specific scenarios has also led to improved outcomes from major trauma. In the past 20 years, transcatheter arterial embolisation for traumatic injury has played a pivotal role in improving survival, reducing morbidity, and decreasing operative blood loss. Its effectiveness has been demonstrated in several body regions, including the liver, spleen, kidneys, and pelvis.

Additionally, embolisation and vascular reconstruction with covered stents have been found to be effective in many vascular beds that are relatively inaccessible to operative interventions, such as subclavian, intercostal, lumbar, and phrenic arteries, and should be considered on a case-by-case basis in those scenarios.

Intervention should be performed with expediency to minimize haemorrhage. In a patient with ongoing blood loss, an earlier intervention can prevent further massive blood loss, which has been widely recognized as a cause of multiple-organ failure and disseminated intravascular coagulation.

3 Purpose of the Guideline

3.1 Aims & Objectives

The aims and objectives of this guideline are:

- To provide a system-wide approach for management of patients with major trauma who might benefit from interventional radiology
- To define appropriate patient pathways for these patients
- To list appropriate accepted routes of communication
- To highlight continuing areas of contention
- To help meet TQUINs requirements for creation of network-agreed guidelines for the Network and Trauma Units (TUs)

3.2 Principles

- The role of IR in the seriously injured patient is to stop haemorrhage as quickly as possible with minimal interference to the patient's already damaged physiology.
- Whole-body contrast-enhanced head-to-thigh CT (CT Traumagram) is the default imaging procedure of choice for seriously injured adults (from RCR Standard 9). See also [STN Guideline – Imaging for Trauma – adults and children](#).
- Information supplied by a CT Traumagram is key to informing the decision-making process and guiding a catheter to the haemorrhage site.
- A patient whose condition is too unstable for a CT Traumagram is not suitable for IR.
- The decision on whether a patient with traumatic haemorrhage has endovascular treatment, open surgery, a combination of both or non-operative management should be made by both the trauma team leader and the interventional radiologist after consultation with other consultants involved - see [Appendix 5](#).
- IR for trauma should only be performed in facilities with available on-site surgical expertise in case rescue surgery is required.

- If a TU or LEH does not have available IR facilities and suitably qualified staff, then there should be protocols for transfer of suitable patients to a MTC if IR is appropriate.

4 Definitions

Interventional radiology is a medical sub-specialty of radiology using minimally-invasive image-guided procedures to diagnose and treat diseases in nearly every organ system.

5 Scope

The guideline covers all major trauma patients within the Sussex Trauma Network. It replaces and supersedes all previous Interventional Radiology Guidelines covering Sussex Trauma Network and is applicable to adults and children.

6 Relevant Documents and Guidance

This guideline assumes and incorporates compliance with:

- [The Royal College of Radiologists - Standards of practice and guidance for trauma radiology in severely injured patients](#)
- [The Royal College of Radiologists – Paediatric Trauma Protocols](#)

This guideline also aspires to compliance with the relevant 2016 Major Trauma Service Quality Indicators (TQUINs) issued by the NHS England Quality Surveillance Team - [tquins resources measures major trauma measures final 230416 7 .pdf \(wymtn.com\)](#) and the subsequent 2020 version applying to Trauma Units.

The relevant extracts from the indicators are:

6.1 For Trauma Networks

- **T16-1C-107**
There should be network agreed clinical guidelines for the management of:
 - Interventional radiology

6.2 For Major Trauma Centres

- **T16-2B-109**
Interventional radiology should be available 24/7 within 30 minutes of a request. Interventional radiology should be located within operating theatres or resuscitation areas.

There should be a protocol for the safe transfer and management of patients which includes the anaesthetics and resuscitation equipment.

- **T16-2B-113**

There following consultants should be available to attend an emergency case within 30 minutes

- an interventional radiologist

- **T16-2C-114**

There should be facilities for endovascular surgery, including EVAR, available 24/7.

