

CASE ONE

A R40 is called in with a 20yo male in a high speed roll-over; he was trapped in vehicle for 30min before extrication by the emergency services. They will be in the department in 10minutes.

BP 90, HR 120, RR 30, Sats 92%, GCS 13 (M6)

1. What are your clinical concerns for this patient and how would you prepare for this arrival?

- Trauma call – team organisation and plan of approach – VERBALISE plan
 - High risk multi organ injury and instability
 - Blood available (Blood fridge, blood bank)
 - Equipment available : ICD/Thoracostomy, pelvic binder, access, airway
 - Drugs: RSI dx, analgesia (fentanyl/ketamine)
- Pre hospital hypotension and prolonged extrication = high risk serious injury

2. The patient arrives and is handed over by the ambulance team. He has been given 200mg ketamine IV total, 10mg morphine, and 1L crystalloid.

His obs: BP 90/50, HR 130 sinus, RR 28, 92% o/a, GCS 13 (M6)

- There are no obvious deformed long bone injuries or external blood loss, no significant external head injuries.
- **Discuss your approach to resuscitation management and investigation?**
- Haemodynamically unstable patient – look for source/s
 - Permissive hypotension/careful volume use
 - Avoid cold crystalloids
 - Early warmed blood products
 - Consider pelvic binder
 - ? PTX/Haemothorax
- Analgesia
- TXA 1g IV stat
- Determine if airway control required :
RESUCITATE BEFORE YOU INTUBATE MANTRA
- Utilise eFAST early (skilled operator) : **LIMITATIONS**
 - ? significant Free fluid (does not exclude intra abdo injury)
 - Pleural effusion/blood
 - Ptx
 - Pericardial effusion
- VBG – acute Hb, Base excess and lactate indicators shock
- Consider RED BLANKET CALL is appropriate (see guideline)
- Imaging: CXR/pelvis, Trauma CT if stable/safe to do so

3. The patient becomes more hypotensive and tachycardic despite 1unit RBC and prior 1L N saline. BP 70/40, HR 140bpm. His eFast is negative. There are no external sources of blood loss. What is your concern and how will you manage and investigate further?

- Haemorrhagic shock:
 - Pelvic, retroperitoneal
 - Cardiac, mediastinal or great vessel injury
 - Intra abdo and thoracic injury not fully excluded
- Urgent SMO involvement: Surg/Ortho/ED/ICU, consider vascular/interventional
- MTP – activate and resuscitate
- Urgent portable CXR + pelvis
- Rpt eFast - ? FF ? chest pathology, cardiac views
- Ensure pelvic binder insitu

4. His portable CXR looks essentially normal. His pelvic xray is below. What is your interpretation?



VERTICAL SHEAR INJURY

5. Despite a further 4 units RBC and 2 units FFP he remains with a BP of 70 and HR 120. He looks pale and now is becoming cerebrally irritated with increasing O2 requirement. What are your priorities?

- Haemorrhage control is required ASAP!
 - Likely will have on going resistant shock and worsening coagulopathy
- Continue MTP (see pathway) – ensure warmed/avoid cold volume
- Urgent SMO discussion – ortho/surg/interventional-plan

- CT is not going to save their life they need definitive bleeding control
 - Interventional angiography and embolization
 - Open laparotomy/packing/vascular control/ ex fix
 - REBOA ? (future option)

- Airway/breathing control will be required if going to interventional suite
 - Anaesthetics and ICU involvement
 - High risk RSI
 - Senior input

CASE TWO

R40 High speed RTC 100kph +, unrestrained 32yo male driver who is intoxicated is being transported to your department. The patient seems to have a spinal cord injury. They are 2minutes away. They observations provided are:

GCS 14 (M6), RR 25, Sats 94% oa, BP 80/50, HR 100bpm

1. **Discuss your preparation and clinical suspicions for injury?**

- Trauma call – team approach
 - Prepare equipment and drugs
 - Consider need for volume/blood products
 - Make a plan
- At risk of multi organ traumatic injury
 - Hypotensive
 - Tachypnoea
 - ? c spine injury – impair clinical assessment
- C spine and spinal precautions
 - Consider need for airway support and difficult airway

