



**Midland Regional
Trauma System**

Midland Regional Trauma Guidelines

Flip chart

Disclaimer: Trauma patients are variable in their injury patterns and clinical requirements and different organisations and services have variable capabilities and capacities, therefore Midland DHBs can accept no responsibility for suboptimal outcomes as a result of these guidelines.

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This flip chart is based on the information and algorithms from the Midland Regional Trauma Guidelines. The Midland Regional Trauma Guidelines are based on international “best practice”. They have been endorsed by the regional chief medical advisors and regional chief executives.

This flip chart is designed for quick reference information only and does not contain all information relating to specific injuries or procedures. For full details refer to the Midland Regional Trauma Guidelines.

Trauma call criteria

Mandatory criteria:

Physiologic criteria (adults)

(NB "at any stage" means at any time from point-of-injury)

- GCS < 13 for > 5 minutes, at any stage
- RR < 10 or > 29 at any stage
- SBP < 90mmHg at any stage
- HR > 120bpm at any stage

Anatomic criteria

- Non-trivial penetrating injury to head, neck, torso or limbs adjacent to major nerves or vessels.
- Known or suspected spinal cord injury.
- Airway obstruction
- Burns >25% (or >15% paediatrics) or involving airway

Special criteria

- Age > 70 years with chest injury
- Pregnancy > 24 weeks with torso injury
- Major trauma from any other hospital within 48 hours of injury
- Major crush injury

Discretionary criteria:

Two or more criteria mandate a trauma call. One criterion alone mandates a trauma call unless cancelled at the discretion of the on-call ED consultant. The following patients are at very high risk of occult injury or trauma-related complications.

- Major co-morbidities and evidence of significant impact or injury
- Significant injury to 2 or more body regions
- Two or more long bone fractures
- Fall greater than 3 metres
- Cyclist, motorcyclist or pedestrian hit by vehicle >30kph

Personal protective equipment

Patient behavior and spillage from interventions is frequently unpredictable in the resuscitation room. Blood and body fluid splashes are common, often involving patients whose infection status is unknown. Standard hospital scrubs are comfortable and convenient but provide no protection to exposure on the upper limbs and neck and face, or to strike-through from high volume splashes of body fluids

Protective gown:



Safety glasses:



Gloves:



Lead apron/X-ray gown:



(Pictures sourced from internet)

Primary survey

Airway

- Assess the airway
- Create or maintain an airway by:
 - Looking - use suction
 - chin lift or jaw thrust
 - intubation naso/oropharyngeal; orotracheal; cricothyroidotomy, etc

Relative indications for intubation

- Airway or breathing compromise (present or predicted)
- Threatened airway
- GCS<9
- Combative and likely to injure self or others

Breathing

- Administer high flow oxygen
- Assess the chest by clinical examination
- Recognise and treat: tension pneumothorax, massive haemothorax, flail chest, sucking chest wounds, pericardial tamponade
- Emergent CXR and treat as required

Circulation

The patient with cold, pale peripheries has shock until proven otherwise.

Assess circulation by:

- Looking for external haemorrhage
- Observing skin colour, temperature and capillary refill
- Feeling the pulse
- Taking the blood pressure
- Distended neck veins, hypotension, muffled heart sounds, (pericardial tamponade)

Interventions for circulatory management

- **Arrest external haemorrhage** by local pressure. Suture if possible
- **IV access.** Insert at least 2 antecubital large-bore IV cannulas. Use femoral vein if necessary. USS may help this but should not delay progress. Unless the patient is exsanguinating this process should not hold up other team members in the Trauma Call process
- **Blood gases:** Arterial Blood Gas (ABG) in unstable patients, preferably via an early arterial line; or by immediate femoral stab if an arterial line may delay definitive management. Venous blood gas is satisfactory for stable patients but becomes unreliable if the patient's blood pH is <7.2. (*Arch Surg. 2005;140:1122-112*)
- **Take trauma bloods:** (FBC, Biochem, Ethanol, cross match) Pregnancy test if child-bearing age female.
- Judicious infusion of warmed 0.9% saline.
- **Massive transfusion protocol**

Monitors: pulse oximeter, ECG, temperature probe, BP cuff

- Recognise hypothermia and give warmed fluids as appropriate. Replace cooled fluid pre-hospital fluids with warmed fluids.
- Exsanguinating patients get Group O-neg blood ASAP
- Be meticulous with fluid management in all patients, with special attention to the elderly or those with underlying cardiac disease.

Disability

Estimate GCS

- Talk to the patient
- Painful stimulus = pressure on toes or fingers. Consider central stimulus to sternum, earlobe or forehead if unreliable peripheral response.
- Assess papillary size and response
- Examine for localising signs (differing motor scores on each side) and signs of cord injury. (Evidence of tentorial herniation requires immediate neurosurgical assessment and consideration of measures to reduce ICP which may include Mannitol)

Exposure/environmental control

- Expose the patient fully for the initial surveys then keep covered
- Measure core temp and repeat if warming underway
- N.B. Hypothermia is a major barrier to successful surgical intervention

Analgesia

- Most trauma patients are in significant pain, therefore analgesia should be considered as soon as resuscitation has been initiated and the patient's injuries and physiologic responses have been established. In general pain relief is aided by: establishing rapport with the patient, splinting of injured extremities, gentle movement and handling, prevention of shivering, cooling of burns.
- Opioids should be given intravenously in severe trauma or if in significant pain: titrate in small increments until comfortable. Beware hypotension, respiratory depression and vomiting (Consider antiemetic if the patient is nauseated or vomiting).
- Local Anaesthetic allows wound exploration and minor suturing. Femoral block is used in femoral fractures.

Secondary survey

Overall schema in secondary survey

Complete the history

- A Allergies
- M Medications
- P Previous medical/surgical history
- L Last food
- E Events associated with the injury (what happened?)

Examination

- This assessment is a complete examination of the patient from top to toe, front to back. Be thorough and document your findings.

Examine:

- Head/neck/nerves
- Chest
- Back/spine
- Abdomen/pelvis
- Limbs
- Neurology/GCS

Make a definitive plan

- All members of the trauma team have a responsibility to ensure their actions, findings, names and roles are recorded in a legible fashion in the patients medical record.
- Definitive care decisions may require further documentation: specialty, specialist, plans and prioritization. When several teams are involved, explicit instructions (e.g. NBM, mobility, observation limits, etc) are required. The Trauma Team Leader is responsible for making sure this task is completed.
- It is expected that all appropriate specialty teams have been notified prior to the patient leaving the resuscitation room.

Paediatric trauma

Overview

Same algorithms as adults but more scope for non-operative management

Trauma call criteria same; GCS is different (see appendix)

Understand the risks of ionising radiation but do not withhold critical imaging:

- Mortality from uncontrolled bleeding = 1% per 3 minutes
- The lifetime risk of any neoplasia from 2 abdominal CT scans goes from 25% to 25.5%
- Choice of diagnostic modality must be based on careful risk assessment not guesswork

Compliance

- Kids do best when close to parents
- Emergency Departments are noisy, cold and frightening places – speak quietly and explain what is happening
- Use toys or songs for distraction

Resuscitation tips and tricks

Have the paediatric team assembled. Outside normal working hours the paediatric registrar may not be in the hospital, therefore the on-call general surgical registrar will attend the trauma call.

