

INTRODUCTION

Thoracic injuries are one of the most common causes of death from trauma, accounting for approximately 25% of such deaths.

Despite the very high percentage of serious thoracic injuries, the vast majority of these patients can be managed in hospital by chest drainage and resuscitation and only 10–15% require surgical intervention.

In the field, the most common problem associated with thoracic injury is hypoxia, either from impaired ventilation or secondary to hypovolaemia from massive bleeding into the chest (haemothorax), or major vessel disruption (e.g.: ruptured thoracic aorta).

HISTORY

The mechanism of injury is an important guide to the likelihood of significant thoracic injury. Injuries to the chest wall usually arise from direct contact, for example, intrusion of wreckage in a road traffic collision or blunt trauma to the chest wall arising from a direct blow. Seat belt injuries come into this category and may cause fractures of the clavicle, sternum and ribs.

If the force is sufficient, the deformity and damage to the chest wall structures may induce tearing and contusion to the underlying lung and other structures. This may produce a combination of severe pain on breathing (pleuritic pain) and a damaged lung, both of which will significantly reduce the ability to ventilate adequately. This combination is a common cause of **hypoxia**.

Blunt trauma to the sternum may induce myocardial contusion, which may result in ECG rhythm disturbances.

Penetrating trauma may well damage the heart, lungs and great vessels, both in isolation or combination. It must be remembered that **penetrating wounds to the upper abdomen and the neck may well have caused injuries within the chest, remote from the entry wound**. Conversely, penetrating wounds to the chest may well involve injury to the liver, kidneys and spleen.

The lung may be damaged with bleeding causing a haemothorax or an air leak causing a pneumothorax. Penetrating or occasionally blunt chest injuries may cause a cardiac wound. Blood can leak into the non-elastic surrounding pericardial sack and build up pressure to an extent that the heart is incapable of refilling to pump blood into the circulation. This is known as **cardiac tamponade** and can be rapidly fatal if not relieved at hospital (*see additional information*).

Rapid deceleration injury may induce shearing forces sufficient to rupture great vessels such as the aorta.

The major thoracic injuries likely to present as serious problems in the field will involve either a developing tension pneumothorax, uncontrolled haemorrhage into the chest cavity causing a massive haemothorax, open chest wounds, major flail chest or cardiac tamponade.

ASSESSMENT

Assess:

- **AIRWAY**
- **BREATHING**
- **CIRCULATION**
- **DISABILITY** (mini neurological examination).

Evaluate whether patient is **TIME CRITICAL** or **NON-TIME CRITICAL** following criteria as per trauma emergencies guideline.

If patient is **TIME CRITICAL**, correct **A** and **B** problems, and rapidly transport to nearest suitable receiving hospital. Send a **Hospital Alert Message**. En-route continue patient management of thoracic trauma (*see below*).

In **NON-TIME CRITICAL** patients perform a more thorough patient assessment with a brief secondary survey.

Patients should normally be transported in the semi-recumbent or upright position, however this may often not be appropriate due to other injuries present or suspected.

MANAGEMENT

Follow **trauma emergencies guideline**, remembering to:

- ensure ABCs and consider immobilisation of cervical spine if indicated (*refer to neck and back trauma guideline*)
- pulse oximetry and ECG monitoring **MUST BE** used as this will assist in recognising hypoxia, but normal readings do not exclude relative hypoxia
- ECG monitoring.

Respiration:

Assess breathing adequacy:

- respiratory rate and volume
- equality of air entry

- administer high concentration oxygen (O₂) (*refer to oxygen protocol for administration and information*) via a non-rebreathing mask, using the stoma in laryngectomy and other neck breathing patients. High concentration O₂ should be administered routinely, whatever the oxygen saturation, in patients sustaining major trauma and long bone fracture, except for patients with chronic obstructive pulmonary disease (COPD) (*refer to COPD guideline*)
- consider assisted ventilation at a rate of 12–20 respirations per minute if any of the following are present:
 - oxygen saturation (SpO₂) is <90% on high concentration O₂
 - respiratory rate is <10 or >30bpm
 - inadequate chest expansion.

NOTE: exercise caution as any positive pressure ventilation may increase the size of a pneumothorax.

Fluid Therapy ¹⁻⁶

Obtain IV access.

Current research shows little evidence to support the routine use of IV fluids in adult trauma patients. In circumstances such as penetrating chest and abdominal trauma, survival worsens with the routine use of IV fluids.¹

Fluids may raise the blood pressure, cool the blood and dilute clotting factors, worsening haemorrhage. Therefore, current thinking is that fluids should only be given when major organ perfusion is impaired.

If there is visible external blood loss greater than 500mls, fluid replacement should be commenced with a 250ml bolus of crystalloid (maximum of 2 litres).