2. **On arrival it is clear that he has a high spinal cord injury with poor diaphragmatic breathing efforts. Discuss your approach to his assessment and management?**

His observations are: BP 80/50, HR 100, RR 25, Sats 93% o/a, GCS 14

- C spine anatomically immobilisation - head blocks/occiput support, hard collar – avoid manipulation of the c spine
- Hypotensive and relative bradycardia
 - Hypovolaemia commonest cause for trauma hypotension
 - Consider neurogenic shock (loss sympathetic tone)
 - Consider obstructive shock – PTX/tamponade
 - External loss and long bone injuries
 - Vascular and cardiac injury
- Consider volume
- eFAST for cause shock
- CXR/pelvis +/- lateral c spine views
- O2 and prepare for possible need for ventilator support
- ? MAP support prevent secondary spinal cord injury (80-90mmHg)
- CT trauma scan once safe to do so

3. **Discuss primary and secondary spinal cord injuries and aims in emergency care?**

- **Primary spinal cord injury** results from blunt or penetrating mechanisms at the time of the initial traumatic event. Fractures, dislocations, hematomas and soft tissue swelling directly injure the spinal cord via mass effect, disrupted blood supply or transection.
- **Secondary spinal cord injury** occurs after primary spinal cord injury due to mechanical instability contributing to on-going direct injury, or insults from other factors such as hypoxia and hypoperfusion. The latter may be due to associated injuries in a multiply injured patient or due to spinal cord injury associated respiratory insufficiency and neurogenic shock.
- Much of the acute management of spinal cord injury is aimed at preventing secondary spinal cord injury
 - Immobilisation
 - Prevent hypotension and hypoperfusion
 - Avoid hypoxia

4. **He deteriorates and becomes more hypotensive 60 systolic with a HR of 40bpm sinus. What are your concerns and how would you treat this?**

REMEMBER NEUROGENIC SHOCK IS RARE – BLEEDING IS NOT

- Neurogenic shock: Distributive shock, vagal tone, autonomic dysreflexia
 - Trial volume bolus compensate for vasoplegia and reduced preloads
 - Atropine for bradycardia and un-opposed vagal tone
 - Will need peripheral squeeze – pressors
 - Be aware of pre dominant alpha agonist effects metaraminol/norad some risk of worsening bradycardia
 - At risk of brady-asystolic arrest (usually later) – peripheral adrenaline
 - May need peripheral infusion – dopamine (alpha, beta, D) dose dependent
- Review other causes for shock- are they losing blood ?
 - Rpt eFAST. Review CXR and pelvic XR
 - GCS ? intracranial pathology
 - Consider vascular/mediastinal/cardiac injuries – CT imaging

5. **You note deteriorating respiratory effort, increased RR and increasing oxygen requirement. Discuss how spinal injuries affect respiration and how you manage this patient?**

- The mechanism of respiratory insufficiency varies according to the level of injury:
 - High cervical injuries may lead to airway obstruction due to local hematoma and swelling.
 - Lesions at the C5 level or higher lead to diaphragmatic paresis or paralysis, as the phrenic nerve arises from the C3-5 levels.
 - Thoracic or higher lesions may lead to respiratory distress due to paralysis of intercostal muscles, as the intercostal nerves arise from the T1-12 levels.

- Other causes include:
 - Coexistent thoracic injuries
 - Coexistent traumatic brain injury (e.g. decreased respiratory drive from coma)
 - Complications of spinal cord injury (e.g. aspiration, atelectasis, pulmonary embolus, metabolic acidosis from spinal shock)
 - Complications of treatment (e.g. sedation, fluid overload, transfusion-associated acute lung injury, ventilator associated pneumonia).

- Likely this patient will need intubation and ventilation:
 - Potentially difficult airway
 - Immobilised C spine – adjuncts/hyper-angulated blades
 - May be anatomical difficulty – swelling/haematoma/distortion
 - Potential haemodynamic and autonomic instability
 - Avoid hypotension and hypoxia prevent secondary injury

CASE THREE

A young man is brought to the front door in the back of a utility with major upper limb, lower abdominal and hindquarter trauma. He has suffered these injuries at a commercial worksite 10 minutes down from the ED after being crushed by a crane. He is placed into the resus bay initially making moaning noises which cease quickly.

