

# Early management of the acute severe trauma patient

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THE APPROACH OF IMMEDIATE assessment and resuscitation followed by a more formal medical appraisal in the management of the critically ill patient has been recognised for some time. Recently, it has been reported that the management of severe trauma patients is improved when a systematic assessment is used.<sup>1</sup> The following approach to the management of a patient with severe trauma is consistent with that recommended by the Royal Australasian College of Surgeons through its Committee on Early Management of Severe Trauma (EMST), and the Advanced Trauma Life Support (ATLS) course of the American College of Surgeons.<sup>2,3</sup>

Clearly, when considering the management of trauma patients in a military setting, not all of the resources described below may be available. However, it is still appropriate to be aware of the “gold standard” of management.

Triage is not discussed in this article, as it is a subject that merits an article in its own right.

As always, in both the military and civilian settings, an initial check for danger is essential before beginning assessment and resuscitation.

## Early management of severe trauma

*The primary objectives of trauma management are:*

- rapid and accurate assessment of the patient’s condition,
- resuscitation and stabilisation, and
- determining whether hospital transfer will be likely.



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## Synopsis

- ◆ Trauma resuscitation relies on an understanding of methods and patterns of injury, a thorough assessment of the patient, an understanding of physiology and pathophysiology, and the ability to perform the procedures necessary for resuscitation.
- ◆ Using a systematic approach, such as the EMST program recommends, enables issues to be attended to in the correct order.
- ◆ The primary objectives of trauma management are:
  - rapid and accurate assessment of the patient’s condition
  - resuscitation and stabilisation
  - determining whether hospital transfer will be likely.
- ◆ Management is divided into four phases:
  - primary survey
  - resuscitation
  - secondary survey
  - definitive care.
- ◆ Although all resources are not always available, the EMST principles of management can be used in patient care in any situation ranging from single person “buddy” first aid through to major hospital multiple member trauma teams.

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*Management is divided into four phases:*

- primary survey,
- resuscitation,
- secondary survey, and
- definitive care.

These proceed sequentially, with the exception that the primary survey and resuscitation usually proceed in parallel, with life-threatening problems being managed as soon as they are found. A repeat of the secondary survey performed 24 hours later (tertiary survey) may also be performed.

## Primary survey

This includes the review of five points:

**Airway:** airway maintenance and cervical spine control (see “Airway assessment”, page 6).

**Breathing:** adequacy of oxygenation and ventilation (see “Breathing assessment”, page 7).

**Circulation:** adequacy of circulation with haemorrhage control (see “Circulation assessment”, page 8).

**Disability:** rapidly reviewing neurological status, which includes an AVPU scale (ie, Alert, responds to Voice, responds to Pain, Unresponsive) or a quick Glasgow coma score (GCS), and pupillary response to light.

**Exposure:** completely undress the patient for review.

## Resuscitation

This is matched to the primary survey:

**Airway:** Removal of foreign debris, chin lift, jaw thrust, inserting oropharyngeal airway or nasopharyngeal airway, orotracheal or nasotracheal intubation and cricothyrotomy. The cervical spine should be maintained in a neutral position, with manual immobilisation by a second person if necessary (eg, during orotracheal intubation). (See “Acute airway management”, page 6.)

**Breathing:** High concentrations of oxygen should always be administered to trauma patients who are not conscious and lucid (the minimum is 12L/minute via face-mask). If a tension pneumothorax exists, it should be treated. An open pneumothorax should be sealed, and artificial ventilation should be performed if ventilatory failure exists. (See “Breathing management”, page 7.)

**Circulation:** Any significant haemorrhage should be controlled. Two large (at least 16 gauge) intravenous lines should be inserted and fluid administered if required. Blood should be obtained for cross-matching, haematology, biochemistry and (if required) alcohol concentration. (See “Circulation management”, page 10.)

**Disability:** The patient may require intubation and/or ventilation due to altered conscious state alone. Usually any trauma patient with a GCS of 8 or less will need intubation and ventilation.

