Chest injuries are significant contributors to death from major trauma and can be difficult to assess adequately in the pre-hospital environment. In addition, the “classical” clinical signs of life-threatening chest injury are often absent, leading to a delay in management. The accompanying guidelines aim to provide a common sense and evidence based approach to the pre-hospital management of patients with chest injury.

Chest trauma can lead to severe internal injuries that are often difficult to assess. A history of chest trauma should lead EMT’s to suspect a serious injury, and patients should be treated with that expectation. Three major chest injury syndromes can lead to rapid death. They must be recognized and treated rapidly. They include:

- Bleeding from rupture of major chest vessel;
- Mechanical decrease of cardiac output (which may be caused by tension pneumothorax, cardiac tamponade or cardiac contusion with or without dysrhythmia); and
- Respiratory distress (which may be caused by tension pneumothorax, flail chest, pulmonary contusion or an open chest wound).

If chest injury interferes with breathing, it must be managed during the initial assessment. Objects penetrating the chest wall should be stabilized whenever possible, and not removed unless absolutely necessary for extrication or transport.

THE PREHOSPITAL APPROACH TO CHEST INJURY MANAGEMENT

The priorities in trauma management are to prevent further injury, provide rapid transport, provide early notification to the receiving facility and initiate definitive treatment. On-scene time should be as short as possible unless there are extenuating circumstances, such as extrication, hazardous conditions or multiple patients. Remember, our on-scene times should be less than 10 minutes in trauma patients. Always consider where the patient should be transported and consider the fastest way to get the patient to that location.

Always use a SAFE approach for any pre-hospital emergency:

- Assess the scene for any potential threat to EMS and for clues in establishing the mechanism of injury
- Evaluate the patient
- Consider ALS interventions and assistance early

Beware of distracting injuries particularly in patients with multiple or dramatic injuries. At all times consider whether the casualty requires immediate transport to hospital (load and go). Chest injuries can cause extremely rapid deterioration and unless the personnel present have the appropriate skills and training to allow necessary intervention, the patient should be transferred to the hospital as soon as transport permits. Assessing the mechanism of injury (e.g., time to hospital and method of transfer) may also guide the EMT between the balance of staying on scene allowing exposure, assessment and intervention versus rapid transfer.

Although the presence of alcohol or other drugs may mask some of the signs of severe trauma, assume that the patient’s condition is caused by trauma until proved otherwise.

Assess airway with cervical spine stabilization, breathing and circulation. Note that in the presence of catastrophic exsanguinating hemorrhage, rapid external hemorrhage control should be achieved before airway management. Recognition of the mechanism of chest injury is essential to guide subsequent assessment and treatment, as severe chest injuries (especially mediastinal injury) can occur in the absence of obvious external injury. The mechanism of injury may also suggest the presence of other life-threatening injuries—for example, to the abdomen or pelvis.

Mechanism of injury
- For vehicle collisions note the speed and the rate of deceleration. Were seatbelts, airbags, or protective devices used/deployed?
- For falls record the height and landing surface. Was the fall broken by an object?
- Is there any deformity of vehicles/ground, etc?
- Is there blunt force trauma, penetrating trauma or both?

Appropriate assessment is essential for a thorough and accurate evaluation. Exposure (make them naked) should be appropriate to the skills available and likely intervention/assessment requirements. Full assessment requires complete exposure to properly assess the left, right, front and back, while avoiding hypothermia or cooling of the patient. EMT’s should be discouraged from unnecessarily exposing patients.

Most assessments can be completed in the ambulance. Do not waste time on the scene to complete your secondary assessments.

**PREHOSPITAL ASSESSMENT**

**Look**
- Respiratory rate and pattern. Count for 1 min. Reassess at regular intervals as this will be the first indicator of deterioration of the patient.
- Chest wounds (especially sucking chest wounds) or bruising.
Movement of the chest wall. Are there any asymmetrical features of chest wall movement? Be vigilant for flail segments with paradoxical or abnormal movements of a section of chest wall. Is there subtle reduced movement of one side of the chest wall with hyperexpansion suggesting a tension pneumothorax? Reduced movement may also be due to pain, pneumothorax or hemothorax.

Neck wounds, subcutaneous emphysema or neck swelling. The swelling of subcutaneous tissues due to the presence of air within the tissues suggests a pneumothorax is likely to be present. Penetrating neck injuries may be associated with pneumothorax or hemothorax.