Observations: BP undetectable, HR 60, GCS 3

1. Below is an image of the injuries; discuss your approach to the management?



Traumatic hypovolaemic PEA arrest

- Trauma call
 - Role allocation with simultaneous role activation
 - Activate MTP
 - Consultant surgeon/vascular in resus now
- Priorities simultaneous
 - Access volume
 - Haemorrhage control
 - Oxygenation/ventilation and consider bilateral finger thoracotomies
 - CPR limited utility indicated unless adequate haemorrhage control and volume resus
 - eFAST

2. Discuss management of cardiac arrest in trauma and role of CPR?

- In cardiac arrest due to trauma, haemorrhage control, restoration of circulating blood volume, opening the airway and relieving tension pneumothorax should have priority over conventional cardiopulmonary resuscitation unless a medical cause for cardiac arrest is reasonably suspected

- Prolonged (>10 minutes) CPR in traumatic cardiac arrest after reversible causes have been addressed is almost never associated with a good outcome

3. There is an obvious RUL amputation, R hindquarter amputation/open pelvic injury; discuss how will you address haemorrhage control?

- High battle tourniquet for upper limb
- Pelvic amputation
 - Direct pressure
 - Direct control vessels with clamping/tie (surgeon/vascular)
 - REBOA may be limited by pelvic disruption/vascular injury
 - Abdominal or thoracic aortic cross clamping?

4. Peripheral IV access is impossible in this patient what are your options?

- IO L humeral (avoid LL limb due to pelvic/hindquarter trauma)
- L subclavian or IJ access , EJ
- Whatever you can get

5. Despite large rapid blood product resuscitation no perfusing output is detected. Discuss if there is a role for resuscitative thoracotomy or REBOA in this patient?

- Torso haemorrhage remains the leading cause of potentially preventable death following traumatic injury.
- A significant proportion of patients with external bleeding can exsanguinate prior to definitive haemostasis due to the inability to apply direct pressure.
- Aortic occlusion as a part of trauma management can decrease the amount of bleeding and provide a window of opportunity for resuscitation and definitive haemorrhage control.
- Internal haemorrhage requires rapid surgical intervention
- Options for aortic occlusion include direct clamping through an open incisional technique (emergent thoracotomy) and resuscitative endovascular balloon occlusion (REBOA)
- Torso haemorrhage may originate from arterial, venous, or combined sources within the chest, abdomen, or pelvis. Junctional haemorrhage from non-compressible sites in the axilla or groin is also included in this definition.

Resuscitative Thoracotomy

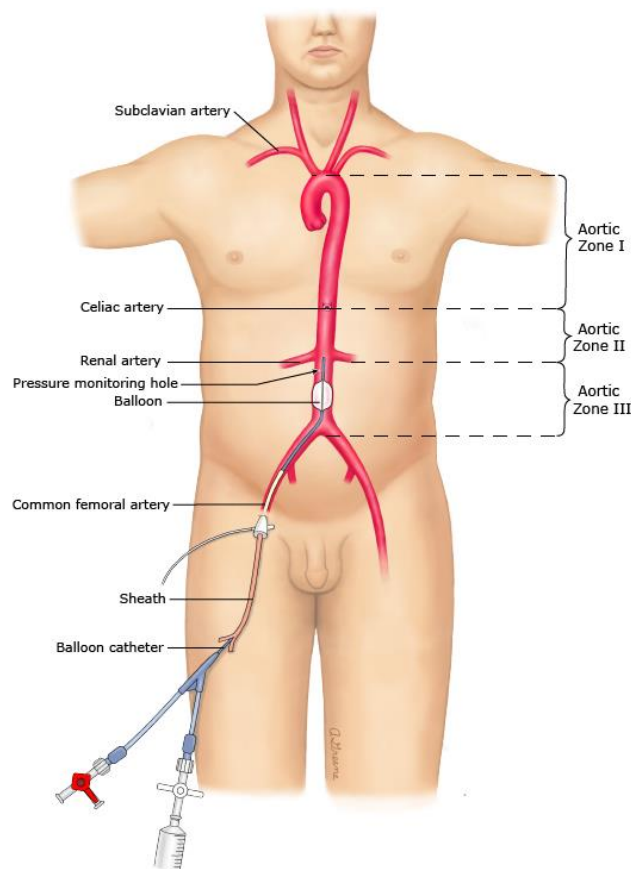
- Resuscitative thoracotomy is a temporizing measure that allows direct control of haemorrhage from exsanguinating thoracic injuries or decompression of cardiac tamponade and allows control of the aorta to limit bleeding from infra-diaphragmatic injuries to facilitate resuscitation.