This guideline also draws information from the [Society of Interventional Radiology Position Statement on Endovascular Intervention for Trauma](#). The specific recommendations of this position statement are as follows:

- The development and adherence to evidence-based treatment algorithms for each trauma scenario is necessary to ensure streamlined and consistent care to optimize patient outcomes.
- Operator expertise in the performance of endovascular interventions is essential for the trauma patient. Small- and large-vessel endovascular interventions each require distinct skill sets and training.
- The development and adherence to evidence-based treatment algorithms for each trauma scenario in paediatric patients is necessary to ensure streamlined and consistent care to optimize patient outcomes.
- Emergency thoracic endovascular aortic repair should be used in anatomically favourable grade 3 and grade 4 aortic injuries, with nonoperative management (antihypertensive and anti-impulse medication with close symptomatic and/or radiographic follow-up) favoured for the management of grade 1 and grade 2 injuries (also known as minimal aortic injury).
- Embolisation for pelvic trauma should be first-line therapy and the standard of care over surgery. **

**(Please note that this recommendation does not list important caveats. In the STN, the recommendation is modified to: Interventional Radiology (IR) is indicated in patients who remain unstable despite adequate resuscitation with active arterial bleed 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.)

- Nonoperative management should be the treatment of choice in patients with blunt hepatic injury who are in hemodynamically stable condition, with embolisation to be considered in cases of ongoing bleeding, identification of an arterial source of bleeding

on imaging, or suspicion of persistent source of arterial bleeding despite operative intervention. (See [Appendix 2](#) for grading of liver injuries)

- Splenic artery embolisation should be considered for patients in hemodynamically stable condition with grade IV/V blunt splenic trauma (see [Appendix 4](#) for grading of splenic injuries).
- Embolisation should be considered in patients in hemodynamically stable condition with any grade injury who have imaging or clinical evidence of ongoing splenic haemorrhage.
- Angiography and embolisation should be considered in patients with grade III/IV renal injuries when surgical exploration is not warranted as a result of other indications. (See [Appendix 3](#) for grading of renal injuries).

7 Responsibilities, Accountabilities and Duties

7.1 Emergency Medicine Consultant on duty (MTC and TUs)

The Emergency Medicine Consultant(s) on duty in the MTC take overall responsibility for patients with suspected major trauma from the time they arrive in the Emergency Department until the Polytrauma Consultant or other relevant consultant takes over care.

They will act as the Trauma Team Lead Consultant and following discussion and opinion from other trauma team members, will take responsibility for initiating contact with the on-call IR Consultant in cases where interventional radiology management is considered appropriate.

They will ensure that there is discussion with the IR Consultant and other relevant specialty consultants concerning treatment options for the patient.

They also are responsible for ensuring that Emergency Department (ED) junior staff are aware of and follow this guideline and other pertinent national guidelines.

7.2 Major Trauma Consultant on call (MTC) – not yet in place

The Major Trauma Consultant (when in place) takes overall responsibility for patients with suspected major trauma once notified of their arrival. Their duties include ensuring patients are managed according to the guideline and that junior staff are aware of the guideline and other pertinent national guidelines.

The Major Trauma Consultant of the day will ensure their availability to assess patients potentially requiring interventional radiology and discuss with the IR Consultant and other relevant Trauma Team members.

7.3 IR Consultant (MTC and TUs)

If working in the MTC, the duty IR Consultant is responsible for attending within 30 minutes when requested, directly or indirectly, to do so by the Trauma Team Lead Consultant.

They are responsible for participating in discussion with the Trauma Team Lead Consultant and other relevant specialty consultants concerning treatment options for the patient.

They are responsible for initiating the relevant processes when a decision for IR has been agreed.