Prepare medications early:

- Under 10 years: $\text{age} + 4 \times 2 = \text{approx. weight kg}$
- 10 years and over: $\text{Wt in kilos} = \text{Age} \times 3$
- Smaller physiologic reserve demands you plan decisively and well ahead.
- Give i.v. analgesia early and titrate
- Large tongue may occlude airway
- Use tubes ($\text{age}/4 + 4$)
- Beware hypoventilation
- Signs of shock may be late
- Fluids 10-20 ml/kg in boluses: reassess frequently
- Use paediatric GCS (see appendix)
- Difficult venous access, consider CVL or IO needle (1-3cm below tibial tuberosity away from growth plate)
- Consider ICP monitoring if $\text{GCS} < 8$
- Kids cool fast – keep them warm

Paediatric assessment

- Non-operative management of abdominal solid organ injury has 90% success. Safety demands close serial observations and a low threshold to re-image or operate.
- Consider SCIWORA (Spinal Cord Injury Without Radiological Signs)
- C2-C3 subluxation is normal in 40%
- Growth plate injuries can cause disability. Gain orthopaedic input early.

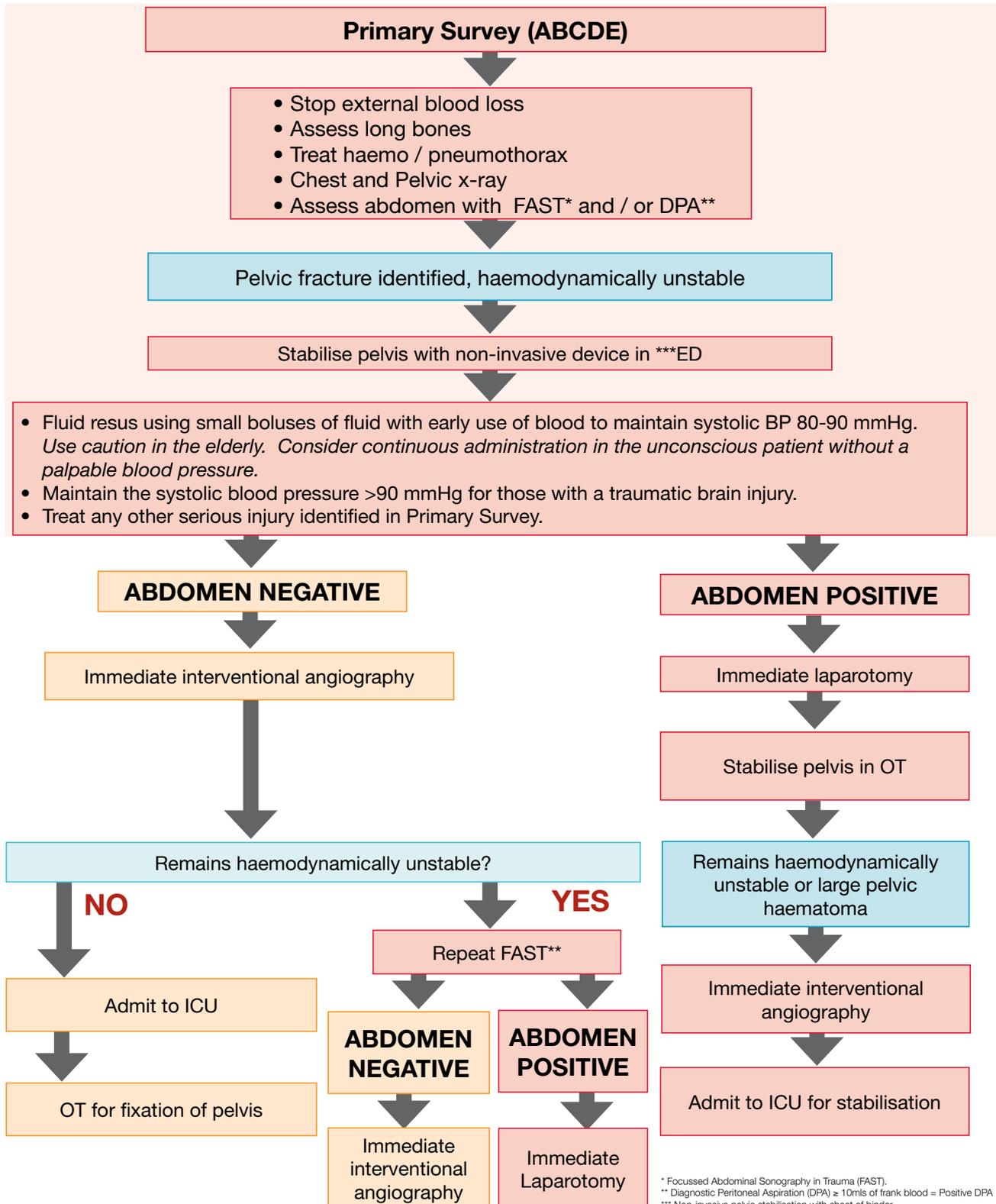
Ending resuscitation

- CPR >20 min and asystole. Pulseless and HR <40

Recommended trauma management algorithms

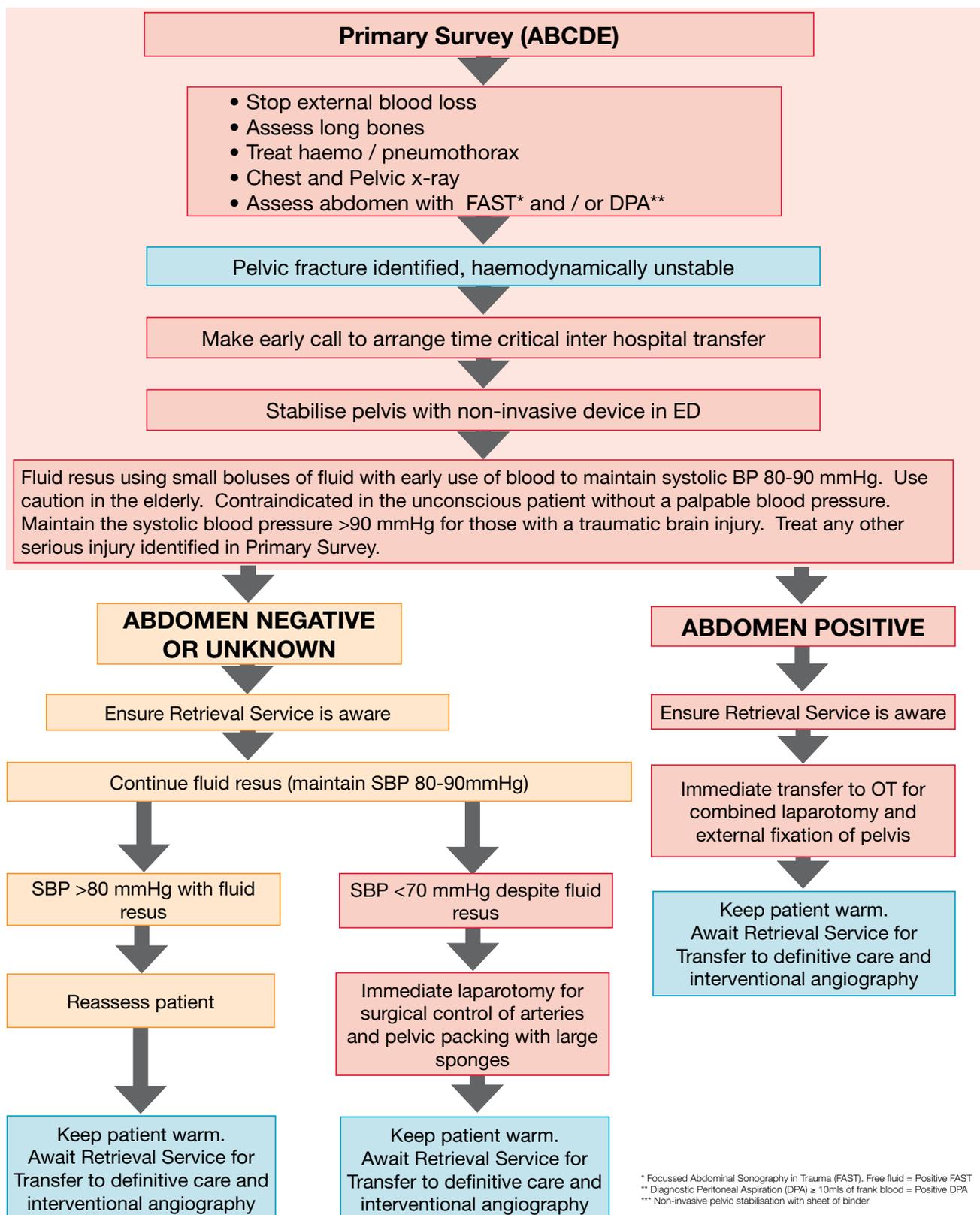
Management of the haemodynamically unstable patient with a pelvic fracture with angiography available