**Exposure:** Active temperature control may also be required (eg, blankets). Provided that there are no contraindications, the patient should have an ECG monitor connected and urinary and gastric catheters inserted.

## Secondary survey

This should follow immediately on completion of the primary survey and resuscitation. Significant injuries may be missed if the primary survey is not performed as a top to toe examination with rigorous attention to detail. The body areas to be covered include:

**Head/face:** Inspection, palpation (maxillary, mandibular and orbital fractures), cranial nerves and pupils.

**Neck:** Inspection, palpation, lateral cervical spine x-ray (must be down to C7/T1 interspace).

**Chest:** Inspection, palpation, percussion, and auscul-

tation. May need pleural decompression, pericardiocentesis, chest x-ray.

**Abdomen:** Inspection, palpation, percussion, auscultation. May need peritoneal lavage, computed tomography, military antishock trousers (MAST), laparotomy.

**Perineum:** Inspection, palpation. Abnormalities include blood at meatus, scrotal haematoma, and high riding prostate, which are all suggestive of ruptured urethra. Examination *per rectum* is required to assess anal sphincter tone, rectal blood, rectal wall integrity and prostate position. A urethrogram is required before catheterisation if there is evidence of rupture.

## Case study: Crush injury and entrapment



A 20-year-old man was trapped under a pile of 500kg cement blocks in a factory. He sustained a compound brain injury (GCS 5), facial injuries with fractures and a ruptured eye, flail chest, tension pneumothorax, fracture dislocation of vertebra T12 with partial loss of motor and sensory function, and crushed lower limbs with multiple fractures. He was trapped for five hours. During this time he was anaesthetised, intubated and ventilated, a chest drain

was inserted, he was given intravenous fluid including O negative blood, and various monitors were applied, including SpO<sub>2</sub>, EtCO<sub>2</sub>, and an intra-arterial line (Figure 1). Spinal care was continued during the extrication process. Following a prolonged period in intensive care and complex rehabilitation he made a good recovery (Figure 2).



**Back:** Inspection, palpation. Includes checking for bony deformity, penetrating or blunt trauma. The patient must be “log rolled” to inspect the back.

**Extremities:** Include inspection and palpation (fractures, dislocated joints). May need appropriate splinting, MAST suit, analgesia, and tetanus prophylaxis.

**Neurological:** Includes sensorimotor evaluation (which may need adequate immobilisation of the whole patient). X-rays (apart from lateral cervical spine, chest and pelvis) should only be performed after the assessment side of the secondary survey is finished.

## Definitive care

Definitive care begins only after primary survey, resuscitation and secondary survey have been completed. By this time all injuries (major and minor) should have been identified.

## Tertiary survey

There is evidence that a repeat of the secondary survey 24 hours or so later will facilitate the detection of injuries that may have been missed previously because the signs and symptoms were masked initially by other injuries, drugs, alcohol, or an altered conscious state.<sup>4</sup>

## Acute airway management

Airway assessment and management takes precedence in the acute management of the trauma patient. At all times during assessment and management of the airway, consideration must be given to the possibility of cervical spinal injury. This is particularly true in the presence of neck pain, neurological signs or symptoms, or any injury above the level of the clavicles. Many airway manoeuvres can be managed with the cervical spine immobilised as much as possible.

## Airway assessment

Initial assessment of airway patency can be as simple as asking the patient to answer a question. A lucid response to the question “How are you?” indicates not only airway patency, but also provides information about ventilation and circulation (ie, the brain is receiving enough oxygenated blood to enable cognition). However, if there is not a lucid response, further investigation of the airway is essential. Patients who are not lucid should receive high flow oxygen (at least 12L/minute) whenever it is available.

A hand placed in front of the mouth and nose may detect warmth or moisture from exhaled gases. It is important to determine whether there is evidence of respiratory effort, as absent respirations remove many of the signs of airway obstruction. The mouth should be opened and a visual inspection made to see if any foreign bodies are present, such as vomitus, false and/or broken teeth or chewing gum. Any obvi-

ous foreign bodies should be removed, except that correctly sited false teeth should be left *in situ*.

