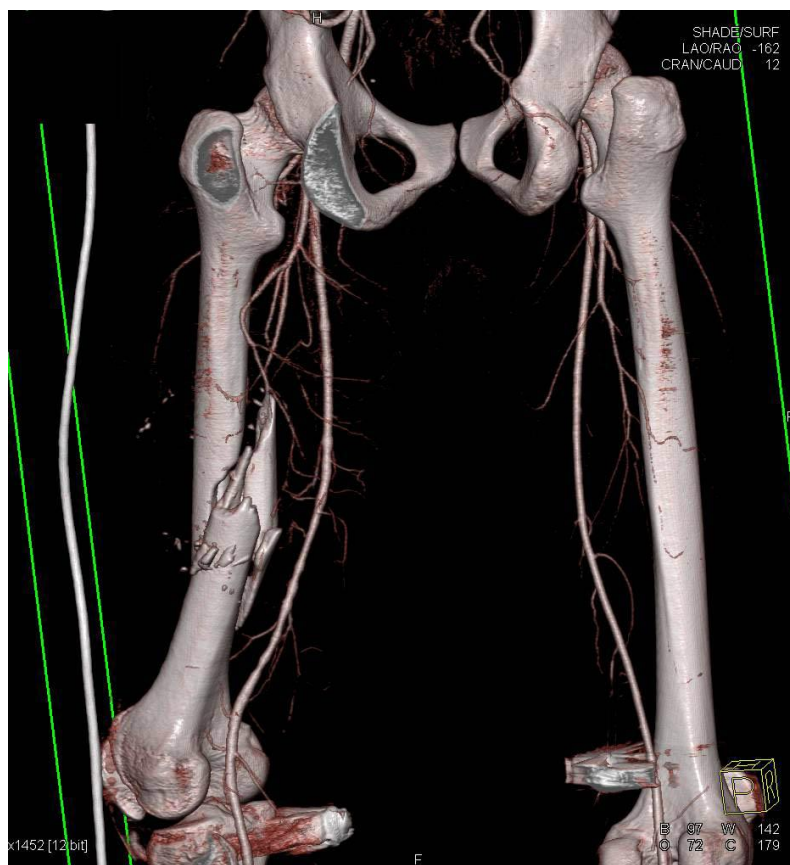


Sussex Trauma Network
Guidelines for Management of:
Vascular Injuries



May 2024

Management of Vascular Injuries

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1 Executive Summary

- All hospitals and networks that are responsible for the management of patients with vascular injury must have clear emergency referral and transfer protocols that should include points of contact.
- Centres providing definitive care must have an agreed protocol and pathway standardising the management of these complex injuries.
- Most patients with vascular injury will be conveyed to hospital by pre-hospital services, using their existing triage algorithms.
- Most patients with significant vascular injury causing persistent haemorrhage or limb ischaemia should be conveyed directly or transferred after assessment to the appropriate Major Trauma Centre (MTC).
- For adult patients, this will be the Royal Sussex County Hospital, Brighton.
- For paediatric patients (under the age of 16), if the patient has polytrauma, they should be referred to the nearest Paediatric MTC.
- Patients with possible significant vascular injury (persistent haemorrhage, shock or limb ischaemia) should be given high priority for assessment in hospital, such that they can be identified as requiring timely haemorrhage control or revascularisation.
- This assessment should include assessment and documentation of the vascular and neurological status.
- All adult patients with suspected vascular injury should have a CT Traumagram, with angiography of the affected area.
- Children with suspected vascular injury should be discussed with a Paediatric Radiologist to determine the need for CT scanning.
- Patients with vascular compromise should be seen and assessed by a vascular surgeon, after transfer if necessary.
- If a patient requires transfer to get the appropriate urgent surgery, then that transfer should be done urgently and the request for transport for the transfer should convey the urgency.
- All patients should receive information regarding expected functional recovery and rehabilitation, including advice about return to normal activities.

2 Introduction

A vascular injury is an injury to an artery or vein due to a trauma or blow. These injuries can affect the arterial, lymphatic, or venous systems. Vascular injuries are potentially life and limb threatening injuries and can lead to long term disability when complications in healing occur.

They are most often located on a limb, especially lower limbs (80-90% of cases). But they may also occur in the neck, chest and abdomen.

The most frequent clinical signs of vascular injury are either haemorrhage, with external bleeding or evidence of persistent hypovolaemic shock, or acute ischaemia.