Venous engorgement (JVD). This is an inconsistent sign especially if the patient has hypovolemia and may only be visible if the cervical collar is removed to expose the patient’s neck.

Hemoptysis may indicate a tracheo-bronchial injury or a lung contusion. However, it may simply result from a bleeding facial injury or blood from a nose bleed.

Listen
- Auscultation is often difficult due to location and noise. The EMT must be proficient on auscultation of breath sounds. It will only be of benefit if the environment permits and the practitioner is trained and competent in interpreting the sounds heard on auscultation.
- The lateral chest and anterior armpit should be auscultated to avoid misinterpretation of transmitted sounds from the contralateral (opposite side) chest.

Feel
- Swelling
- Subcutaneous emphysema (snap,crackle,pop)
- Crepitus.
- Chest wall tenderness or fractures
- Laryngeal crepitus
- Deviation of the trachea indicating tension pneumothorax (a late sign)
- Percussion should be performed if ambient noise allows and the EMT is trained.
- Examination of the back and armpits is mandatory to prevent missed posterior or lateral chest injuries.

All patients should have initial and repeated vital signs:
- Respiratory rate
- Peripheral (radial) and core (carotid) pulse rate
- Level of consciousness—AVPU (Alert, responds to Voice, responds to Pain, Unresponsive) – use the Glasgow Coma Scale
- Pulse oximetry
- Blood pressure
- ECG monitoring.
The patient should be constantly reassessed and whenever there appears to be a change in the patient’s clinical status.

**INTERVENTIONS**

- Oxygen high-flow through non-rebreather mask (15 l/min).
- Consider positive pressure ventilations (BVM). **But recognize that if a pneumothorax is present especially with a closed chest injury, you may create more problems for the patient.**
- Cover open wounds of the chest with an occlusive dressing.
- Stop external hemorrhage from chest wounds by dressings and direct pressure.
- Manual splinting of flail chests (particularly for the short term in the absence of analgesia). Methods of splinting include direct pressure applied by the hand of the patient or practitioner; positioning the patient lying on the flail segment; or with bulky dressings.
- Rapid sequence induction of anesthesia with intubation may be necessary but is infrequently indicated. (ALS skill)
- Intravenous therapy (two large bore IV’s i.e. 14-16 gauge). Fluid replacement follows the principles of hypotensive resuscitation to maintain a radial pulse only. High volumes of fluids can be particularly dangerous for the chest injured patient. Aurora Health Care protocols allow for 200cc boluses to maintain a systolic blood pressure $\geq$ 90mm. If unable to gain IV access, consider placement of IO.
- Rapid transport. Unless transfer times are prolonged, such as in prolonged extrication, BLS crews should not await the arrival of paramedic or ALS support before transporting the patient. When prolonged transfer times are expected, consideration should be made to the use of helicopter transport or an intercept point to meet paramedic or ALS support enroute to the hospital.
- Pericardiocentesis (ALS skill)
  - The technique is difficult and associated with cardiac injury. It is unlikely that clotted pericardial blood can be aspirated by a needle, and this technique does not stop continued bleeding from the ventricle into the pericardial sac.
  - Penetrating trauma
  - Suspected cardiac tamponade
  - Vital signs have been lost in the past 10 min and the hospital is not accessible within the same 10 min
- Management of open pneumothorax:
  - Rapid closure of the hole is required using a three sided occlusive dressing. The skin may need to be shaved or wiped dry of sweat or blood to enable adequate adhesion. If this also fails to secure the device it can be maintained in position with direct pressure.
- Needle decompression for tension pneumothorax. (ALS skill)

Tension pneumothorax is a rare prehospital event, particularly in blunt trauma. It is difficult to assess the exact numbers accurately as needle decompression is often performed in the absence of a true tension pneumothorax. **Tension pneumothorax is more likely to occur by rescuers when positive pressure ventilation is used on patients who have a pneumothorax.** If the patient with multiple trauma is deteriorating, with an
unknown cause, specifically look for tension pneumothorax. If localizing features are not found consider the presence of bilateral pneumothoraces. Common features in patients who are awake include universal symptoms of chest pain and respiratory distress, with tachycardia and ipsilateral (same side) decreased air entry found in 50–75% of cases. In ventilated patients, the universal findings are rapid onset deterioration with a decrease in oxygen saturations and blood pressure. High ventilation pressures, reduced chest wall movement and air entry are found in about 33% of cases.

