Northwest Community EMS System
Continuing Education Independent Study Materials – August 2012

Thoracic Trauma

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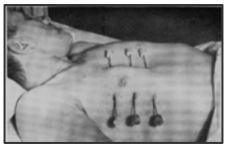
Morbidity and Mortality



"Trauma is the leading cause of death, morbidity, hospitalization, & disability in Americans aged 1 year to the middle of the fifth decade of life." As such, it constitutes a major health care problem. According to the Centers for Disease Control and Prevention, approximately 118,000 accidental deaths occurred in the United States in 2005. [1]

Incidence of Chest Trauma

Statistically speaking, thoracic injuries account for 20-25% of deaths due to trauma & contribute to 25-50% of the remaining deaths. Approximately 16,000 deaths per year in the United States alone are attributable to chest trauma. Therefore, thoracic injuries are a contributing factor in up to 75% of all trauma-related deaths. These statistics show that trauma patients significantly present with thoracic injury. Thoracic trauma can be looked at in three different categories: chest wall injury, pulmonary injury & cardiovascular injury. [1]

Etiology

Each type of injury can have multiple mechanism of injury (MOI) associated with them but MOI should be assessed as it can be a good predictor of what injury may occur and which anatomical structure may be affected.

Blunt chest injuries can potentially pose a threat to the A, B, C s of the trauma patient, therefore directly affecting the clinical course & outcome. In the US, the mortality rate in pts with blunt chest trauma can be as high as 60%.

With penetrating injury, the MOI may be categorized as: low, medium, or high velocity.

Low-velocity injuries include: Impalement (eg, knife wounds), which disrupts only the structures penetrated.

Medium-velocity injuries include: bullet wounds from most types of handguns & air-powered pellet guns & are characterized by less primary tissue destruction than wounds caused by high velocity forces.

High-velocity injuries include: bullet wounds caused by rifles & wounds resulting from military weapons.

Chest Wall Injuries

Any inconsistency within the chest wall can lead to compromise of the pt by way of fractures, specifically to the ribs.

Of all of the blunt thoracic injuries, rib fractures are most common; usually involving ribs 4-10. Up to 50% of patients with blunt cardiac injury have rib fractures. Pain is usually reported over the area of involvement & increases upon inspiration. Additional findings include localized tenderness and crepitus over the fracture site. These fractures should lead to a high index of suspicion for additional & more serious injury such as pneuomothorax, pulmonary contusions & blunt cardiac injury. First & second rib fractures are indicative of associated cranial, major vascular, thoracic, & abdominal injuries. Upon palpation, if fractures are felt lower in the thoracic cage, (ribs 8-12) there should be a higher index of suspicion for associated abdominal injuries.

Statistics prove a 1.5x greater likelihood of splenic & hepatic injury in those with rib fractures. [3]

Elderly patient concern

Pts with 3 or more rib fx have been shown to develop a 4x greater risk of pneumonia & 5x greater likelihood of overall mortality.

Effective pain control is a priority for these patients in order to encourage adequate breathing, however EMS should be continuously monitoring RR & effectiveness with these pts upon administration of fentanyl at the ↓ dose of 0.5mcg/kg for pts >65years old.

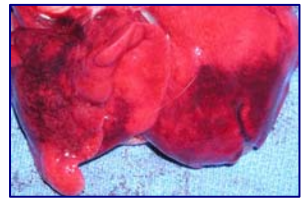
Flail chest

A significant amount of force is required to produce a ***flail segment*** (3+ ribs broken in 2+ areas). Multi-system trauma is common & EMS should specifically be concerned about pulmonary involvement. If closed head injury occurs in combination, it would significantly ↑ the mortality associated with flail chest.