Rapid, accurate diagnosis of arterial injuries is crucial for optimum outcome as well as access to immediate referral to, and joint management with, a surgeon capable of performing vascular repair, and / or interventional radiologist.

Well documented pathways are important in promoting best care of these patients.

3 Purpose of the Guideline

The purpose of this guideline is to clearly define the care pathway for patients with vascular injuries including referral pathways to and from the Major Trauma Centre (MTC) (Royal Sussex County Hospital (RSCH)) and network Trauma Units (TUs). It includes guidance for pre-hospital and hospital management, indications for surgery and rehabilitation.

3.1 Aims & Objectives

The aims and objectives of this guideline are:

- To provide a system-wide approach for management of patients with vascular injuries
- To define appropriate patient pathways for these patients
- To list appropriate accepted routes of communication
- To highlight continuing areas of contention
- To help meet TQUIN requirements for creation of network-agreed guidelines for the Network and Trauma Units (TUs)

4 Scope

The guideline covers all major trauma patients with vascular injuries within the Sussex Trauma Network. It replaces and supersedes all relevant previous STN guidelines.

It is applicable to adults and children, but relevant sections contain statements where different processes apply to management of children.

5 Relevant Documents and Guidance

This guideline refers to:

- [NICE Guideline \[NG39\] – Major trauma: assessment and initial management](#)
- [BOAST 6 Guideline – Diagnosis & Management of Arterial Injuries Associated with Extremity Fractures and Dislocations](#) - updated April 2021. See also in [Appendix 2](#)
- [Wessex Children's Major Trauma Guidelines](#) – on the Paediatric Innovation, Education and Research Network website (piernetwork.org)

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:

5.1 For Trauma Networks

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

5.2 For Pre-hospital Providers

- **T16-2A-104**
There should be protocols in place for the pre-hospital management of major trauma patients which includes:
 - management of major haemorrhage including:
 - the administration of tranexamic acid
 - application of haemostatic dressings
 - application of tourniquets

5.3 For Major Trauma Centres

- **T16-2B-110**
There should be 24/7 access to a fully staffed and equipped emergency theatre. Patients requiring acute intervention for haemorrhage control should be in an operating room or intervention suite within 60 minutes.
- **T16-2B-113**
The following consultants should be available to attend an emergency case within 30 minutes:
 - a vascular surgeon

- **T16-2B-119**
Patients with significant haemorrhage should be administered Tranexamic Acid within 3 hours of injury and receive a second dose according to CRASH-2 protocol.
- **T16-2C-114**
There should be facilities for open vascular and endovascular surgery, including EVAR, available 24/7.

5.4 For Trauma Units

- **T20-2B-310**
Patients requiring acute intervention for haemorrhage control should be in an operating room or intervention suite within 60 minutes.
- **T20-2B-311**
There are network agreed guidelines in place for the management of major trauma including:
 - vascular injuries.

6 Standard Operating Procedure

6.1 Pre-Hospital Care

6.1.1 Pre-Hospital Triage

Most patients with vascular injury 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.

Pre-hospital practitioners are required to use clinical judgement to determine the most appropriate destination hospital for patients with major trauma. The suspicion of or presence of vascular injury does not of itself mandate transfer to a Major Trauma Centre (MTC).

However, according to the current SECAmb Major Trauma Decision Tree (see [STN Patient Pathways](#) document) the following features often associated with vascular injury do justify primary transport to the MTC:

- Sustained respiratory rate <10 or >29 per minute (or paediatric equivalent)
- Sustained systolic blood pressure <90mmHg or absent radial pulse
- Major pelvic injury
- More than 1 fracture femur/humerus
- Penetrating trauma to chest, abdomen, back, pelvis neck or groin
- Mangled or amputated limb proximal to wrist or ankle

However, if the patient's vital signs are unmanageable, prehospital staff may consider primary transport to the nearest Trauma Unit (TU) or MTC.

Children identified or suspected of having sustained these injuries should be conveyed to the nearest paediatric MTC if within 60 minutes. If the nearest paediatric MTC is >60 minutes away the child should be taken to the nearest TU or adult MTC for stabilisation.