- Resuscitative thoracotomy is restricted to patients with specific indications as determined by the patient's clinical status en route and immediately upon arrival to the emergency department, the mechanism of injury, or the need to perform therapeutic manoeuvres to manage correctable causes of shock, including decompressing cardiac tamponade, cross-clamping the aorta, managing exsanguinating cardiac or vascular injuries, and evacuating air embolism
- **Penetrating injury** — Resuscitative thoracotomy is justified in patients with penetrating thoracic trauma who are hemodynamically unstable on arrival to the emergency department despite appropriate fluid resuscitation, or in patients who have been pulseless and receiving cardiopulmonary resuscitation (CPR) for less than 15 minutes, but only if appropriate resources (eg, operating room, appropriately trained surgeon) are available for continued resuscitation and definitive repair
- **Contraindications** — Resuscitative thoracotomy is likely to be futile in patients with penetrating injury in the following circumstances:
 - The patient has no signs of life at the scene of injury
 - Asystole is the presenting rhythm and there is no pericardial tamponade
 - Prolonged pulselessness (>15 minutes) occurs at any time
 - Massive, non-survivable injuries have occurred
- **Blunt injury** — The subset of patients with blunt injury who might benefit from resuscitative thoracotomy includes patients who lose vital signs in transit or in the emergency department, and have no obvious non-survivable injury (eg, massive head trauma, multiple severe injuries), or patients with cardiac tamponade rapidly diagnosed by ultrasound, with no obvious non-survivable injury, but only if appropriate resources (eg, operating room, appropriately trained surgeon) are available for continued resuscitation and definitive repair.
 - Thoracic aortic cross-clamping prior to abdominal exploration may benefit a subset of patients with penetrating abdominal injury and exsanguinating haemorrhage.
- **Contraindications** — In patients with blunt injury, resuscitative thoracotomy is likely to be futile if:
 - The patient requires >10 minutes of pre-hospital CPR

- The patient has no signs of life at the scene of injury
- The patient has massive, non-survivable injuries

REBOA

- **Abdominal trauma with shock** — Patients presenting in haemorrhagic shock with clinical signs of traumatic hemoperitoneum require expeditious haemorrhage control, which generally consists of damage control resuscitation and damage control laparotomy. However, for some patients, any reduction in cardiac afterload (such as with anaesthesia induction agents causing vasodilation) can lead to circulatory arrest. Under this circumstance, a Zone I REBOA may offer a "physiological bridge."
- **Pelvic trauma with shock** — for patients with pelvic trauma, Zone III REBOA can be used, provided the patient has no evidence of intra-abdominal bleeding. A lower level of aortic occlusion has the advantage of maintaining visceral and renal perfusion, thereby reducing the degree of ischemia/reperfusion injury upon balloon deflation



6. Discuss the use of the MTP and the aims of blood product resuscitation in trauma?

- Early blood product use for volume resuscitation
 - RBC may not be the best option
 - Reasonable evidence for the use of whole blood resuscitation rather than partitioned, but not available at MMH (Auckland Trauma is sometimes using)
 - Some evidence pre hospital plasma use compared to crystalloid in severe trauma requiring volume have reduced mortality (PAMPER study)
- Keep patient warm and warm products key
- Give TXA 1g stat immediately (delay increases mortality)
- Good evidence for 1:1:1 mimics whole blood ; protocol for massive transfusion (see MMH guideline)

CASE FOUR

R40 44 yo male single occupancy high speed RTC off road into a tree and rollover, he was apparently ejected from the vehicle. The ambulance will be in the department in 5 minutes. Obs provided area: GCS 12, HR 120, BP 90