8 Standard Operating Procedure

8.1 Pre-Hospital Triage

Most patients with injuries warranting IR are conveyed to hospital and have pre-hospital triage by one or both of the two main pre-hospital service providers – SECAMB and AAKSS. Each of these services cover a wider area than the STN and has its own pre-hospital triage algorithms to determine which hospital an individual patient is conveyed to - see [STN Patient Pathways](#).

Availability of IR facilities itself does not form part of the triage decision making. Hence patients arriving at TUs and the MTC may require and should have access to IR, even if a secondary transfer proves necessary.

8.2 Initial Assessment

This is performed as normal by a trauma team led by a qualified team leader.

8.3 Imaging

Whole-body contrast-enhanced head-to-thigh CT (CT Traumagram) is the default imaging procedure of choice for seriously injured adults (from RCR Standard 9). See also [STN Guideline – Imaging for Trauma – adults and children](#).

For injured children, limited or focused CT may be done instead.

In the majority of cases, the decision to contact an interventional radiologist will be based on the trauma CT findings.

Following the report of the trauma CT by the general radiology consultant or registrar, the IR consultant can be contacted via hospital switchboard.

8.4 Decision-Making

The decision on the treatment options for a patient with traumatic haemorrhage requires active discussion between the relevant specialists. This should include the trauma team leader, an interventional radiologist if IR is a possible option, and the relevant consultant(s) who will look after the patient after IR and if IR is not chosen. According to local protocols and the actual injured body sites, this may include vascular, cardiothoracic, general surgical, orthopaedic, urology and intensivist consultants.

See [Appendix 5](#) for guidance about suitable treatment options for different scenarios.

Embolisation for the treatment of active haemorrhage should be considered early in the patient pathway if there is CT proven injury to the liver, kidneys, spleen or pelvic fractures. This is particularly important in the context of cardiovascular instability. Embolisation is less effective after multiple unit blood transfusions and in the context of haemorrhage related coagulopathy or DIC. Embolisation is also ineffective in the context of venous pelvic bleeding where surgical packing should be considered.

Following the decision to treat with embolisation, the trauma team (including anaesthetic support) will accompany the patient to the IR suite.

Embolisation of solid organs or pelvic vessels can be performed under local or general anaesthetic (GA) and so the decision for GA should be made by the trauma anaesthetist based on patient stability, compliance and associated injuries, as with all trauma cases. Embolisation can however be painful in the post-operative period due to ischaemic organ pain depending on extent of embolisation and appropriate analgesia will need to be planned.

8.4.1 Other IR procedures in Trauma:

IR may also have a role in the endovascular management of patients with trauma related aortic dissection or transection, in conjunction with cardiothoracic surgery and vascular surgery.

IVC filter placement – this has a very limited role after trauma due to cost, potential harm to patients and high risk of being lost to follow up. If there is proven pulmonary embolism following lower limb/pelvic trauma-related venous thrombosis, the first line treatment is anticoagulation. An IVC filter would only be considered if the patient has a contra-indication to anti-coagulation which is expected to persist beyond day 7. Most commonly this contra-indication would be intra-cranial bleed. All potential cases must be first discussed with consultants in IR and haematology.

Angiography – may be appropriate in the context of traumatic arterial injury with peripheral ischaemia following vascular surgical discussions.

8.5 Specialist Referral

For each patient undergoing IR for trauma, there must be a non-radiology consultant who takes responsibility for admission and post-IR care or rescue surgery. The non-radiology

consultant must be readily available to perform timely rescue surgery if IR fails. The speciality concerned will depend on the relevant body site(s) injured. The Trauma Team leader is responsible for ensuring that speciality is involved in discussions and care of the patient.

If there is no local interventional radiologist available (TUs), then the Trauma Team leader must ensure that the team takes in to account the physiological stability of the patient in deciding whether the patient should be referred to the MTC for consideration of IR. Clearly patients who are so unstable that their chance of survival is no better if transferred, should be managed at the TU.