6.1.2 Pre-Hospital Care

Pre-hospital practitioners with the requisite competence may provide the following care prior to transport or arrival at hospital:

- Large bore intravenous or intraosseous cannulation
- External haemorrhage should be controlled immediately by direct pressure with simple dressings.
- In patients with major limb trauma, they may apply a tourniquet if direct pressure has failed to control life-threatening external haemorrhage.
- If active bleeding is suspected from a pelvic fracture after blunt high-energy trauma, they may apply a purpose-made pelvic binder.
- Give intravenous tranexamic acid as soon as possible in patients with major trauma and active or suspected active bleeding.
- Permissive hypotensive resuscitation without dilutional restoration of circulating volume is ideal. In the awake patient titrate volume replacement to maintain consciousness, or if not conscious aim for systolic BP of 80mmHg.
- A pulseless, deformed limb should be re-aligned, splinted and the vascular examination repeated and documented at the time of diagnosis and prior to transport.

6.2 Hospital Care

6.2.1 Identifying the High-Risk Patient

Patients with possible significant vascular injury (persistent haemorrhage, shock or limb ischaemia) should be given high priority for assessment in hospital, such that they can be identified as requiring timely haemorrhage control or revascularisation.

This assessment should include assessment and documentation of the vascular and neurological status.

The MTC should have a protocol for initiating a Code Red Trauma Call for patients with potentially life-threatening haemorrhage. Code Red Trauma Calls should result in rapid attendance of appropriate specialists including general, orthopaedic, and vascular surgeons, as well as activation of the major haemorrhage protocol.

TUs should have a mechanism to rapidly summon appropriate specialists and activate a major haemorrhage protocol for stabilisation of patients with potentially life-threatening haemorrhage.

Use physiological criteria that include the patient's haemodynamic status and their response to immediate volume resuscitation to activate the major haemorrhage protocol. Do not rely on a haemorrhagic risk tool applied at a single time point to determine the need for major haemorrhage protocol activation.

6.2.2 Persistent Bleeding

In all cases of suspected major arterial injury, whether controlled or not, permissive hypotensive resuscitation without dilutional restoration of circulating volume is ideal. In the awake patient titrate volume replacement to maintain consciousness, in the anaesthetised patient aim for systolic BP of 80mmHg. Large bore IV access and provision for rapid access to blood products should of course be made.

6.2.2.1 Uncontrolled bleeding

- Control by direct digital pressure ideally, with simple dressings or specific haemostatic dressings. If not feasible the following are alternatives:
 - foley balloon pressure can be useful for bleeding from stab injuries,
 - tourniquet to limb well above injury, ischaemic time is likely to be short and arresting haemorrhage and avoiding further damage to injury is the priority,
 - compression dressing,
- Call Vascular registrar or consultant early to advise on control and review wound before dressings are placed when feasible.
- Blind clamping should not be undertaken.

6.2.2.2 Tranexamic Acid

- Use intravenous tranexamic acid as soon as possible in patients with major trauma and active or suspected active bleeding.
- Do not use intravenous tranexamic acid more than 3 hours after injury in patients with major trauma unless there is evidence of hyperfibrinolysis.

6.2.2.3 Anticoagulant reversal in hospital settings

- Rapidly reverse anticoagulation in patients who have major trauma with haemorrhage.
- Hospital trusts that admit patients with major trauma should have a protocol for the rapid identification of patients who are taking anticoagulants and the reversal of anticoagulation agents.

- Use prothrombin complex concentrate immediately in adults (16 or over) with major trauma who have active bleeding and need emergency reversal of a vitamin K antagonist.
- Do not use plasma to reverse a vitamin K antagonist in patients with major trauma.
- Consult a haematologist immediately for advice on adults (16 or over) who have active bleeding and need reversal of any anticoagulant agent other than a vitamin K antagonist.
- Consult a haematologist immediately for advice on children (under 16s) with major trauma who have active bleeding and may need reversal of any anticoagulant agent.
- Do not reverse anticoagulation in patients who do not have active or suspected bleeding.

6.2.3 Peripheral Limb Ischaemia

A pulseless, deformed limb should be re-aligned, splinted and the vascular examination repeated and documented at the time of diagnosis – if not already done pre-hospital.

Continue normal trauma management including CT angiography (see [below](#)).

Neurological examination must be documented as a timed entry in all patients with extremity trauma; associated nerve injury should be presumed until disproven.

The ischaemic limb should be revascularised within four hours from injury.

Where rapid definitive restoration of arterial flow cannot be achieved, arterial shunts should be used to restore flow (e.g. while skeletal stabilisation is placed). Definitive repair or direct interposition grafts are preferred to bypass grafts.

Where cognition allows, patients must be made aware of the possibility of amputation. Any decision to perform early amputation must be made by two consultants and clearly documented.