If the patient is breathing, the presence of noisy respirations indicates a degree of respiratory obstruction. Total obstruction results in no flow and therefore no noise. In the prehospital setting it may not be easy to hear respiratory sounds over other noises. In these circumstances, a hand placed over the larynx may detect vibrations due to partial obstruction. This is a very useful technique if travelling by helicopter or road ambulance.

## Airway management

Removal of foreign bodies is important and often overlooked. Opening the mouth and clearing large foreign bodies with a gloved finger is the first option. A wide bore suction device can be used for material out of reach of the finger.

Simple manoeuvres should always be tried first. Correct positioning of the jaw should be achieved to eliminate possible obstruction from the tongue lying against the back of the pharynx. This can be either by chin-lift or jaw-thrust. These both rely on the translational movement of the temporomandibular joint. It is easiest to move the jaw forward with it slightly open. This should be done without extending the neck.

Either oropharyngeal or nasopharyngeal airway tubes can be used to secure the airway of an unconscious patient. Insertion of an oropharyngeal airway may not be tolerated by a patient with an intact gag reflex. Nasopharyngeal airways can be difficult to insert, although they tend to stimulate the gag reflex less. The nasal turbinates can physically obstruct passage through the nose, and may fracture during insertion, causing bleeding and further airway problems.

Endotracheal intubation should be considered if all the above are unsuccessful or if mechanical ventilation is required for other reasons. Either nasal or oral routes can be used. The nasal route is preferred for blind intubation as the tube is firmly supported. However, all the problems of the nasopharyngeal airway tube can occur with a nasotracheal tube. There have been reported cases of intracranial insertion of nasal tubes in the presence of a fractured skull (particularly with fractures of the cribriform plate).<sup>5-7</sup> Although this has usually occurred when attempting nasogastric insertion, the problem has also occurred with nasotracheal tubes. Care should be exercised in the presence of head injuries.

Oral endotracheal intubation usually cannot be performed blind and requires a laryngoscope and direct laryngoscopy. Correct positioning of the endotracheal tube must be confirmed by auscultation of both sides of the chest and the epigastrium. Air rushing up and down the oesophagus can simulate normal breath sounds, so it is important to listen over the epigastrium in all cases. If the ambient noise is too high, visual chest wall movement is a helpful sign. Sometimes air entry can be felt and palpation over both sides of the chest wall and the epigastrium may be helpful. The gold standard for confirming intubation is end-tidal CO<sub>2</sub> analysis.

An endotracheal tube should be inserted to about the 21 cm mark in an adult of average size. This will position the cuff

below the vocal cords and still leave the tip of the tube above the carina. During laryngoscopy the tube should be inserted until the cuff is just below the cords. A tube inserted too far will usually go down the right main bronchus, resulting in unequal ventilation. The endotracheal tube may become obstructed by secretions, blood or by the cuff herniating over the end. Consideration should be given to removing or replacing the endotracheal tube in cases of an inability to ventilate or adequately oxygenate the patient. Repeated laryngoscopy may be useful to confirm that the tube has not become dislodged and is still passing through the vocal cords. Severe bronchospasm or tension pneumothorax can simulate airway obstruction in the intubated patient.

If intubation is impossible and airway access is urgently required, consideration must be given to the creation of a surgical airway.

Cricothyroid insufflation has been advocated as a temporising measure to provide oxygenation, although it is not adequate for carbon dioxide clearance. A large bore (16 gauge at least) cannula is passed through the cricothyroid membrane and connected to a high flow oxygen source. The source must be intermittent to allow exhalation. This can be achieved by using a special injector, or by using a constant flow with a Y-piece which is occluded for inspiration to occur. This is the technique of choice for prepubescent children.