**Technique of needle decompression (ALS ONLY)**

- Avoid thick muscle, breast tissue or areas with subcutaneous emphysema
- The first choice of site is the 2nd intercostal space in the midclavicular line. Studies have shown that there is a low accuracy in correct anatomical placement and therefore practitioners should be familiar with the landmarks.
- The standard 14G cannula is 4.5 cm long, and depending on the body mass index of the patient this may not be long enough to decompress all tension pneumothoraces.
- The cannula may also fail to decompress the tension pneumothorax due to obstruction by blood, tissue or kinking. Therefore, the cannula should be inserted into the chest attached to a syringe and flushed with 2 ml of air, if there is no obvious air release on insertion.
- Other causes of failure include a localized tension pneumothorax in the patient with pre-existing lung disease, or the presence of a large air leak in which the air will collect in the pleural space quicker than can be drained by the narrow bore of the cannula.
- If the anterior approach fails due to suspected depth of chest wall, then the lateral approach should be attempted in the 5th intercostal space, anterior axillary line if the chest wall appears thinner at this site.
- Consider using a longer needle or a commercial device designed for this purpose.
- Needle decompression should not be used for simple pneumothorax or hemothorax.
- There is considerable risk of iatrogenic pneumothorax if misdiagnosis and decompression is performed. Needle decompression in the absence of a pneumothorax may even create an iatrogenic tension pneumothorax. There is increasing concern regarding the number of needle decompressions being performed without the appropriate clinical indications, leading to significant morbidity and unnecessary interventions for the patient.
- Continuing observation and reassessment is essential by a person who can repeat decompression if necessary: this includes during transfer. If the cannula fails to work and the patient is beginning to retension, repeat needle decompression should be performed adjacent to the initial successful site.

**Positioning**

- In an isolated chest injury the ideal position may be sitting up. This depends on the acuity of injury. Patients self-splinting using their own chest muscles will be
reduced if they lay flat. Avoid long periods positioned supine on a spinal board. If the patient is conscious, with no neck pain and no distracting pain or injuries, patients who wish should be allowed to sit up.

- Unconscious patients with the appropriate mechanism of injury should have full spinal immobilization.

**Other considerations of patient care**

- No significant mechanism of injury
- No significant co morbidity
- No distracting injuries
- No steering wheel deformation if they are the driver of a vehicle
- No significant marks to the chest
- Normal vital signs
- Glasgow Coma Score of 15
- Rational behavior (A & O x 4). This is a more reliable indicator as to the patients’ status than is A & O x 3. For A & O x 4, we use person, place, time and event.

**SPECIAL CIRCUMSTANCES**

**Pediatrics**

- Assume time critical. Children can compensate well for injury and evidence of shock is a late sign. Often children can have severe internal chest injuries with minimal or no external evidence of chest injuries. Rib fractures in children signify a significant mechanism of injury and therefore serious injury should be suspected.
- Check for multiple injuries. An isolated chest injury is rare in children.
- Consider non-accidental injury

**Blast injury**

- Any individual exposed to a blast should be taken to hospital.
- Absence of tympanic (ear drum) damage does not exclude blast lung injury.
- Being shielded from blast fragments does not exclude blast lung injury.
- Prehospital management is supportive.

**Embedded/penetrating objects**

- Knives or other objects penetrating the chest should be left in place and not removed.
- The object should be protected from external movement during transfer.
- Movement of a penetrating object (in direct proximity to the heart) with each heartbeat should not be prevented by bandaging or padding.

**Cardiac arrest**

In the event of cardiac arrest after chest trauma the potential reversible causes will be hypoxia, hypovolemia, tension pneumothorax and cardiac tamponade. Management should be directed to the treatment of these conditions.
Hospital Contact

Early reporting to the hospital of all patients with chest injuries, or potentially serious chest injuries, allows for appropriate trauma team standby at the receiving hospital. This should be done as soon as reasonably possible as appropriate expertise for chest injuries may take longer to mobilize than other alerts. Consider direct transfer to a recognized trauma facility if available. Early hospital notification should include:

- Mechanism of injury
- Suspected injuries
- Current vitals including respiratory rate, pulse and blood pressure
- Treatment provided
- Expected time of arrival.

CONCLUSIONS

As with any patient, a complete and thorough assessment is key to identification of injuries. Too often, chest injuries can overwhelm even the experienced provider. Many times there is little a prehospital provider can do for a patient with a serious chest injury other than provide basic life support and rapid transport to an appropriate facility. Short on-scene time with rapid transport to an appropriate facility capable of stabilizing and managing a patient’s injuries are the key to patient survival.