- 1. On arrival to the resus bay he is obvious respiratory distress. Below is an image of his injuries. Discuss your approach to his management and your priorities?**

Obs: GCS 12 (M5), HR 130, RR 35, Sats 88% on mask 15L, BP 88/50

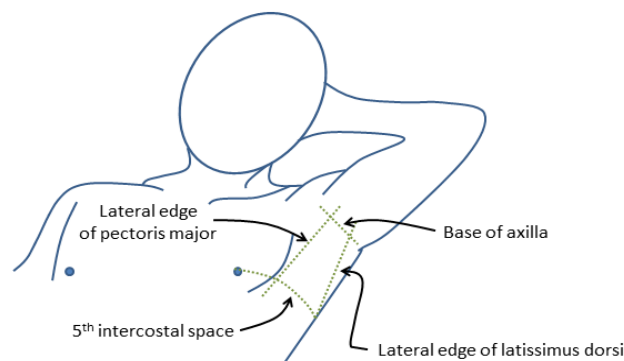


- Haemodynamically unstable patient with obvious major chest trauma
 - Consider : haemo-pneumothorax, tension, rib/flail injuries
 - At risk Head/neck and abdo/pelvis injuries
 - Priorities:
 - Oxygenation and optimise ventilation
 - Relieve tension/pneumothorax consider bilateral thoracostomies early
 - Analgesia
 - Access and some volume – Blood early (warm)
 - TXA
 - Consider need for RSI/simultaneous to tx any PTX resuscitate before you intubate
- 2. Discuss the technique of performing a primary finger thoracostomy and why it is preferred by most over needle decompression in unstable patient?**
 - Why the standard approach to needle decompression sucks
 - Normal IV catheters do not reach in up to 65% of the cases
 - Can J Surg. 2010 Jun;53(3):184-8.
 - Prehosp Emerg Care. 2009 Jan-Mar;13(1):14-7
 - J Trauma. 2008 Jan;64(1):111-4
 - J Trauma 2008 Oct;65(4):964
 - Accid Emerg Med 1996;6:426-7
 - Injury 1996;5:321-2.

- Brand New Study state failure in 42% of cases (Radiologic evaluation of alternative sites for needle decompression of tension pneumothorax [Arch Surg. 2012 Sep 1;147\(9\):813-8](#))

- Indications:

- Unstable Tension [pneumothorax](#)
- [Traumatic](#) cardiac arrest or peri-arrest: often bilateral
- Can be extended into a [lateral or clamshell thoracostomy](#) if cardiac tamponade considered