Cricothyrotomy may be performed by making a formal incision through the cricothyroid membrane. This membrane lies superficially in the neck and can usually be felt easily between the thyroid cartilage and the cricoid ring. A scalpel is used to make an incision through the skin and the membrane. A tube is then passed into the trachea. An endotracheal tube may be used, but care must be taken not to pass it into the right main bronchus (check for equal chest movement and breath sounds). The procedure should take only a few seconds. It is not recommended for prepubescent children.

## Breathing and immediately life-threatening chest trauma

### Breathing assessment

The same initial question used for airway assessment (ie, "How are you?") may help with assessment of breathing. A person who responds in a lucid manner is receiving enough oxygen and ventilating enough for reasoned brain function and speech. The absence of a lucid response requires further assessment. As mentioned above, high flow oxygen (12L/minute) should be applied early. Once the airway has been reviewed, it is essential to check for the presence and adequacy of respiration. Chest movement and warmth or moisture from exhaled gases are useful signs. When breathing is identified as being present, it is necessary to determine its adequacy. Respiratory rate and depth are important. Tachypnoea may be associated with any form of shock or anx-

iety, but it should always be assumed to be due to respiratory difficulties until proven otherwise.

Examination of the chest using inspection, palpation and auscultation may reveal a number of abnormalities. It is essential to expose the chest to adequately assess any disordered breathing.

On inspection, the normal chest moves symmetrically, with no paradoxical movements and no indrawing of intercostal muscles or the trachea. Asymmetrical chest movement may suggest voluntary splinting due to fractures, flail segment, partial lung collapse on one side, haemothorax or pneumothorax (tension or simple). On inspection, seat belt and other bruising may suggest underlying injury. Penetrating wounds are usually obvious, but may be missed if the back of the chest and axillae are not examined.

A flail segment should be obvious by the paradoxical chest movement associated with it, but side impacts may result in flail segments in the axillae, which can be hidden by a dependent arm.

Palpation may detect crepitus from surgical emphysema, fractured ribs or both. Vibrations felt under the hand may indicate fluid in the bronchial tree. This may be blood or aspirated vomitus. It is unlikely to be acute pulmonary oedema following injury, except for neurogenic pulmonary oedema, which may occur after severe head injury. The clavicles, scapula, sternum and individual ribs should all be palpated. Pain or tenderness may be quite localised.

Auscultation should reveal equal breath sounds on both sides. A decrease in breath sounds on one side should be considered in association with other signs. A decrease in or absent breath sounds on the right side, distended neck veins, midline tracheal shift away from that side, shock, a decrease in movement of the right chest and apparent hyperexpansion all suggest a tension pneumothorax. The same signs, but without midline shift or distended neck veins, may suggest a massive haemothorax.

Percussion may also help but is usually of limited value in trauma.

### Breathing management

EMST lists six immediately life threatening chest injuries which should be considered during the primary survey. These are:

- Airway obstruction
- Open pneumothorax
- Tension pneumothorax
- Massive haemothorax
- Flail chest
- Cardiac tamponade

**Airway obstruction:** Management of airway obstruction has been considered previously.

**Open pneumothorax:** Most penetrating injuries to the chest will seal themselves. However some wounds (particularly

larger ones) may remain open, causing a “sucking chest wound”. The presence of bubbling at the chest wound generally indicates an open pneumothorax. Usually there will also be underlying lung damage. The immediate management is to seal the wound with a hand, followed by the use of a sterile occlusive dressing. This should be taped securely on three sides. The fourth side is left untaped so that if a tension pneumothorax occurs, the air will leak out during expiration. During inspiration the dressing is sucked into the wound, effectively sealing the hole. This method is not fail-safe, however, and, if signs of a tension pneumothorax appear, the dressing should be removed temporarily to allow venting to occur. As soon as possible after sealing an open chest wound a formal underwater seal drain should be inserted in an area remote from the wound. The ideal location of the drain is at the fifth intercostal space, anterior axillary line.