Central pulse **ABSENT**, radial pulse **ABSENT** – is an absolute indication for urgent fluid. If the patient has a carotid pulse but no radial pulse then other clinical factors should also be considered before decision on fluid administration.

Central pulse **PRESENT**, radial pulse **ABSENT** – is a relative indication for urgent fluid depending on other indications including tissue perfusion and blood loss.

Central pulse **PRESENT**, radial pulse **PRESENT** – **DO NOT** commence fluid replacement,² unless there are other signs of poor central tissue perfusion (e.g. altered mental state, cardiac rhythm disturbance).

Reassess vital signs prior to further fluid administration.

DO NOT delay at scene for fluid replacement; wherever possible cannulate and give fluid **EN-ROUTE TO HOSPITAL**.

Specifically consider:

- cover open chest wounds with an Asherman chest seal or adherent non-permeable dressing taped down on three out of four sides to allow some air to escape.
- consider (*refer to Appendix 1* for assessment and treatment of these conditions):
 - tension pneumothorax
 - flail segments
 - surgical emphysema
 - cardiac tamponade.
- impaling objects, e.g. a knife must be **LEFT IN-SITU** for removal under direct vision in the operating theatre. Any **impaling objects** should be adequately secured prior to transfer to further care. If the impaling object is pulsating, then it should not be completely immobilised, but allowed to pulsate.

Analgesia

Patient's pain should be managed appropriately (*refer to pain management guidelines*); analgesia in the form of Entonox (*refer to Entonox drug protocol for administration and information*) should be used with caution in chest-injured patients as there is significant risk of enlarging a pneumothorax.

Adequate morphine analgesia (*refer to morphine drug protocol for dosages and information*) may improve ventilation by allowing better chest wall movement, but high doses may induce respiratory depression. Careful titration of dosage is therefore required.

Key Points – Thoracic Trauma

- Thoracic injury is commonly associated with hypoxia, either from impaired ventilation or secondary to hypovolaemia from massive bleeding into the chest (haemothorax) or major vessel disruption.
- Pulse oximetry **MUST BE** used as this will assist in recognising hypoxia.
- The mechanism of injury is an important guide to the likelihood of significant thoracic injury.
- Blunt trauma to the sternum may induce myocardial contusion, which may result in ECG rhythm disturbances.
- Impaling objects should be adequately secured; if the object is pulsating, do not completely immobilise, but allow the object to pulsate.
- ECG monitoring

REFERENCES

- ¹ Turner J, Nicholl J, Webber L, Cox H, Dixon S, Yates D. A randomised controlled trial of pre-hospital intravenous fluid replacement therapy in serious trauma: The NHS Health Technology Assessment Programme 4(31), 2000.
- ² Revell M, Porter K, Greaves I. Fluid Resuscitation in Prehospital trauma care: a consensus view. *Emergency Medical Journal* 2002;19(494-98).
- ³ Bickell WH, Wall MJJ, Pepe PE, Martin RR, Ginger VF, Allen MK, et al. Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries. *N Engl J Med* 1994;331(17):1105-9.
- ⁴ de Guzman E, Shankar MN, Mattox KL. Limited volume resuscitation in penetrating thoracoabdominal trauma. *AACN Clinical Issues* 1999;10(1):61-68.
- ⁵ Pepe PE, Mosesso VNJ, Falk JL. Prehospital fluid resuscitation of the patient with major trauma. *Prehospital Emergency Care* 2002;6(1):81-91.
- ⁶ Stern SA. Low-volume fluid resuscitation for presumed hemorrhagic shock: helpful or harmful? *Current Opinions in Critical Care* 2001;7(6):422-30.

METHODOLOGY

Refer to methodology section.

APPENDIX 1

TENSION PNEUMOTHORAX

This is a rare respiratory emergency which may well require immediate action at the scene or en-route to hospital. A tension pneumothorax occurs when a damaged area of lung leaks air out into the plural space on each inspiration but does not permit the air to exit from the chest via the lung on expiration.

This progressively builds up air under tension on the affected side, collapsing that lung and putting increasing pressure on the heart and great vessels and opposite lung. Coughing and shouting can make the situation worse. If this air is not released externally, the heart will be unable to fill and the other lung will no longer be able to ventilate, inducing cardiac arrest.