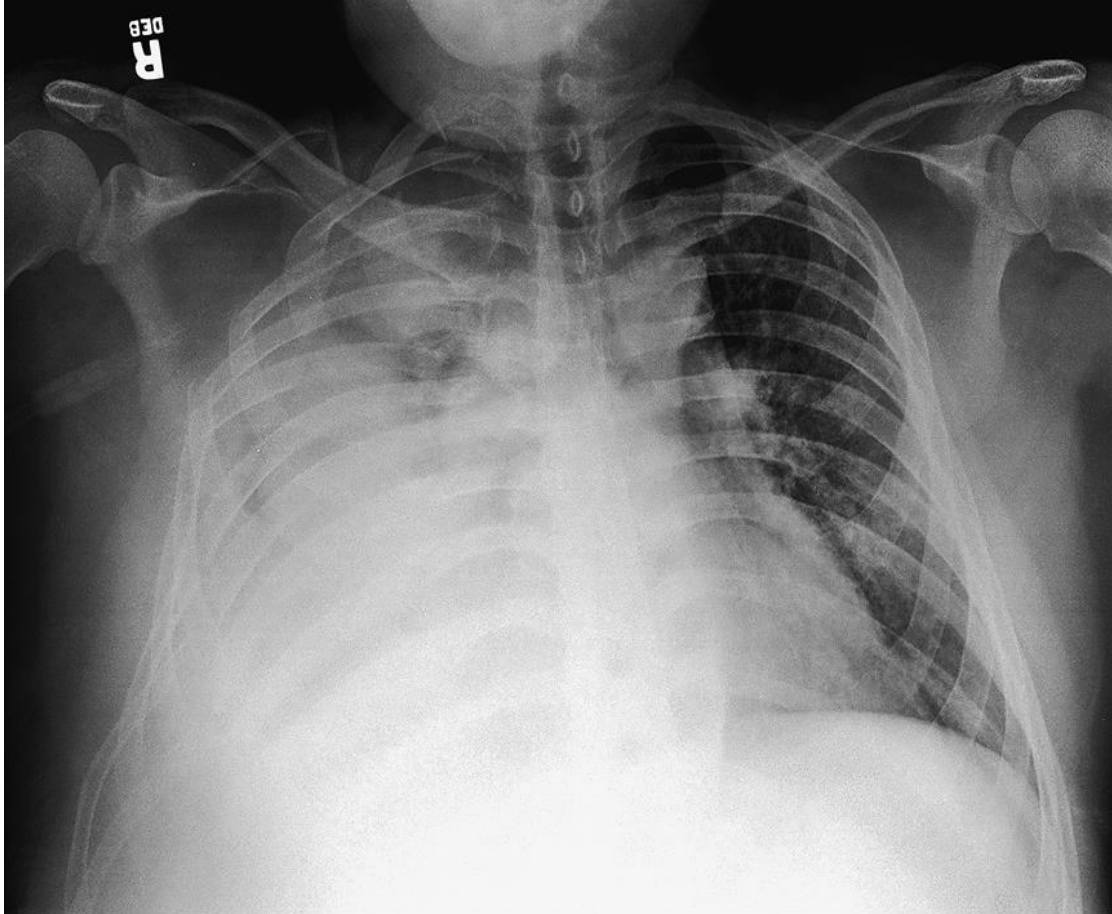


- *Insertion:*

- Prepare with [Chlorhexidine](#) or Povidine Iodine
- +/- [LA](#) infiltration if time permits
- 3-5cm incision in-line with intercostal space into adipose
- blunt dissection with forceps/Kelly clamp
- Insert finger into incision
- Sweep finger 360o to feel for lung re-expansion

- *Subsequent insertion of chest tube soon after*

3. A right finger thoracostomy is performed on arrival under some fentanyl analgesia with relief of a pneumothorax, there are obvious rib fractures. The patient has an improvement in oxygenation and BP after this procedure. Below is his CXR please discuss the findings and your next management options?



Multiple R rib fractures displaced likely flail with large haemopneumothorax

- Needs R ICD inserted
- Chest tube placement is the first step in the management of traumatic haemothorax. The majority of haemothoraces have already stopped bleeding and simple drainage is all that is required. All chest tubes placed for trauma should be of sufficient calibre to drain haemothoraces without clotting.
- Immediate intercostal catheter insertion (re-expanding lung may tamponade the bleeding vessels)
- Be aware potential massive blood loss from haemothorax
- Prepare for requirement blood products
- Have a plan

4. **A Right sided chest drain is inserted through the finger thoracostomy site. Immediately 1000ml blood drains from the tube. He becomes less responsive with a HR of 120 and BP down to 70 systolic. Discuss your management?**

- Management
 - High flow oxygen to maintain SpO2 target (e.g. 15L/min via non-rebreather mask)
 - Clamp tube is not recommended
 - Treat with rapid restoration of blood volume
 - Hemostatic resuscitation — activate massive transfusion protocol, use of an autotransfuser is ideal
 - Thoracotomy?

- Thoracotomy is required in under 10% of thoracic trauma patients. Most haemothoraces stem from injury to lung parenchyma or venous injury and will stop bleeding without intervention. Penetrating trauma is more likely to be associated with arterial haemorrhage requiring surgery.

- The indications for thoracotomy are usually quoted as the immediate drainage of 1000-1500mls of blood from a hemithorax. However the initial volume of blood drained is not as important as the amount of on-going bleeding. If the patient remains haemodynamically stable they may be admitted and observed. The colour of the blood is also important - dark, venous blood being more likely to cease spontaneously than bright red arterial blood. Patients admitted for observation who have continuing drainage with no signs of reduction in chest tube output over 4-5 hours should also undergo thoracotomy. The threshold for this is usually stated at around 200-250mls of blood per hour.

- Urgent surgical/cardiothoracic input
- ICU input