

## West Yorkshire Major Trauma Network

### Guidelines for the initial management of vascular injuries

#### Background

Within UK trauma systems, most vascular injury will be the result of blunt rather than penetrating mechanisms. However, delayed diagnosis of vascular compromise is more common following blunt injury. Amputation rates are lower after penetrating than blunt arterial injury.

#### TU vs MTC management

Not all patients with vascular injuries will require transfer to the MTC. Examples would include dislocations with vascular compromise where relocation restores normal perfusion, isolated limb penetrating trauma requiring exploration and mycotic pseudo-aneurysms. Local expertise may well be available to permit prompt and effective treatment within the TU.

A further group of patients may be too unstable for transfer and will require direct damage control surgery within the TU.

Advice can be sought at any time from the MTC vascular consultant on-call.

#### Network Referrals

- **Emergency transfers to the Major Trauma Centre should follow the standard pathway. Stabilise, arrange immediate transfer, inform ED consultant at LGI (0113 392 8927 or 392 8908). When time permits contact relevant specialty / ies.**
- The vascular trauma surgeon is the first point of call for all vascular trauma advice.
- Between 08.00 - 18.00, the case should be discussed with the on call Consultant Vascular Trauma Surgeon at Leeds General Infirmary (switch board 0113 243 2799).
- From 18.00 - 08.00 the case should be discussed with the on-call resident Vascular Registrar or Vascular Consultant (switch board 0113 243 2799).

#### Initial assessment & management

- Patients should be assessed by the trauma team as per ATLS guidelines<sup>1</sup>.
- Patients with suspected arterial injury need to be discussed with the on call vascular surgeon at an early stage. This includes at the time of the pre-hospital alert.
- Time of injury, mechanism of injury / type of projectile, blood loss at scene and haemodynamic observations are useful information to obtain from the pre-hospital team.

- In the absence of associated blunt trauma a cervical collar is not indicated for a patient with penetrating injury and if fitted may obscure wounds<sup>2</sup>. Only when there are neurological signs attributable to penetrating injury to the neck is C-spine protection indicated.
- Patients with penetrating injury must be log rolled to identify all sites of injury. Beware of missing wounds within skin creases especially axilla and perineum.
- For patients with penetrating injury balanced resuscitation should be utilized unless contraindicated (head injury) and used with caution in the elderly.
- Active bleeding from wounds should be controlled with direct pressure (bandage or fingers). Rarely and only when this fails and it is felt that the limb may need to be sacrificed to save life should a tourniquet be applied to a limb on the direction of the team leader. It should be applied as distally as possible.
- Vascular and neurological examination of the limb should be undertaken. If there is concern regarding a vascular injury pressure measurements should be taken: an ankle brachial pressure index (ABPI, lower limb only) or an arterial pressure index (API, upper or lower limbs). An API is defined as the Doppler systolic arterial pressure distal to the site of injury divided by the Doppler systolic arterial pressure measured at the same point in the uninjured extremity. An ABPI or API >0.9 indicates a very low risk of a significant arterial injury. The ABPI or API are less reliable in older patients due to concomitant peripheral arterial disease<sup>3</sup>.
- Plain radiographs (with markers on skin wound) of the injured part should be undertaken for gunshot injury. Trajectory determination is helpful to injury identification and to detect bone fractures. Radiographs for stab wounds may reveal retained foreign material. Paper clips taped to skin make useful skin markers with intact clips used for anterior wounds and *opened* clips for *posterior* wounds.

## Management

- Patients with limb ischaemia secondary to displaced, angulated long bone fractures and / or joint dislocations e.g. knee or ankle dislocation, mid shaft femoral or supracondylar humeral fracture, should have the injury realigned or relocated as quickly as possible. This will require appropriate analgesia with neurological and vascular examination documented both before and after any manipulation.
- In general, patients with hard signs of vascular injury (List 1) require urgent operative intervention<sup>3,4</sup>. Those with exsanguinating active bleeding and / or rapidly expanding haematoma require immediate operative intervention for haemorrhage control.

### List 1: Hard signs of vascular injury

External pulsatile bleeding

Large, expanding, pulsatile haematoma

Palpable thrill or audible bruit

Absent distal pulse

Signs of distal ischaemia (pain, pallor, paralysis, paraesthesia, perishingly cold)

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. Such situations include:

- When difficult to determine 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 preexisting 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 bodies (retained knife blade, pellets & bullets) will produce artifact on CT angiography. Therefore, preoperative digital subtraction intra arterial angiography or on table angiography may be more appropriate. If preoperative imaging is indicated it must be undertaken rapidly to reduce ischaemic time to a minimum.

- Patients with soft signs of vascular injury (List 2) require further assessment with a low threshold for imaging<sup>4</sup>. Those with penetrating injury have 3-25% chance of significant injury. A CT angiogram is likely to be first line investigation but artifact from retained foreign bodies may necessitate intra-arterial angiography.