Assessment of Tension Pneumothorax

- Tension pneumothorax is mostly related to penetrating trauma but can arise spontaneously from blunt or crushing injury to the chest. This will present rapidly with increasing breathlessness and extreme respiratory distress (respiratory rate often > 30 breaths per minute).
- The chest on the affected side may appear to be moving poorly or not at all. The chest wall on the affected side may appear over expanded. Air entry will be greatly reduced or absent on the affected side and in the absence of shock, the neck veins may become distended. Later on, the trachea and apex beat of the heart may become displaced away from the side of the pneumothorax and cyanosis may appear. Occasionally the patient will present with just rapidly deteriorating respiratory distress.
- The patient may appear shocked as a result of decreased cardiac output. They are usually tachycardic and hypotensive.
- Tension pneumothorax, however, is more commonly seen in the pre-hospital setting in chest-injured patients who are ventilated. Forcing oxygenated air down into the lungs under positive pressure will progressively expand a small, probably undetected, simple pneumothorax into a tension pneumothorax. This will take some minutes and it may well be several minutes after ventilation has commenced before increasing back pressure is noticed, either by the bag becoming harder to squeeze or the ventilator alarm sounding. Once the airway has been checked, the chest must be viewed to see if both sides are moving and

auscultated to ensure air entry is present on both sides. The findings of the chest signs described above will confirm the diagnosis.

Management of Tension Pneumothorax

Tension pneumothorax must be decompressed rapidly by needle thoracocentesis.

Treatment must be closely assessed as the procedure may fail. In such an event a further procedure should be carried out.

OTHER TYPES OF CHEST TRAUMA

Flail Chest

Small flail segments may not be detectable. Large flail segments however, may impair ventilation considerably as a result of pain. Splinting with a large pad or a hand supporting and immobilising the flail segment helps reduce pain, and improves ventilatory function. Traditionally, the patient has been turned onto the affected side for transportation, but this **CANNOT** be achieved on a long board. The segment can be immobilised in the boarded patient by manual splinting as described above.

Surgical Emphysema

This produces swelling of the chest wall, neck and face, with a crackling feeling under the fingers when the skin is pressed. This indicates an air leak from within the chest, either from a pneumothorax, ruptured large airway or ruptured larynx.

It requires no specific treatment, but indicates potentially **SERIOUS** underlying chest trauma. It may be gross causing the patient to swell up. If a patient with gross surgical emphysema is continuing to deteriorate, look for a possible underlying tension pneumothorax.

Cardiac Tamponade

The heart is enclosed in a tough, non-elastic membrane, the pericardium.

A potential space exists between the pericardium and the heart itself. If a penetrating wound injures the heart, blood may flow under pressure into the pericardial space. As the pericardium cannot expand, a leak of only 20-30ml of blood can cause compression of the heart, reducing cardiac output and causing tachycardia and hypotension. Further compression reduces cardiac output and cardiac arrest may occur.

Signs of hypovolaemic shock, tachycardia and

hypotension, accompanied by either blunt or, more commonly, penetrating chest trauma, may be only the initial evidence of cardiac tamponade. Remember, upper abdominal and posterior chest stab wounds may well have penetrated the heart.

Other signs include distended neck veins and muffled heart sounds when listened to with a stethoscope (sounds are diminished by the layer of blood between the heart and chest wall). The heart cannot fill because of the pressure in the pericardium, hence the neck veins become distended.

In cardiac tamponade, the compressing blood requires rapid evacuation, initially by a long needle attached to a syringe, and then surgically, with an open chest operation, as rapidly as possible.

Patients will die in the field if any unnecessary delay occurs in reaching hospital. If cardiac tamponade is suspected, remove at once to the nearest suitable receiving hospital with ongoing ABC care.

DO NOT waste time at the scene commencing IV lines or infusions with these patients as **ANY DELAY** will threaten their survival. Pericardiocentesis is not recommended as it is rarely successful, has significant complications and delays definitive care.

ADDITIONAL INFORMATION

Chest trauma is treated with difficulty in the field and **prolonged treatment before transportation is NOT indicated if significant chest injury is suspected.** Penetrating trauma, in particular where lung or cardiac wounds are suspected, must be transported **immediately** to a suitable hospital, with resuscitation en-route.

Airway management, oxygenation, assistance with ventilation as required and external haemorrhage control only should be applied in critical chest trauma cases particularly with penetrating injuries. **LOAD AND GO TO NEAREST suitable receiving Hospital.** Specifically consider the need for thoracic surgery intervention.

Remember, any stab or bullet wound to the chest, abdomen or back may penetrate the heart.

Massive haemothorax frequently presents as profound shock with breathing difficulty and reduced air entry in the lower chest on the affected side. The breathlessness is seldom extreme and shock is the overwhelming finding. These patients must be managed as **TIME CRITICAL**, transported rapidly and IV access secured en-route.

Patients with significant chest trauma may often insist on sitting upright and this is especially common in patients with diaphragmatic injury who may get

extremely breathless when lying down. In this instance a decision will have to be made as to whether a patient is best managed sitting upright or whether immobilisation on a longboard should be continued.

In the rare incident of gunshot injury to Police personnel using ballistic protection vests, the vest may indeed protect from penetrating injury, but serious underlying blunt trauma, (e.g. pulmonary contusion) may be caused to the thorax. **NEVER UNDER ESTIMATE THESE INJURIES.**

There is a strong link **between serious chest wall injury and thoracic spine injury** – maintain a high index of suspicion.