Midlands Critical Care, Trauma and Burns Networks
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1. General principles

Vascular injuries are a significant cause of morbidity and mortality in trauma. The initial assessment and management of patients follows usual ATLS protocols. Control of catastrophic external haemorrhage should be performed with direct pressure or by the application of a tourniquet. When indicated, tourniquets should be applied early, and time of application be recorded as well a duration (1).

Vascular injury should be suspected according to the presence of hard and soft signs (Table 1). Hard signs mandate urgent surgery, or immediate transfer to a major trauma centre (MTC).

Suspicion of arterial injury, in the presence of soft signs warrants further investigation. The investigation of choice is computed tomography angiogram (CTA). These images should be transferred at the same time as the patient transfer on inter-hospital image exchange portal (IEP).

In patients who are haemodynamically unstable and deteriorating, damage control surgery (DCS) is indicated. This should be undertaken locally when possible(1). Where this is not possible, a critical transfer should be arranged and the MTC consultant trauma leader should be notified.

Table 1: Hard and soft signs of vascular injury

Hard Signs	**Soft Signs**
Active arterial bleeding	Proximity of injury to vascular structure
Rapidly expanding or pulsatile haematoma	History of arterial bleeding at scene
Absent pulses	Major single nerve deficit
Bruit or thrill	Reduced (but present) unilateral pulses
Signs of limb ischaemia/compartment syndrome	Posterior knee or elbow dislocation

2. Management of Extremity Vascular Injury

In extremity vascular injury, patients with hard signs (Table 1) will usually require urgent surgery. If the patient is haemodynamically unstable and DCS is indicated, this should be performed in the local trauma unit (TU) within 30 minutes, otherwise the patient should be sent as a critical transfer to the MTC.

In haemodynamically stable patients with soft signs, An ABPI is a useful measurement to guide the need for imaging. An ankle-brachial pressure index (ABPI) of <0.9 in a patient with no previous history of peripheral vascular disease suggests vascular injury and a CTA is indicated. A normal ABPI (>0.9) does not exclude vascular injury (2)

Patients with vascular injury, associated with fractures and dislocations require combined review by orthopaedic and vascular surgeons and should be transferred to the MTC. Vascular examination before and after re-alignment and splinting of the limb is required as part of the initial assessment. The aim of management is to revascularise the ischaemic limb within 4 hours from injury, either via DCS or definitive repair. Emergency primary limb amputation should only be undertaken in cases where attempts to preserve the limb pose an unacceptably high risk to the patient's life and where the limb is deemed unsalvageable (a two-consultant decision taken in conjunction with a consultant orthopaedic surgeon) (3).

3. Management of Cervical Vascular Injuries

a. Penetrating Cervical Vascular Injuries

Penetrating injuries of the neck are conventionally evaluated according to three zones relating to the relevant vascular structures. The description of injuries according to zone is only a guide and the possibility of injury to structures outside their conventional zone should be appreciated. These patients can decompensate rapidly, therefore close assessment and initial evaluation via ATLS protocol is paramount. An expanding haematoma with associated airway compromise mandates immediate anaesthetic assessment for guidance on best method of airway management.

The ‘no zone’ approach has become the mainstay for assessing these injuries. Signs detected on examination, dictate the need for further investigation and management. Patients with vascular hard signs require urgent surgical exploration. If the superficial fascia of the neck is not breached, then a significant vascular injury is often excluded. If it is not possible to determine this, or there are any soft signs of vascular injury a CTA should be performed immediately at the TU or failing this the patient should be transferred to the MTC (4).

If damage control surgery is required this should be performed in the TU within 30 minutes, otherwise the patient should be sent as a critical transfer to the MTC. Exploration of neck injuries should not be performed in the TU without imaging unless damage control surgery is required.

Where CTA demonstrates a vascular injury, the patient should be transferred as an immediate transfer to the MTC along with CTA images. The duty trauma leader should be informed of the specific vascular injuries and the relevant surgical teams should be notified accordingly.

b. Blunt Cervical Vascular Injuries (BCVI)

BCVI are frequently missed during the primary survey. The presence of any of the criteria listed in table 2, raise suspicion of an unidentified vascular injury and warrant further investigation with a CTA (5).

Table 2: Denver Criteria for BCVI

Signs and Symptoms	**Risk Factors (high energy transfer mechanism plus any of the following**
Potential arterial haemorrhage from neck/nose/mouth	Le Fort II or III fracture
Cervical bruit in patients < 50 years of age	Mandible Fracture
Expanding cervical haematoma	Traumatic Brain Injury (TBI) with GCS <6
Focal neurological deficit	C-spine fracture, subluxation or ligamentous injury
Neurological exam incongruous with CT head findings	Near hanging with anoxic brain injury
Stroke on CT or MRI	Seat belt abrasion with swelling, pain or altered mental status
	TBI with thoracic injury
	Scalp degloving
	Thoracic vascular injury
	Blunt cardiac rupture
	Upper rib fracture

If a BCVI is detected in a TU that is not a vascular hub then the patient should be transferred to the MTC and the vascular team notified.

The severity of BCVI can be divided into five grades (6):

- Dissection (grade I-II),
- Pseudo-aneurysm (grade III)
- Occlusion (grade IV)
- Transection (grade V)

Grades I, II, and IV can be managed conservatively. Grade III injuries require surveillance and may require interventional treatment. Grade V injuries require urgent surgery and should be managed for penetrating injuries.

4. Management of Blunt Thoracic Vascular Injury (BTVI)

Blunt injuries to the major vessels of the thorax most commonly occur following road traffic collisions or falls from height. The most common type of injury is a false aneurysm, followed by dissection and intimal tear. Physical signs are not reliable in the diagnosis of BTVI. Plain film chest x-ray features suggestive of BTVI include aorto-pulmonary window opacification, left displacement of trachea/oesophagus, left main bronchus displaced downwards, left apical cap, left haemothorax and fractures of the 1st rib, scapula, sternum, or vertebrae. The absence of these features does not exclude vascular injury.

Hypotension in the presence of a widened mediastinum should prompt a search for an extra-thoracic haemorrhage, as a complex injury of the aorta often leads to rapid exsanguination. Blunt chest injury associated with hypovolaemia, a high-speed deceleration injury or chest x-ray signs raise the possibility of BTVI and an urgent CTA should be performed. Direct and indirect features of BTVI on CTA are summarised in table 3. A normal CTA effectively excludes BTVI.

Direct Features	Indirect Features
Pseudoaneurysm	Mediastinal haematoma
Intramural haematoma	Isolated intimal flap
Dissection flap	
Contract extravasation	

Table 3: CTA features of BTVI. Direct features are more specific for aortic injury.

Patients with BTVI diagnosed in a TU should be transferred to the MTC as critical transfers, CTA images should be transferred and the duty trauma team leader informed of the injuries and the vascular and cardiothoracic teams informed. If possible, fluid resuscitation should be performed with invasive blood pressure monitoring. Aggressive fluid resuscitation should be avoided (permissive hypotension).

References

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