**List 2: Soft signs of vascular injury**

History of arterial bleeding at the scene (no ongoing bleeding)

Small, non expanding, non pulsatile haematoma

Shock with no other injury (suggesting large volume blood loss)

Weak pulse

Injury to anatomically related nerve

Proximity of wound to vessel

Ankle brachial pressure index <0.9 or arterial pressure index <0.9

Dampened flow on Doppler examination

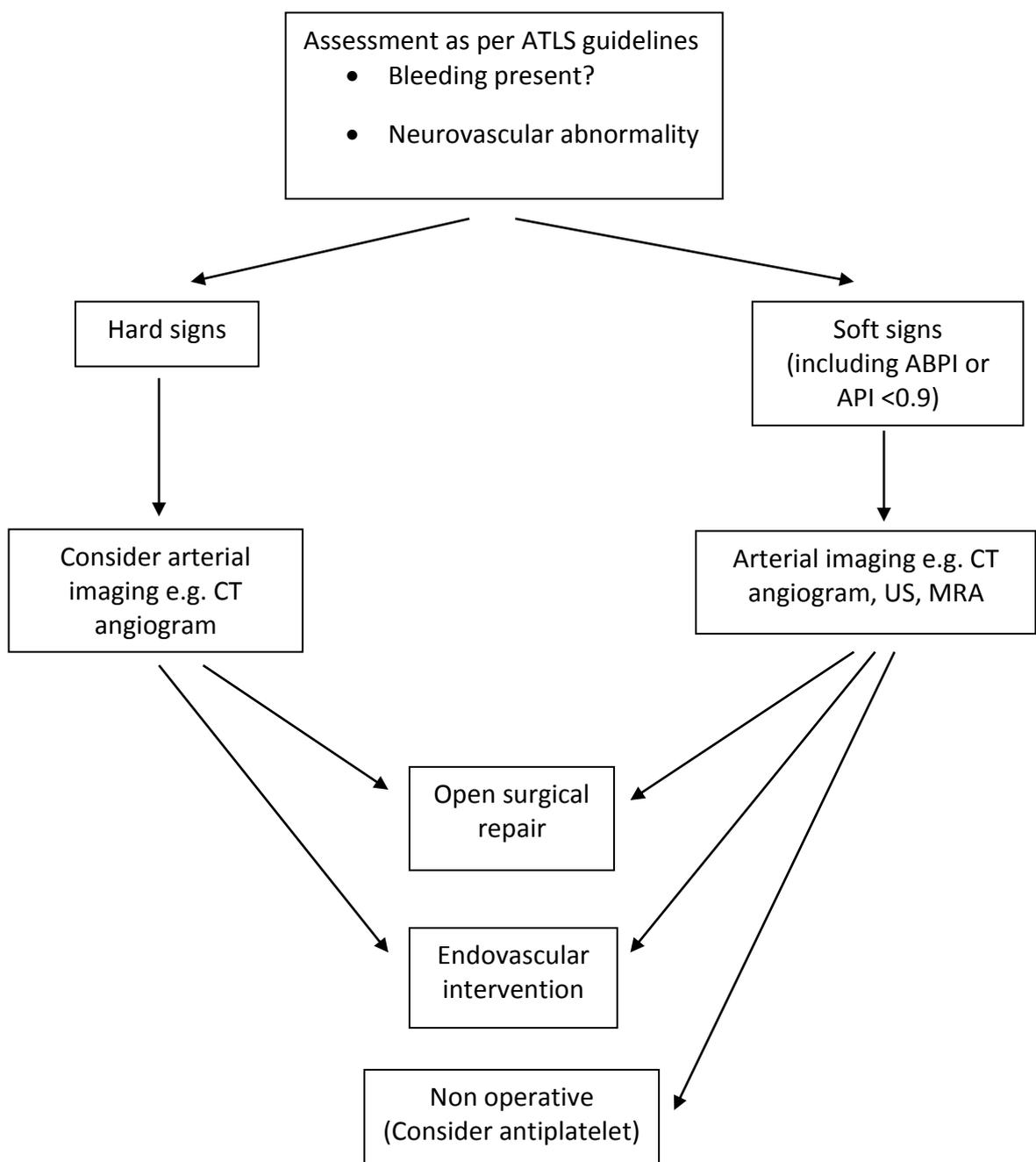
- Patients with a normal vascular and neurological examination with an ABPI or API >0.9 are extremely unlikely to have a significant arterial injury and do not usually require further vascular investigation. In particular, patients following knee dislocation with normal ankle pulses and ABPI or API >0.9 do not usually need further imaging<sup>3</sup>. However, the requirement for imaging following knee dislocation is debated and the case for imaging should be considered on a case by case basis.

**Operative and therapeutic principals**

- 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 base basis<sup>3</sup>.
- Extravasation, pseudoaneurysm, occlusion or arteriovenous fistula of major "named" 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<sup>3</sup>.

- Temporary intravascular shunts are an excellent damage control solution to arterial and large vein injury. No heparinisation required as the patient is usually coagulopathic. Carotid shunts, IV tubing or chest drains can be utilized depending on vessel size.
- Consider performing a fasciotomy prior to vascular repair<sup>5</sup>.
- 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)<sup>3</sup>.

**Figure 1.** Algorithm for management of peripheral arterial injury



**Further reading**

1 = ATLS 9th edition.

2= Spine Immobilization in Penetrating Trauma: More Harm Than Good? Haut. ER et al. J Trauma. 2010;68: 115–121.

3= Evaluation and Management of Peripheral Vascular Injury. Part 1. Western Trauma Association/Critical Decisions in Trauma. Feliciano. D et al. J Trauma. 2011;70: 1551–1556.

4 = Evaluation and management of penetrating lower extremity arterial trauma: An Eastern Association for the Surgery of Trauma practice management guideline. Fox. N et al. J Trauma Acute Care Surg. 2012;73: S315- S320.

5=Western Trauma Association Critical Decisions in Trauma: Evaluation and management of peripheral vascular injury, Part II. Feliciano. D et al. J Trauma Acute Care Surg. 2013;75: 391-397.