Referral of a patient from a TU to a MTC for consideration of IR should follow the processes defined by the [STN Patient Pathways](#) document. The actual pathway used depends on the urgency of the patient's condition and age.

8.5.1 Adult Patients

Adult patients with a life-threatening condition can be managed using the **Immediate Transfers** pathway, where the referral is to MTC ED consultant. In this pathway there is no referral to an MTC consultant prior to transfer because the expectation is that the patient cannot be managed at the TU and will have to be transferred to the MTC.

However, in cases where there is clear evidence of ongoing active arterial (not venous) bleeding from liver or pelvic injuries with significant cardiovascular instability, patients should not be transferred with the expectation that they will be getting IR at the MTC, unless this has already been discussed with a MTC interventional radiologist, in case IR is not possible, in which case Damage Control Surgery (DCS) at the TU may be the best option. But if DCS is not available at the TU, the **Immediate Transfer** pathway should be followed.

All other adult patients should be managed by a **Non-Immediate Transfer** pathway. In this case the referral is to the relevant specialty according to the body site(s) injured (see above). It will then be up to that speciality at the MTC to determine whether they should contact the IR consultant for a discussion about management and to make appropriate arrangements about treatment and admission.

8.5.2 Paediatric Patients

Royal College of Radiologists guidance states that:

- Paediatric patients who require interventional radiology should be treated in a dedicated tertiary referral centre by an expert in interventional radiology with appropriate skills where possible.

Except in an emergency when a local interventional radiologist believes they have the required skills, children requiring IR will need discussion with and possible transfer to the nearest paediatric MTC. These are Kings College Hospital, St. George's Hospital or Southampton General Hospital. At present, none of the interventional radiologists at RSCH have the required skills.

8.6 Admission

All patients undergoing IR for trauma should have a period of admission under the relevant speciality (see above).

8.7 Audit

Any patients whose treatment falls outside this guideline should be reported via the network [Clinical Governance Framework](#) and discussed through internal clinical governance mechanisms.

Most patients warranting IR for trauma should be included in the TARN audit data submissions for the hospital(s) involved.

9 Training Implications

All within the trauma team must be aware of the Guideline and ensure that the guideline is followed.

10 Documentation

All decision process about management of patients with conditions suitable for IR should be documented the medical records. The outcome of those decisions, including options available and reasons for the decisions made should be recorded.

All IR procedures must be fully documented and that documented musty form part of the medical records.

11 Monitoring Arrangements

These include:

- [STN Clinical Governance log](#)
- NMTR Audit

12 Equality Impact Assessment Screening

None in process.

13 Links to other SOPs and Trust policies

This guidance refers to and links with the following STN and Trust publications:

- [STN Patient Pathways](#) (present version called Patient Pathway v9.10)
- [STN Guideline – Imaging for Trauma – adults and children](#) (present version v1.0)
- [STN Guideline – Vascular Injuries](#) (present version v1.0)
- [STN Guideline – Severe Pelvic Fractures including Urethral Injury](#) (present version v1.0)

14 References

- [The Royal College of Radiologists - Standards of practice and guidance for trauma radiology in severely injured patients](#)
- [Major Trauma Services Quality Indicators \(TQUINS\)](#)
- [Society of Interventional Radiology Position Statement on Endovascular Intervention for Trauma](#)
- [Injury Scoring Scale - A Resource for Trauma Care Professionals](#)

15 Appendices

15.1 Appendix 1 – Abbreviations

AAKSS	Air Ambulance Kent Surrey Sussex
CT	Computed Tomography
DCS	Damage Control Surgery
DIC	Disseminated Intravascular Coagulation
ED	Emergency Department
EVAR	Endo-Vascular Aneurysm Repair
GA	General Anaesthetic
IR	Interventional Radiology
LEH	Local Emergency Hospital
MDT	Multi-Disciplinary Team
MTC	Major Trauma Centre
NMTR	National Major Trauma Registry
NOM	Non-Operative Management
RCR	Royal College of Radiologists
SECAMB	South East Coast Ambulance Service NHS Foundation Trust
STN	Sussex Trauma Network
TQUINs	Trauma Quality Indicators
TU	Trauma Unit
TUs	Trauma Units
UHSx	United Hospitals Sussex NHS Foundation Trust