**Tension pneumothorax:** A tension pneumothorax develops when a one-way valve effect allows air into the pleural cavity during part of the respiratory cycle, but not out again during the rest of the cycle. Air accumulates in the pleural space, causing lung collapse and eventually midline mediastinal shift towards the other side. The increase in intrathoracic pressure will tend to collapse intrathoracic vessels (especially low pressure veins) and interfere with cardiac filling. This can significantly reduce venous return and therefore cardiac output. It is important to remember that a tension pneumothorax is a clinical rather than a radiological diagnosis. It requires immediate decompression by inserting a large bore (at least 16 gauge) needle in the second intercostal space midclavicular line. Penetration of the pleura results in a characteristic hissing sound as air rushes out, and an immediate improvement in the patient’s condition. This manoeuvre converts the tension pneumothorax into an ordinary pneumothorax. The cannula is left in place. It is then necessary to insert a formal underwater seal drain. This is true even if air fails to rush out, as there is a possibility that the needle itself could damage the lung and lead to a further air leak.

A tension pneumothorax should always be considered following positive pressure ventilation in the trauma patient, as mechanical ventilation increases the risk of this development.

**Massive haemothorax:** This entity is rare, but life threatening. Its presentation is similar to that of a tension pneumothorax, but (unlike the tension pneumothorax) the ipsilateral chest is dull to percussion. Usually more than 1500 mL of blood has been lost into the chest cavity which may lead to lung compression, so that blood loss is compounded by hypoxia. Inserting an underwater seal drain may release a tamponade effect on the bleeding points, so it is essential to restore adequate intravascular volume as soon as possible. A thoracotomy will need to be performed if the initial drainage of blood is 1500 mL or more, or if the ongoing loss is 200 mL/hour or more.

**Flail chest:** A flail chest occurs when a segment of the thoracic wall does not have bony continuity with the rest of the

thoracic cage. This is commonly caused by multiple rib fractures, although damaged cartilages and sternal fractures may also contribute. The flail segment moves paradoxically (ie, moves in when the rest of the chest is expanding and out when the rest of the chest is moving in). This paradox will only be present in the spontaneously breathing patient, as mechanical ventilation will cause all segments to move the same way at the same time. A flail chest is invariably associated with underlying lung contusion.

Many of these patients can be managed with oxygen, analgesia and careful fluid administration. However, in the acute situation, if ventilation appears inadequate consideration should be given to early mechanical ventilation. The requirement for this is not related to the size of the flail alone, but rather to the underlying lung contusion. Respiratory function will usually deteriorate over the first 24–48 hours after a lung contusion.

**Cardiac tamponade:** Cardiac tamponade is considered below, under “Circulation management” (page 10).

## Circulation and haemorrhage control

### Circulation assessment

Hypovolaemia due to blood loss is probably the major cause of preventable death from trauma. It must be treated urgently. Frequent reassessment during resuscitation is the cornerstone of good management.

One of the major errors in acute trauma management is to assume that a normal blood pressure indicates that the circulation is normal. Blood pressure alone can be extremely misleading and should be considered in conjunction with other parameters of circulatory assessment, including pulse rate, capillary refill, respiratory rate, conscious state, urine output and the expected effects from identified injuries. Haemorrhage can be arbitrarily grouped into four classes.

**Class 1:** Haemorrhage equivalent to donating blood (ie, less than 15% of blood volume). It results in virtually no detectable physiological change.

**Class 2:** Haemorrhage equivalent to 15%–30% of blood volume. The patient has a mixture of normal and abnormal signs, making class 2 haemorrhage difficult to diagnose. At a cursory glance the patient may appear to have a normal circulation. The only abnormal findings may be mild tachycardia, mild tachypnoea, anxiety and delayed capillary refill. The blood pressure may be normal (as blood pressure may not drop until 30% or more of the blood volume has been lost). The signs of class 2 haemorrhage may be interpreted as signs of pain, anxiety or cold; therefore, it is important to look at all clinical parameters. At this stage it is also important to identify individual injuries and the blood loss that might be associated with them (see below).