Management of the Haemodynamically **Unstable** Patient with a Pelvic Fracture **with** Angiography Services available

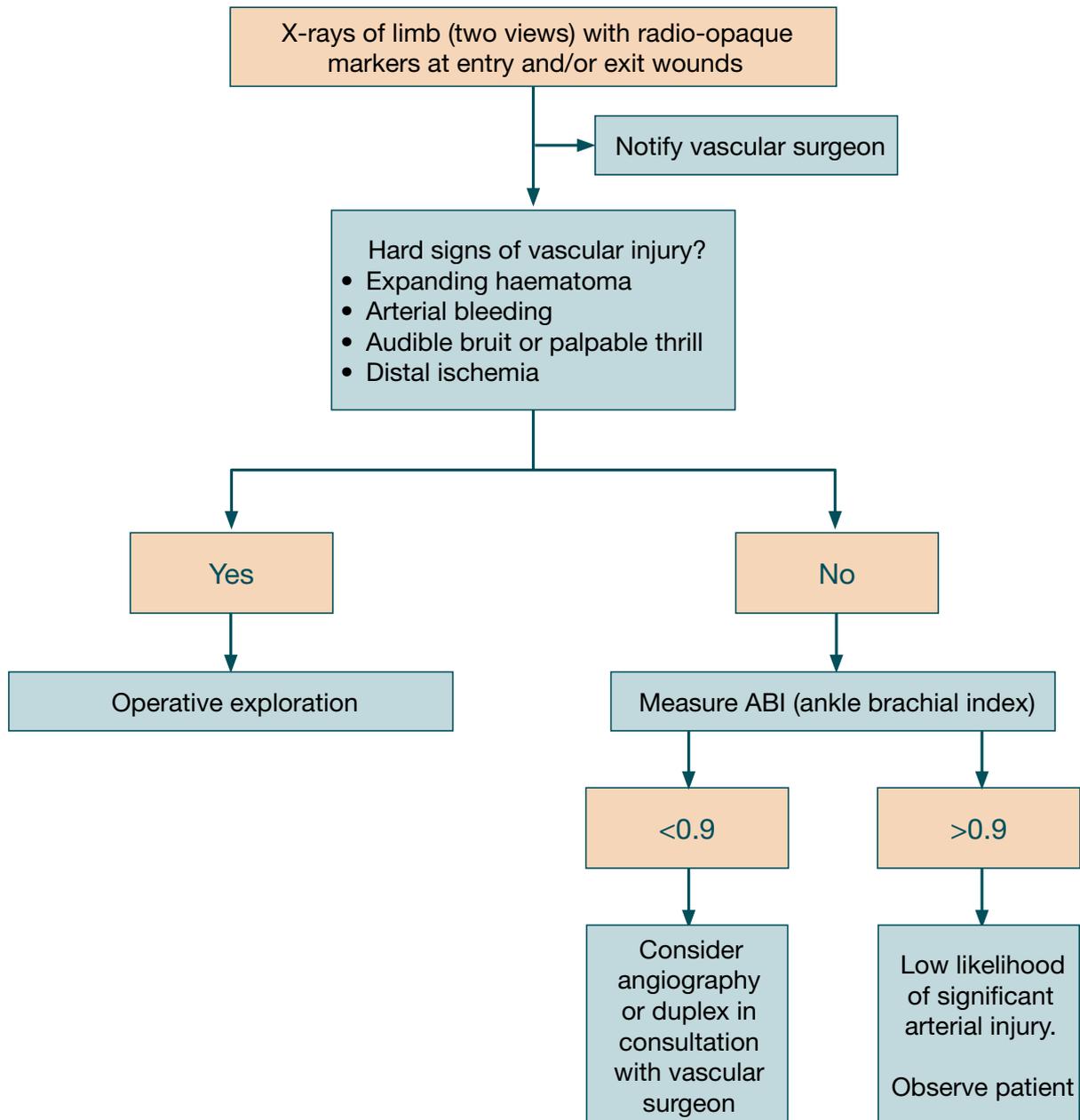


Management of the haemodynamically unstable patient with a pelvic fracture without angiography available

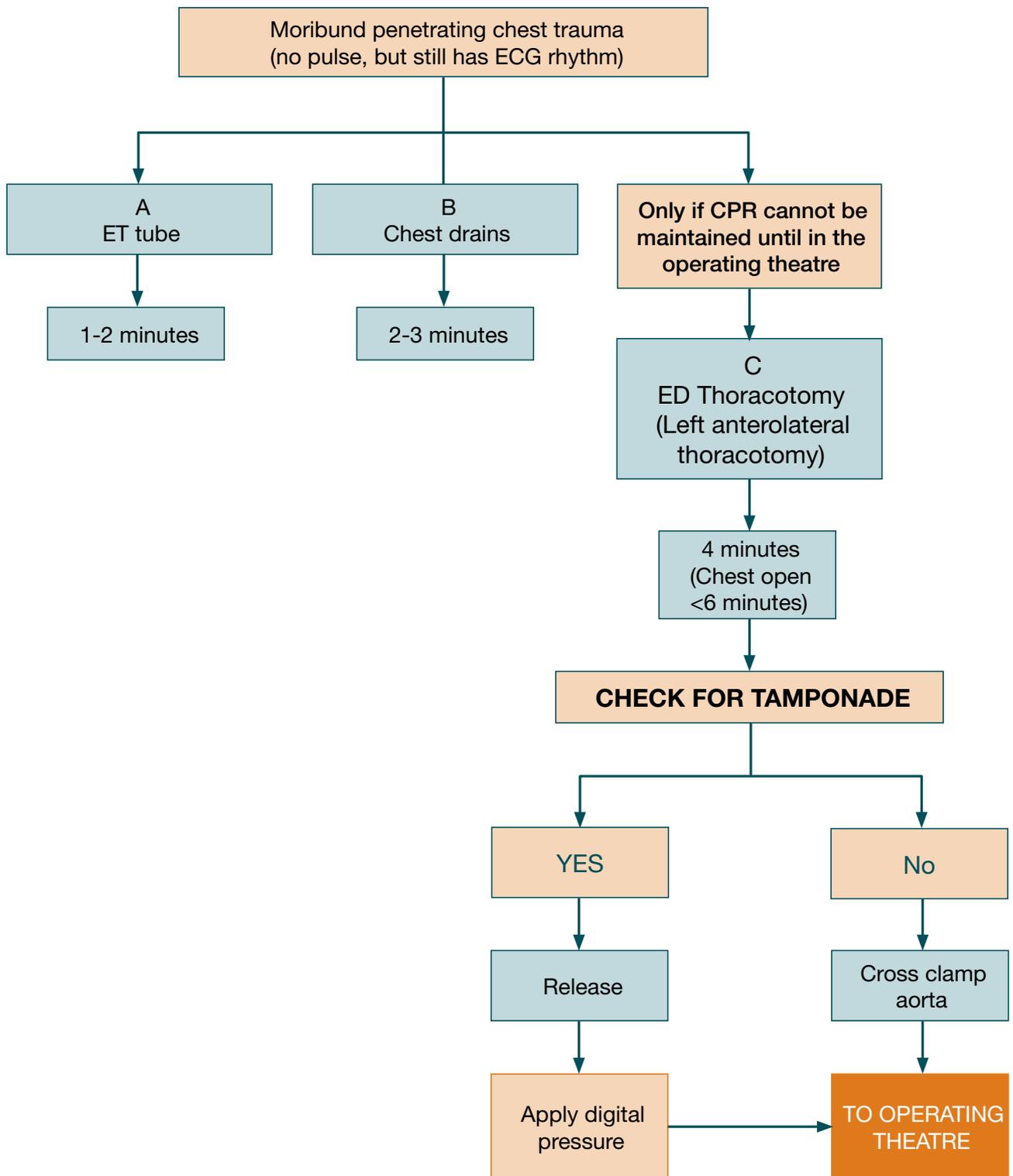
Management of the Haemodynamically unstable Patient with a Pelvic Fracture without Angiography Services available