Fasciotomies should always be considered. They should either be performed or the decision not to perform documented with the name of the senior decision maker. There is a low threshold for fasciotomy in these cases.

Post-operative care should be delivered in an appropriate area with nursing and medical staff competent in the assessment of the critically injured limb.

6.2.4 Imaging

According to the [STN – Imaging for Trauma Guideline](#), for seriously injured adult patients, whole-body contrast-enhanced head-to-thigh CT (CT Traumagram) is the default imaging procedure of choice. However, if vascular injury of a lower limb is suspected, then this should be extended to the whole of both lower limbs.

If required, separate CT angiography of the extremity should occur immediately following the Traumagram, without requirement for patient repositioning. There should be a local policy on the inclusion of angiography in any extremity CT if there is suspicion of vascular compromise.

In children, the routine use of adult trauma protocols is inappropriate. Exposure to ionising radiation should always be kept to a minimum using as low as reasonably achievable principles. Children with suspected vascular injury should be discussed with a Paediatric Radiologist to determine the need for CT scanning.

6.2.5 Secondary Transfer (TUs)

Patients with significant vascular injury may present to TUs or be transported there by prehospital services either because the patient does not meet the present criteria for primary transport to the MTC, or because the patient is deemed to be too unstable for primary transport.

All TUs should have mechanisms in place to accurately assess, triage and resuscitate these patients. Patients should not be turned away whilst still in an ambulance. On rare occasions, surgical haemorrhage control may be needed at the TU.

However, most patients with significant vascular injury will warrant secondary transfer to the appropriate MTC. As described in [STN Patient Pathways](#), adult patients with immediately life-threatening injuries, such as persistent haemorrhage that cannot be managed within the TU, may be managed via the Immediate Secondary Transfer protocol, with Emergency Department to Emergency Department referral.

All other adult patients with significant vascular injury requiring transfer, i.e. those with arterial occlusion, should be managed via the Non-Immediate Secondary Transfer protocol with referral from specialist to appropriate specialist (see [below](#)).

6.2.6 Specialist Referral

The appropriate specialist(s) for a particular case, whether for secondary transfer to the MTC or referral within the MTC, will depend on the site of the vascular injury as follows:

- Neck – vascular surgery +/- ENT surgery
- Chest – cardiothoracic surgery
- Abdomen – vascular surgery
- Pelvis – trauma & orthopaedic surgery – see also STN Guideline – Severe Pelvic Fractures including Urethral Injury
- Limbs – blunt injury or fracture related – trauma & orthopaedic surgery, +/- vascular surgery

- Limbs – penetrating injury – vascular surgery

Another option available in the MTC and some TUs for haemorrhage control is Interventional Radiology. This is covered in a separate guideline – [STN Guideline – Interventional Radiology](#).

To make a non-immediate referral from a TU to the MTC Trauma & Orthopaedic surgeons – follow [Processes for Urgent Referral to the Trauma and Orthopaedic Service at the Major Trauma Centre at the Royal Sussex County Hospital](#). This policy involves:

- Completion of the relevant electronic online referral form that can be found on the following webpage on the old BSUH Intranet nww.bsuh.nhs.uk/clinical/teams-and-departments/trauma-and-orthopaedics/complex-trauma-service-referral-form/. This can ONLY be accessed from hospital computers.

Attach any photographs to the electronic form.

- Then make a telephone referral in person by phone either from a Trauma and Orthopaedic (T&O) Registrar to the on-call T&O Registrar at RSCH (01273 696955 bleep 8629) or from a T&O Consultant to the on-call T&O Consultant at RSCH.

To make a non-immediate referral from a TU to the other MTC specialist, ring the hospital switchboard on 01273 6969655 and ask for relevant speciality.

6.3 Rehabilitation

All patients should receive information regarding expected functional recovery and rehabilitation, including advice about return to normal activities such as work and driving.

6.4 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.

All patients with traumatic vascular injury are eligible for inclusion in and should be entered into the National Major Trauma Registry (NMTR).

7 Training Implications

This document represents the standard of practice acceptable for trauma networks and so all participating clinicians should already have relevant skills and training. No extra training requirements have been identified.

Staff in both TUs and the MTC should have training sufficient to allow adequate care for patients with chest wall injury. This includes nursing on general and trauma wards.