## Case study: A child with head injuries

A 9-year-old child fell from a tree, landing head-first on cement. He sustained a complex skull fracture involving both the vertex and base (Figure 1). At the scene he had a GCS of 6 with blood in his pharynx. He had aspirated blood. He was hypotensive (blood pressure 60/-mmHg and bradypnoeic (8 breaths per minute). Treatment included intubation (Figure 2) and ventilation, intravenous access and fluids and helicopter evacuation to a military field medical facility (Figure 3). Computed tomography was not available. After three days' ventilation — during which he experienced a septic shock episode resulting from aspiration of blood — he made a full recovery (Figure 4).



**Class 3:** The patient has lost 30%–40% of his or her blood volume and is obviously unwell. He or she will be confused, oliguric, tachypnoeic, tachycardic and hypotensive, and requires urgent resuscitation. It is safer to initially assume that confusion or agitation is due to blood loss rather than head injury, because an incorrect assumption concerning head trauma may lead to underestimation of blood loss. Also head injury outcome is adversely affected by periods of hypotension. When a confused or agitated patient becomes quiet and stops fighting, this may indicate that he or she has gone from class 3 to class 4 haemorrhage and is about to die.

**Class 4:** The patient has lost more than 40% of his or her blood volume and is *in extremis*. He or she is lethargic or unconscious, pale, sweaty, anuric, hypotensive, tachypnoeic and tachycardic. The patient will die soon unless major resuscitation efforts are rapidly instituted. Young fit patients may remain conscious right up to the time of a bradycardic arrest from blood loss.

The change in clinical features with varying degrees of hypovolaemia due to haemorrhage is tabulated in Box 1.

Limb fractures are inevitably associated with blood loss. Box 2 lists the expected blood loss from different fractures and other injuries.

If the class of haemorrhage is worse than the obvious injuries would suggest, then it is likely that there is concealed blood loss. This can be either in the pelvis, abdomen (including retroperitoneum) or chest. Thus, a person with an isolated shaft of femur fracture who has a class 4 haemorrhage is bleeding from somewhere else, until proven otherwise.

Inadequate response to resuscitation fluids also suggests ongoing and perhaps concealed bleeding.

Hypotension in the presence of a head injury should not be assumed to be due to the head injury.

The history of the event is important, as it may give a guide to expected injuries (eg, a high speed frontal deceleration impact may result in a torn aortic arch or duodenum).

Two other specific injuries can simulate the clinical picture of blood loss. These are tension pneumothorax and cardiac tamponade. In both, the patient is hypotensive with distended neck veins. Tension pneumothorax will be associated with unilateral decreased breath sounds and hyperresonance, and a midline tracheal shift away from that side. Cardiac tamponade is usually associated with soft heart sounds.

Although neurogenic, cardiogenic and even septic shock can occur acutely in a trauma patient, inadequate circulation should always be assumed to be due to hypovolaemia until proven otherwise.

## Circulation management

Likening the damaged human circulation to a bucket of water with a hole in it, the principles of management become logical and straightforward — plug the hole(s) and refill the bucket. Probably the most important part of correct management is to get the assessment (ie, diagnosis) right. If circulation is inadequate, the steps to be considered are:

**1. Stop external haemorrhage:** This can nearly always be managed by direct pressure. If you can see the bleeding point, you can control it with pressure. Use large dressings and firm bandages. The benefit of military antishock trousers (MAST) is limited, with no data to support their use in most trauma cases. There are data to suggest that they can be harmful. Their role is probably limited to stabilising multiple lower limb fractures in the presence of a pelvic injury, and even this role is uncertain. Tourniquets should not be used except for extremely short-term control. If the bleeding point is not externally visible, then a laparotomy or thoracotomy may be warranted to manage suspected internal bleeding.