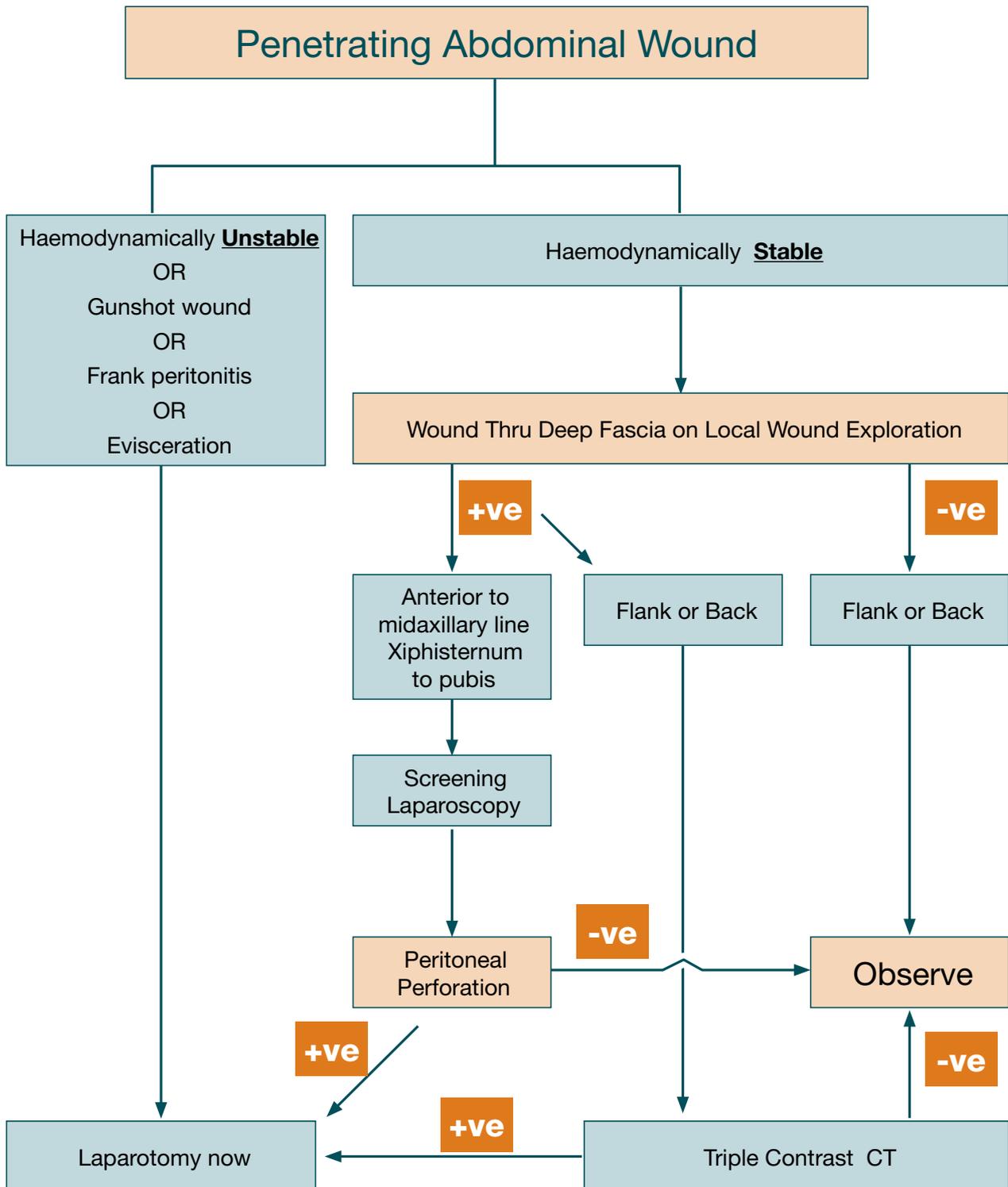
Extremity penetrating algorithm



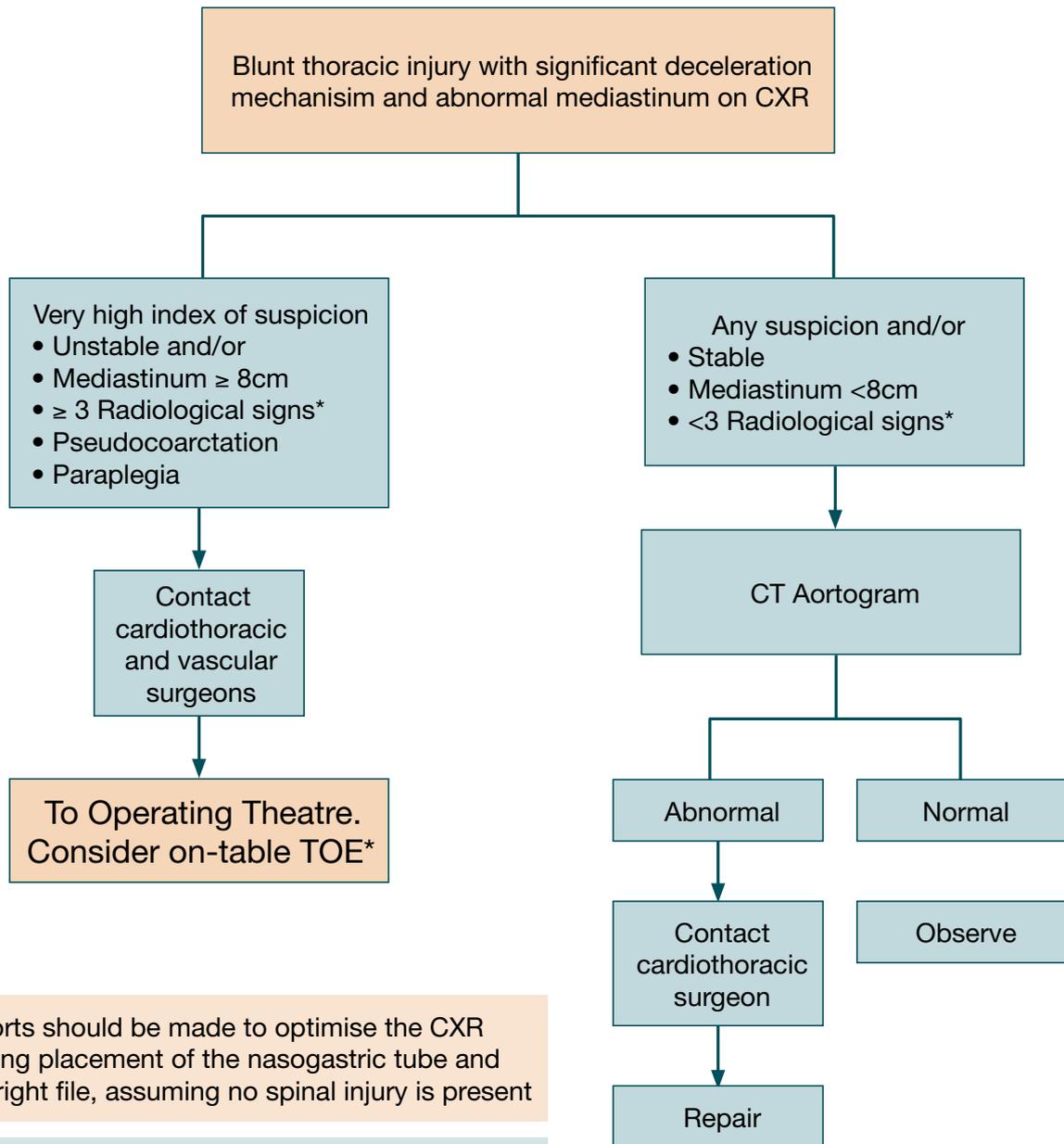
Moribund penetrating chest trauma



Recommended penetrating abdominal wound algorithm



Suspected thoracic injury algorithm

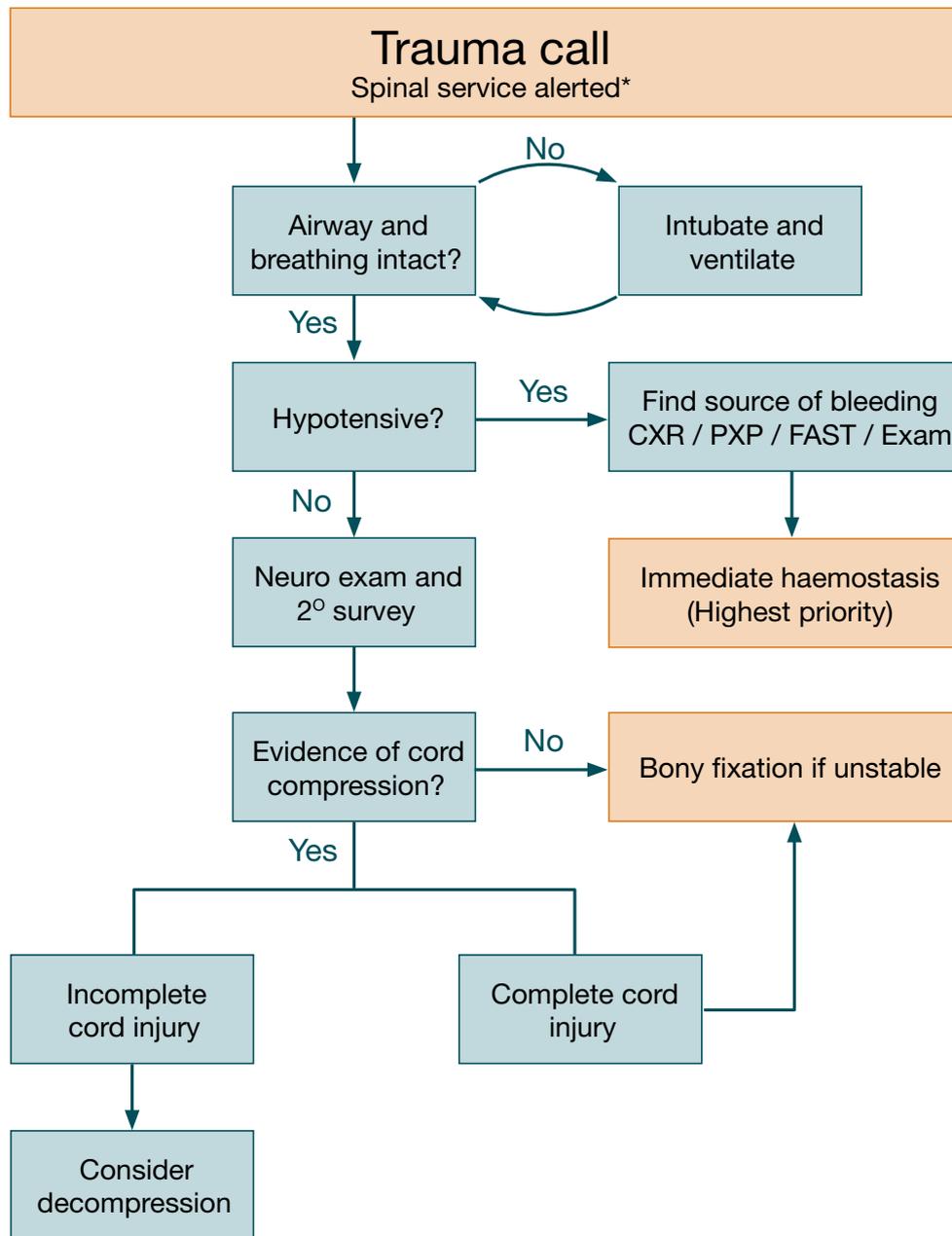


All efforts should be made to optimise the CXR including placement of the nasogastric tube and PA/upright file, assuming no spinal injury is present

- *Radiological signs include:
- Left haemothorax apical cap
 - Depressed left mainstem bronchus or elevated right mainstem bronchus
 - First or second rib fractures or multiple rib fractures
 - Deviation of nasogastric tube or trachea to right
 - Poorly defined aortic knuckle
 - Loss of aortopulmonary window
 - Widened right paratracheal stripe