8 Documentation

There is no formal documentation of these processes, other than the following:

- Written and computer patient medical records
- Electronic order comms records
- PACS images
- Paper and/or electronic imaging reports

9 Monitoring Arrangements

These include:

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

10 Equality Impact Assessment Screening

None in process.

11 Links to other Guidelines and Policies

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

- [STN Patient Pathways](#)
- [STN Guideline – Imaging for Trauma – adults and children](#)
- [STN Guideline – Interventional Radiology](#)
- [STN Guideline – Severe Pelvic Fractures including Urethral Injury](#)
- [Processes for Urgent Referral to the Trauma and Orthopaedic Service at the Major Trauma Centre at the Royal Sussex County Hospital](#)

12 References

- [NICE Guideline \[CG176\] – Major trauma: assessment and initial management](#)
- [BOAST 6 Guideline – Diagnosis & Management of Arterial Injuries Associated with Extremity Fractures and Dislocations](#) - updated April 2021. See also in [Appendix 2](#)

- [Wessex Children's Major Trauma Guidelines](#) – on the Paediatric Innovation, Education and Research Network website (piernetwork.org)

13 Appendices

13.1 Appendix 1 – Abbreviations

AAKSS	Air Ambulance Kent, Surrey and Sussex
BOAST	British Orthopaedic Association Audit Standards for Trauma
BSUH	Brighton and Sussex University Hospitals
CT	Computed Tomography
ED	Emergency Department
EDs	Emergency Departments
ENT	Ear, Nose and Throat
EVAR	EndoVascular Aneurysm Repair
MTC	Major Trauma Centre
NHS	National Health Service
NMTR	National Major Trauma Registry
PACS	Picture Archiving and Communication System
RSCH	Royal Sussex County Hospital
SECamb	South-East Coast Ambulance Service
STN	Sussex Trauma Network
T&O	Trauma and Orthopaedic
TQUIN	Trauma Quality Indicator
TU	Trauma Unit
TUs	Trauma Units
UHSx	University Hospitals Sussex, NHS Foundation Trust

13.2 Appendix 2 – BOAST 6 Guideline - Diagnosis & Management of Arterial Injuries Associated with Extremity Fractures and Dislocations



BOA STANDARDS

Dec 2020

Diagnosis & Management of Arterial Injuries Associated With Extremity Fractures and Dislocations

Version 2.1*

Background and justification

Rapid, accurate diagnosis of arterial injuries to the extremities is crucial for optimum outcome with immediate referral to, and joint management with, a surgeon capable of performing vascular repair.

Inclusions

Patients of all ages with vascular injuries to the extremity associated with musculoskeletal trauma.

Standards for Practice

1. All hospitals and networks that are responsible for the management of injured patients must have clear emergency referral and transfer protocols that should include a single point of contact.
2. Centres providing definitive care must have an agreed protocol and pathway standardising the management of these complex injuries.
3. This protocol should include combined review and decision making in person by Consultant surgeons skilled in vascular repair and skeletal trauma on reception of the patient.
4. Haemorrhage should be controlled immediately by direct pressure or tourniquet. Blind clamping should not be undertaken.
5. A pulseless, deformed limb should be re-aligned, splinted and the vascular examination repeated and documented at the time of diagnosis and prior to transfer.
6. Neurological examination must be documented as a timed entry in all patients with extremity trauma; associated nerve injury should be presumed until disproven.
7. Any patient undergoing CT scan following major trauma should have a head to toe scanogram.
8. CT angiography of the extremity should occur immediately following the scanogram, without requirement for patient repositioning.
9. The ischaemic limb should be revascularised within four hours from injury.
10. Where rapid definitive restoration of arterial flow cannot be achieved, arterial shunts should be used to restore flow (eg while skeletal stabilisation is placed).
12. Definitive repair or direct interposition grafts are preferred to bypass grafts.
13. Where cognition allows, patients must be made aware of the possibility of amputation. Any decision to perform early amputation must be made by two consultants and clearly documented.
14. Fasciotomies should always be considered. They should either be performed or the decision not to perform documented with the name of the senior decision maker. There is a low threshold for fasciotomy in these cases.
15. Post-operative care should be delivered in an appropriate area with nursing and medical staff competent in the assessment of the critically injured limb.

Evidence base

Studies with level-1 evidence are lacking. Predominantly retrospective series, with some good prospective studies, meta-analyses, reviews and expert opinion

* On 30th April 2021, the BOAST was updated to remove bullet point 11 that had appeared in the earlier version in error. We have preserved the numbering on all other bullet points for consistency with the previous version