15.2 Appendix 2 – American Association for the Surgery of Trauma (AAST) Liver Injury Scale (2018 Revision)

AAST Grade	Imaging Criteria (CT findings)
I	<ul style="list-style-type: none"> Subcapsular haematoma <10% surface area Parenchymal laceration <1 cm depth
II	<ul style="list-style-type: none"> Subcapsular haematoma 10-50% surface area Intraparenchymal haematoma <10 cm in diameter Laceration 1-3 cm in depth and ≤10 cm length
III	<ul style="list-style-type: none"> Subcapsular haematoma >50% surface area Ruptured subcapsular or parenchymal haematoma Intraparenchymal laceration >10 cm Laceration >3 cm depth Any injury in the presence of a liver vascular injury or active bleeding* contained within liver parenchyma
IV	<ul style="list-style-type: none"> Parenchymal disruption involving 25-75% of a hepatic lobe Active bleeding extending beyond the liver parenchyma into the peritoneum
V	<ul style="list-style-type: none"> Parenchymal disruption >75% of hepatic lobe Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins

* Vascular injury is defined as a pseudoaneurysm or arteriovenous fistula and appears as a focal collection of vascular contrast that decreases in attenuation with delayed imaging. Active bleeding from a vascular injury presents as vascular contrast, focal or diffuse, that increases in size or attenuation in delayed phase. Vascular thrombosis can lead to organ infarction.

Grade based on highest grade assessment made on imaging, at operation or on pathologic specimen.

More than one grade of liver injury may be present and should be classified by the higher grade of injury.

Advance one grade for multiple injuries up to grade III

15.3 Appendix 3 –American Association for the Surgery of Trauma (AAST) Kidney Injury Scale (2018 Revision)

AAST Grade	Imaging Criteria (CT findings)
I	<ul style="list-style-type: none"> Subcapsular haematoma and/or parenchymal contusion without laceration
II	<ul style="list-style-type: none"> Perirenal hematoma confined to Gerota fascia Renal parenchymal laceration ≤ 1 cm depth without urinary extravasation
III	<ul style="list-style-type: none"> Renal parenchymal laceration >1 cm depth without collecting system rupture or urinary extravasation Any injury in the presence of a kidney vascular injury or active bleeding contained within Gerota fascia*
IV	<ul style="list-style-type: none"> Parenchymal laceration extending into urinary collecting system with urinary extravasation Renal pelvis laceration and/or complete ureteropelvic disruption Segmental renal vein or artery injury Active bleeding beyond Gerota fascia into the retroperitoneum or peritoneum* Segmental or complete kidney infarction(s) due to vessel thrombosis without active bleeding
V	<ul style="list-style-type: none"> Main renal artery or vein laceration or avulsion of hilum Devascularized kidney with active bleeding* Shattered kidney with loss of identifiable parenchymal renal anatomy

* Vascular injury is defined as a pseudoaneurysm or arteriovenous fistula and appears as a focal collection of vascular contrast that decreases in attenuation with delayed imaging. Active bleeding from a vascular injury presents as vascular contrast, focal or diffuse, that increases in size or attenuation in delayed phase. Vascular thrombosis can lead to organ infarction.

Grade based on highest grade assessment made on imaging, at operation or on pathologic specimen.

More than one grade of kidney injury may be present and should be classified by the higher grade of injury.

Advance one grade for multiple injuries up to grade III.