TOE = Transoesophageal echocardiogram

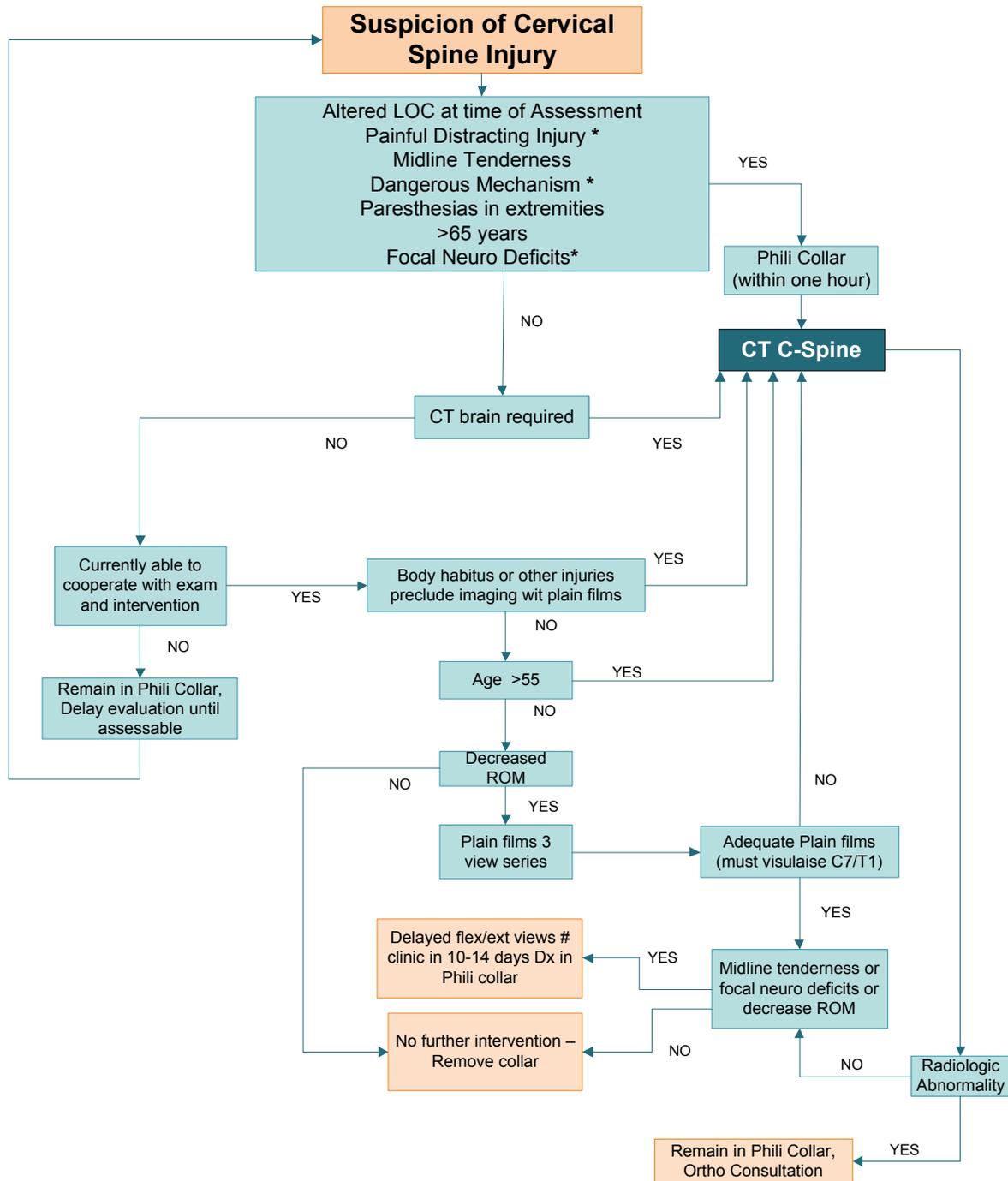
Suspected spinal cord injury algorithm



*Spinal Cord Impairment Action Plan:

www.acc.co.nz/PRD_EXT_CSMP/groups/external_providers/documents/papers_plans/wpc134157.pdf

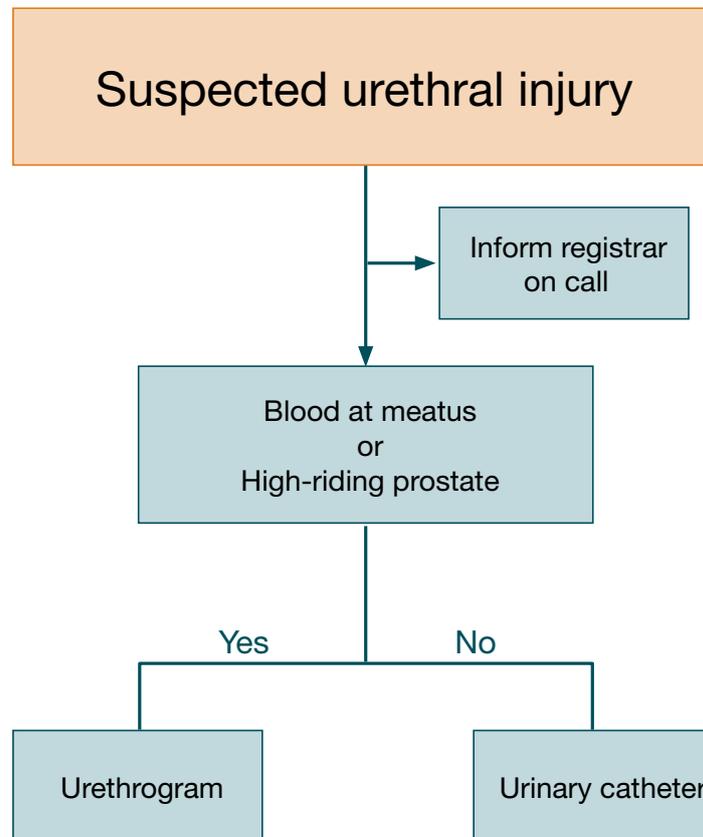
Recommended cervical spine evaluation algorithm



* Definitions:

1. **Distracting Injuries:** Including but not limited to long bone fracture, visceral injury requiring surgical consultation, large laceration, degloving injury, crush injury, large burns, or any injury causing acute functional impairment.
2. **Dangerous Mechanism:** fall from >1m or 5 stairs, an axial load to head, high speed RTC (>100 kph) , unprotected motorcycle collision >30kph, vehicle rollover or ejection, recreational vehicle crash, bicycle collision.
3. **Midline Tenderness:** tenderness to palpation in an 2cm band from occiput to T1.
4. **Decreased ROM:** neck rotation past 45° causes pain.
5. **Focal Neuro Deficit:** any focal neurologic abnormality or motor or sensory examination.

Suspected urethral injury algorithm



Intraosseous access

Intraosseous (IO) access is a safe, reliable, and rapid means of introducing crystalloids, colloids, medications, and blood products into the systemic circulation. The marrow cavity provides access to a non-collapsible venous plexus as blood flows from the medullary venous sinusoids into the central venous sinus and is then drained into the central venous circulation via nutrient and emissary veins.

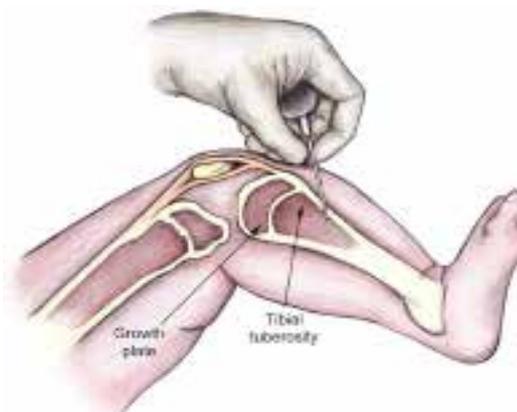
Contraindications

- Contraindications to IO access include the following:
- Ipsilateral fracture of the extremity, because of resulting extravasation and risk of compartment syndrome
- Previous placement or attempted placement in the same leg or site (eg, sternum), because of consequent extravasation into soft tissue compartments through the previous puncture site
- Osteogenesis imperfecta, because of the likelihood that puncture of the bone may cause a fracture
- Osteoporosis, because of the risk of fracture
- Obvious overlying infection at the proposed puncture site, because of the risk of seeding infection (a relative contraindication)
- Prosthetic joint near proposed insertion point

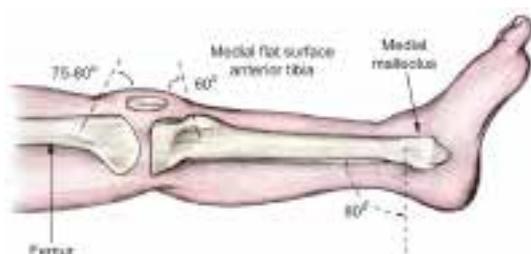
Intraosseous catheter placement technique

Proximal tibia

The insertion site of choice in children and infants is the proximal tibia; the distal tibia and distal femur are alternatives (see the images below).