**2. Establish 2 large bore IV lines (14 or 16 gauge) and administer intravenous fluid** (0.9% saline Haemaccel, 4% albumin in 0.9% saline or blood). This should be performed early, and fluids should be infused rapidly, as the response (eg, change in pulse rate and blood pressure) is useful in assessing blood loss. The choice of fluid will depend on the degree of blood loss identified. As a guide, 0.9% saline or Haemaccel can be used at the beginning, progressing to blood if more than three or four litres of fluid are required. A rule of thumb for crystalloid solutions (eg, 0.9% saline, Hartman's solution) is that three times the blood volume lost will be required. Large transfusions (ie, greater than one blood volume or five

### I Intravascular fluid loss and clinical features

	Haemorrhage class			
	1	2	3	4
Blood loss per 70 kg body mass (mL)	< 750	750–1500	1500–2000	> 2000
Blood loss	< 15%	15%–30%	30%–40%	> 40%
Pulse rate (/min)	< 100	> 100	> 120	> 140
Blood pressure	Normal	Normal	Decrease	Decrease
Capillary refill test	< 2 sec	> 2 sec	> 2 sec	> 2 sec
Respiratory rate (/min)	14–20	20–30	30–40	> 40
Urine (mL/hour)	> 30	20–30	5–15	0–5
Mental state	Normal	Anxious	Confused	Lethargic
Transfusion fluids required	Crystalloid	Colloid	Blood	Blood

## 2 Blood loss expected from fractures and injuries

Bleeding site	Estimated blood loss	Comments
Shaft of femur	1000–1500 mL	Double if compound
Tibia and fibula	500–750 mL	Double if compound
Shaft of humerus	500–750 mL	Double if compound
Radius and ulna	250–500 mL	Double if compound
Pelvis	> 1500 mL	May lose many litres
Intra-abdominal	Any amount	Includes retroperitoneum
Intrathoracic	Any amount	

litres of blood in an adult) will lead to consideration being given to the administration of platelets and other coagulation factors (eg, fresh frozen plasma).

**3. Drain cardiac tamponade:** Cardiac tamponade is identified by the presence of Beck’s triad of muffled heart sounds, decreased blood pressure and distended neck veins. Drainage is done with a cardiac needle using a subxyphoid approach, aiming for the angle of the scapula while aspirating with a syringe. An ECG lead connected to the needle can be useful in identifying where the tip of the needle is. If echocardiography is rapidly available then this is an additional way of diagnosing this condition. It is also useful in facilitating the placement of the catheter. Most traumatic cardiac tamponades will require a surgical approach for definitive management. Tamponade occurs more commonly with penetrating trauma.

**4. Relieve tension pneumothorax:** This should have been identified and performed during the “breathing” assessment.

**5. Take blood for cross match, blood analysis, electrolytes, and other tests.**

## Penetrating torso injuries and fluid resuscitation

A prospective study in 1994 suggested that survival in penetrating trauma of the torso is increased if minimal fluid resuscitation occurs before surgery.<sup>8</sup> However, there are no corresponding data for blunt trauma, and it is also not clear if no fluid is better or worse than minimal fluid for penetrating trauma. Therefore, extreme care should be exercised in fluid resuscitation of patients with penetrating torso injury, with the emphasis on the need for early surgical intervention. The consensus is that minimal fluid (just enough to maintain palpable pulses) is probably the appropriate management.

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## 3 Trauma resources on the web

- ◆ Emergency War Surgery NATO Handbook: Part I: Types of Wounds and Injuries: Chapter VIII: Multiple Injuries. Advanced trauma life support. Available at the Virtual Naval Hospital website ([www.vnh.org](http://www.vnh.org)). <<http://www.vnh.org/EWSurg/ch08/08AdvTraumaLifeSupport.html>>. Other pages on the Virtual Naval Hospital site describe the management of a wide range of diseases and injuries in a military context.
- ◆ Trauma Org <[www.trauma.org](http://www.trauma.org)> — includes the websites of the Australasian Trauma Society, the British Trauma Society and the International Trauma Anesthesia and Critical Care Society, as well as resources and interactive training (moulage scenarios).
- ◆ University of Texas Health Science Center at San Antonio trauma home page <[rmstewart.uthscsa.edu/default.html](http://rmstewart.uthscsa.edu/default.html)>
- ◆ American Trauma Society <[www.amtrauma.org](http://www.amtrauma.org)>