15.4 Appendix 4 – American Association for the Surgery of Trauma (AAST) Spleen Injury Scale (2018 Revision)

AAST Grade	Imaging Criteria (CT findings)
I	<ul style="list-style-type: none"> • Subcapsular haematoma <10% surface area • Parenchymal laceration <1 cm depth • Capsular tear
II	<ul style="list-style-type: none"> • Subcapsular haematoma 10-50% surface area • Intraparenchymal haematoma <5 cm • Parenchymal laceration 1-3 cm
III	<ul style="list-style-type: none"> • Subcapsular hematoma >50% surface area • Ruptured subcapsular or intraparenchymal haematoma ≥5 cm • Parenchymal laceration >3 cm depth
IV	<ul style="list-style-type: none"> • Any injury in the presence of a splenic vascular injury or active bleeding confined within splenic capsule* • Parenchymal laceration involving segmental or hilar vessels producing >25% devascularization
V	<ul style="list-style-type: none"> • Any injury in the presence of a splenic vascular injury with active bleeding extended beyond the spleen into the peritoneum* • Shattered spleen

* Vascular injury is defined as a pseudoaneurysm or arteriovenous fistula and appears as a focal collection of vascular contrast that decreases in attenuation with delayed imaging. Active bleeding from a vascular injury presents as vascular contrast, focal or diffuse, that increases in size or attenuation in delayed phase. Vascular thrombosis can lead to organ infarction.

Grade based on highest grade assessment made on imaging, at operation or on pathologic specimen.

More than one grade of splenic injury may be present and should be classified by the higher grade of injury.

Advance one grade for multiple injuries up to grade III.

15.5 Appendix 5 – Guidance on the indications for non-operative management (NOM), interventional radiology (IR) and damage control surgery (DCS) in the seriously injured patient

(From [The Royal College of Radiologists - Standards of practice and guidance for trauma radiology in severely injured patients](#))

Site	NOM	IR	DCS
Thoracic aorta	No role except small partial thickness tears	Stent graft for suitable lesions	Ascending aortic injury or arch injury involving great vessels
Abdominal aorta	No role	Occlusion balloon, stent graft for suitable lesions	Injury requiring visceral revascularisation or untreatable by EVAR
Peripheral or branch artery	No role	Occlusion balloon, stent graft or embolisation	Any lesion which cannot rapidly be controlled, or which will require other revascularisation
Kidney	Subcapsular or retroperitoneal haematoma without active arterial bleeding	Active arterial bleeding, stent graft or embolisation	Renal injury in association with multiple other bleeding sites or other injuries requiring urgent surgical repair
Spleen	Lacerations, haematoma without active bleeding or evidence of false aneurysm	Active arterial bleeding or false aneurysm Focal embolisation for focal lesion Proximal embolisation for diffuse injury	Packing or splenectomy for active bleeding in association with multiple other bleeding sites
Liver	Subcapsular or intraperitoneal haematoma or lacerations without active arterial bleeding	Active arterial bleeding Focal embolisation is possible Non-selective embolisation if multiple bleeding sites demonstrated, as long as the portal vein patent	Packing if emergency laparotomy needed with subsequent repeat CT and embolisation if required
Pelvis	Minor injury with no active bleeding	Focal embolisation for arterial injury (bleeding, false aneurysm or cut-off)	External compression and subsequent fixation if bleeding from veins or bones
Intestine	Focal contusion with no evidence of ischaemia, perforation or haemorrhage.	Focal bleeding with no evidence of ischaemia or perforation. Or to stabilise patient, allowing interval laparotomy pending treatment of other injuries	Ischaemia or perforation requiring laparotomy +/- bowel resection

15.6 Appendix 6 – Version Changes

Version	Changes
1.1	<ul style="list-style-type: none"> • 6.2 Clarification of guidance for IR in pelvic trauma • Reference to STN Guidelines – Vascular Injuries and Severe Pelvic Fractures including Urethral Injury • Change reference to Clinical Governance Framework • Reference to National Major Trauma Registry • Update local links • This Appendix added