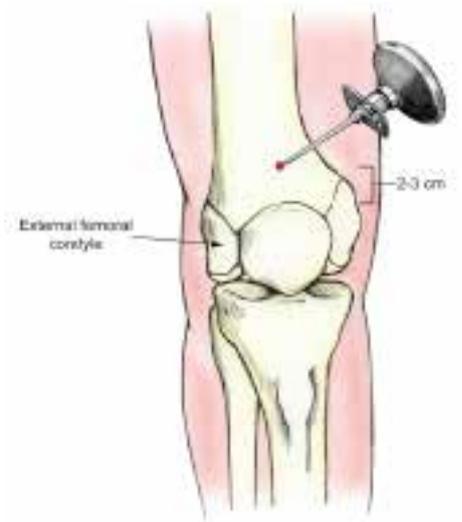


Distal Tibia





Paediatrics 3-39kg



Adult

Alternate site: Distal femur

The distal femur (see the image below) may also be used for IO access, but it generally has much denser covering layers of fat, muscle, and soft tissue, which make identification of landmarks and bony penetration more difficult.

Paediatrics 3-39kg

One finger width proximal to the upper margin of the patella and slightly medial to avoid the patella tendon. Best for children under 6 years, may need to use a longer needle.

In adults, other insertion sites have included several different iliac sites; the sternum, the distal radius or ulna, and, as mentioned above, the humerus

FAST scan

FAST (Focused Assessment by Sonography for Trauma).

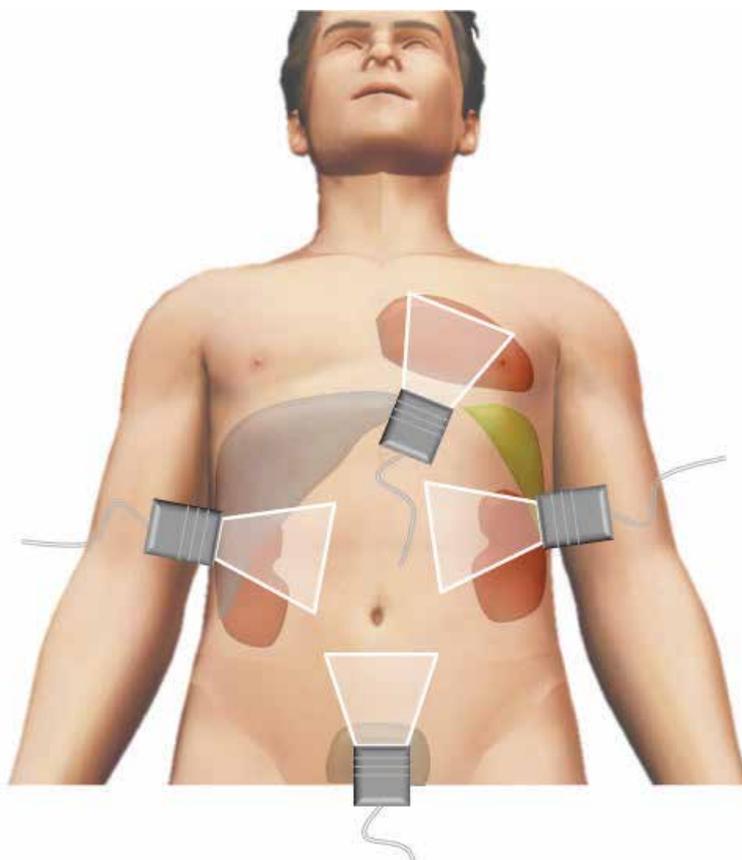
This is a rapid ultrasonographic assessment of the abdomen and pericardium done by a trained operator. The FAST scan should take between 1-3 minutes and has the advantage that it is repeatable and non-invasive.

Key Points about the Indications and Use of FAST Scanning

- FAST is a screening test that has a singular critical function: it determines the presence of free fluid in 3 areas of the abdomen, or the pericardium. Almost always this fluid is blood but beware the ruptured bladder.
- A positive FAST scan must be consistent with the clinical setting of the patient. This means there must be enough fluid on the FAST scan to account for the patient's instability. A sliver of free fluid is not a positive scan in this situation.
- The use of FAST is encouraged for all major trauma patients by experienced operators or those in training with an experienced instructor.
- FAST is only clinically validated as a decision-making tool in unstable patients, to determine whether the patient should go to the operating room or the angiography suite for life-saving intervention.
- It does not diagnose intra-abdominal injuries and cannot assess the retro-peritoneum, therefore should never be used to determine the requirement for CT scanning or not.
- FAST scans on stable patients are for practice and credentialing only and should not slow the progress of the patient to definitive imaging or care.
- Exams from inexperienced or uncredentialed operators should not be recorded in the notes or used for clinical decision-making. [see ACEM and RACS guidelines]

The four views:

1. The Hepatorenal pouch (of Morrison). This is the RUQ scan and should be done first, as it is the most sensitive for fluid identification. If it is positive there is no need to go on to the other four quadrants unless a pericardial effusion is suspected.
2. The Spleno-renal view This looks for fluid between the spleen and left kidney or diaphragm.
3. The Suprapubic region. This looks for fluid in the pelvis. This scan can be misleading, as fluid tracking from a pelvic fracture may be present. Large retroperitoneal haematomas eventually breach peritoneum and give a false positive result. Also in women there may be a small amount of fluid present in the pouch of Douglas that could be physiological.
4. The Sub-Xiphisternal/Pericardial view. This can be useful for both blunt and penetrating trauma in identification of pericardial effusion or tamponade.



E Fast Scan (extended)

The extended FAST scan involves surveying the thoracic cavity for Pneumothorax and Haemothorax

Intercostal drain insertion

Intercostal drains are associated with high rates of complications related to inexperienced operators. Placement requires invasion of a sterile body cavity and therefore demands sterile technique performed with skill and precision. The anatomic approach is best.

Safe zone:

- Anterior border of Lat Dorsi
- Lateral Border of Pect Major
- Nipple line



Drains

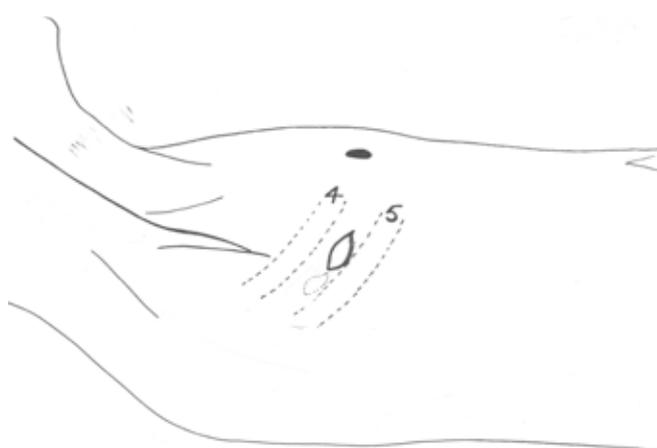
- 32 Fr routinely for trauma patients. 28Fr for shorter people.
- No trocars
- Single dose of Intravenous antibiotic (Flucloxacillin or Cefazolin) is appropriate.
- Sterile prep and drape
- It is vital to understand the anatomy and visualise the direction of the drain before starting the procedure
- Ensure local anaesthesia and be gentle. Consider sedation in consultation with Emergency Physician. Infiltrate 1% lignocaine with adrenaline to skin and into the intercostal spaces. Adrenaline aids haemostasis and prolongs action of LA. Pleura must be infiltrated in all conscious patients. For longer lasting anaesthesia consider adding Marcaine 0.25% with adrenaline as well as Lignocaine.

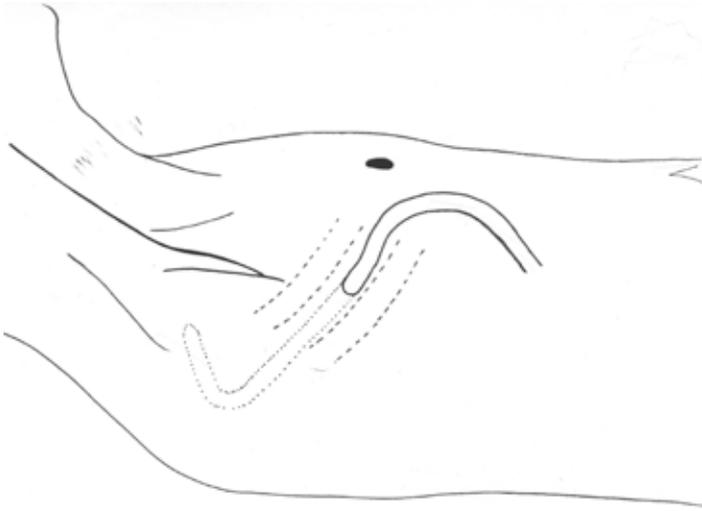
Ideal technique

3 cm incision mid-axillary line along the superior edge of 5th rib. Identify it **exactly** and mark prior to

Incision

- Drain passes **obliquely at 45° to the chest wall** down a **single hole**. Consider using a placement guide if available.
- Sweep **pleura** down firmly with fingertip until the pleura gives way and you feel the slippery lung moving on your fingertip. Document the whoosh of air. Push the tip of drain into thorax with a fingertip. If it does not slide in smoothly it will be in the wrong place.
- Tip goes **posteriorly and toward the apex**, along the line of the rib. This drains the dependant part of the thoracic cavity. This means that the drain exits the chest going anteriorly





Anteriorly

- Connect immediately to underwater sealed drain at **20mmHg continuous suction**.
- Single stitch to one end of the incision, tied at 10-14cm on drain. This ensures all holes are in the thoracic cavity. NB crimp the drain at one point – no “Roman sandal ties”. Drains are soft and are designed to be crimped. No purse string sutures: they are unnecessary and leave unsightly, painful scars.

Placement problems

- Any drains placed anteriorly, inferiorly or transversely risk hilar or parenchymal injury and may not drain the thoracic cavity adequately.
- Use local on skin, intercostal space **and through the pleura** (it is exquisitely sensitive to stretch). If drain placement is painful, anaesthesia is inadequate.
- Make one hole only down to pleura using long, straight forceps so you know where the tip is. If you make more than one the drain tip will always go down the wrong one (Law of Murphy).
- Pierce the pleura with your fingertip.

A practical approach to drain removal

- Remove when:

- <200 mls/day
- Drain not bubbling
- Clinically improving
- Not for further IPPV

Do not clamp drain prior to removal.

- CXR within 1 hour after drain removal
- Be ready to put another one back in the right place immediately if a pneumothorax recurs.
- Warn the patient of signs of recurrence: dyspnoea, sudden chest pain, and have a plan in place.

Radiology

Chest X-ray

- This image is critical to determine respiratory compromise requiring intervention and to exclude sites of life-threatening haemorrhage. Plates should be on the trauma bed before the patient arrives. The image should be on the viewing screen within 7 minutes of the patient's arrival.

Pelvic X-ray

- mandatory in major blunt trauma patients. A pelvic fracture that is not clinically obvious can be the site of unexplained blood loss. A dislocated hip is an orthopaedic emergency can be missed in a patient with multiple injuries, especially if unconscious.

Lateral cervical spine X-ray

- The C-spine cannot be radiologically cleared with a lateral X-Ray alone. This rarely alters treatment and may slow the trauma call process, so is generally not recommended. As a general rule, if there is enough force to cause a brain injury, there is enough to cause cervical spine injury. Brain and neck CTs should therefore be done together and early. Lateral views may be useful if the hypotensive patient has a suspected cervical cord injury as the cause of their hypotension, or in a patient with severe multiple injuries including to the head and neck but requires immediate anaesthesia for damage control surgery.
- Do not delay urgent surgical interventions to get C-spine X-rays- just consider the spine as being fractured and manage in a hard collar. Change to a well fitted Philadelphia or Aspen collar immediately.
- Cervical spine clearance should be done within 3 hours.

Abdominal/pelvic CT

- Abdominal/Pelvic CT for trauma is highly sensitive and specific for significant injury and is the definitive test of choice in stable blunt trauma patients. The accuracy of abdominal CT in diagnosing penetrating injury is inadequate, so penetration of the abdominal wall fascia warrants laparoscopy or laparotomy.
- Clinical assessment of the abdomen is unable to exclude many occult, life-threatening injuries within the abdominal cavity therefore CT should be used to exclude these with knowledge of the risks of ionising radiation.
- CT abdo/pelvis accurately diagnoses pelvic fractures, retroperitoneal injuries, solid organ injuries, lumbar spine fractures, sacral fractures and most hollow viscus injuries. Contrast blush in a solid organ may indicate the need for angio-embolisation in stable patients.
- Hollow viscus injury can have devastating effects if it is missed and CT has a false negative rate (missed injury rate) of 10-13%. The CT signs consistent with hollow viscus injury are: free air or oral contrast extravasation (hard signs); or free fluid, bowel thickening, mesenteric stranding and haematoma (soft signs). Hard signs warrant laparotomy; soft signs warrant either laparotomy or careful serial examinations. DPL is sensitive for hollow viscus injury.
- The negative predictive value of contrast-enhanced abdominal CT is 99.5%. That means if the scan is negative, there is almost no chance of significant injury. Certainty in diagnosis allows other interventions to occur and enables confident decision-making in patients with multiple injuries and multiple competing priorities.

Chest CT

- Most thoracic injuries do not require chest CT, with some notable exceptions.
- Chest CT will reveal occult pneumothoraces, haemothoraces, pulmonary contusions, thoracic spinal injuries and mediastinal injuries, all of which should be excluded or accurately diagnosed prior to prolonged anaesthesia, transport or positive pressure ventilation. The presence of an occult pneumothorax or basal pulmonary contusion may often be seen in the uppermost cuts of an abdominal CT.

Indications for chest CT include:

1. Wide mediastinum in a stable patient
2. Suspicion of pulmonary contusion
3. Suspicion of pneumothorax that is occult to CXR but must be diagnosed prior to transport or positive pressure ventilation.
4. Suspected thoracic spinal fractures

Brain CT scanning for Neurotrauma patients

CT scanning is the diagnostic test of choice for blunt traumatic brain injury.

All patients with **moderate to severe TBI (sustained GCS<14 at any stage)** require CT brain.

The indications for brain CT scan in patients with mild TBI (GCS>13) are:

1. Loss of consciousness > 5 minutes
2. Persistent neurological signs
3. Persistent decrease in level of consciousness
4. Unable to clinically assess (anaesthesia, drugs, young children, etc)
5. Elderly patient taking anticoagulants

CT of the cervical spine

In general CT scanning of the cervical spine gives information that is accurate enough to describe all significant injuries and therefore allow definitive clinical decision-making. Scanning of the brain and cervical spine at the same time is rapid and efficient. Returns to the CT scanner for cervical imaging are wasteful of resources and put patients at risk.

Interventional radiology

This modality is gaining an increasing important role in trauma management, particularly in early diagnosis and treatment of exsanguination in organ systems where surgical access and haemostasis is challenging and less effective. Angioembolisation can also be used in conjunction with stenting procedures in proximal vascular injuries.

Angioembolisation is both diagnostic and therapeutic, and gives excellent results when applied judiciously. It is the standard of care for major pelvic exsanguination and is increasingly used for diagnosis and vascular control in many body regions, including:

Pelvis / retroperitoneum

Liver / spleen / kidneys

Chest wall

Neck and thoracic outlet

MRI

MRI has a limited role in trauma imaging owing to the inherent dangers of undiagnosed metallic foreign bodies, cost and availability. Its use is mainly restricted to non-emergent spinal cord, brain and joint injuries on request of appropriate specialists.