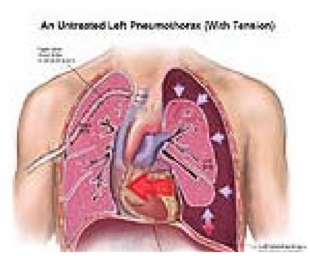
Flail segments can be located either anteriorly, posteriorly or laterally. Anterior blunt trauma can cause either sternal fractures and/or complete disarticulation of the sternum from the ribs (costochondral separation). When the flail segment is allowed to move contralateral to normal breathing, the pt is at greater risk for subsequent injury such as pulmonary contusion, pneumothorax & hypercarbia from inadequate gas exchange. EMS evaluation should include assessing for a pts ↑ WOB due to compressing lung tissue and ↓ tidal volume as noted through shallow & ineffective respiration.

Pulmonary Injury

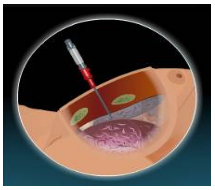
A ***pulmonary contusion*** is basically a bruise to the lung parenchyma (large area of tissue). 23% of pts who suffer from blunt force trauma often suffer from pulmonary contusions. The MOI associated with these injuries are often MVCs in which there is a rapid deceleration force associated. Penetrating injury can also create a pulmonary contusion from the cavitational force generated from a projectile such as a bullet through the lung. Shock waves from an explosion can cause injury to lung tissue. With either MOI, the result is still the same, the *insult to the lung results in damage to capillary beds causing blood to leak into the tissue and alveoli.* The fluid will cause the pts WOB to ↑ & result in impaired gas exchange; creating a respiratory alkalosis as the pt attempts to compensate. The fluid can cause rhonchi to be heard upon auscultation of breath sounds. If not corrected, the pt will develop a tachycardic response; as compensatory shock leads to respiratory failure.



A ***pneumothorax***, although previously discussed in the live portion of CE, is characterized as a collection of air in the pleural space between the lung & the chest wall, with either blunt or penetrating injury. A pneumothorax is classified as simple, open or tension. ***<u>The significance in differentiating between a simple & tension pneumothorax is based on treatment required</u>***. EMS must be able to identify a tension pneumothorax by presenting signs and symptoms including: pt having extreme dyspnea, unilateral absence of BS, resistance to ventilations & most importantly ***hypotension***.



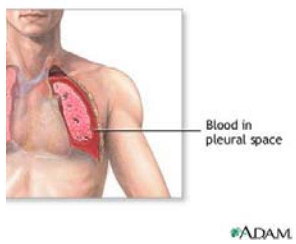
Only when the pt becomes hypotensive is pleural needle decompression to the affected side is indicated. Additionally, after



decompression, paramedics ***MUST*** re-evaluate the patency of the catheter & may even need to repeat the procedure with an additional needle. (SOP p. 39)

The rationale for decompression is hypotension; a result of the compression placed on vascular structures causing a ↓ in venous return, ↓ in preload, a ↓ in cardiac output (CO) & subsequently a ↓ in tidal volume to the "good" lung creating an obstructive shock.

A ***hemothorax*** is characterized by a collection of blood in the pleural space. Underlying MOI can be the result of both blunt & penetrating injury



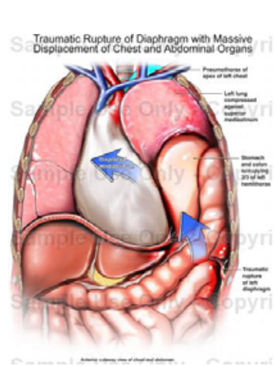
however; most often resulting from an injury to the lung parenchyma. Bleeding from lung tissue can be self-limiting. The enclosed structure creates compression as well as ↑ amounts of thromboplastin. Injury to vasculature (both artery & vein) can result in enough bleeding to cause hypovolemic shock. As the blood collects into the pleural space, it creates pressure on the lung tissue causing a decrease in tidal volume & lung collapse. Tension is also placed on the vena cava causing ↓ in venous return, preload, CO & tidal volume. This "tension hemothorax" presents in the same clinical findings as that of a tension pneumothorax.

EMS should be assessing for an ↑ WOB, ↓ BS on affected side, &↓ $EtCO_2$. The most characteristic indicator is

that of noted dullness upon percussion, an underutilized assessment tool pre-hospital. Additional findings include: tachypnea, tachycardia, hypotension & skin that is pale, cool & diaphoretic.

Treatment should be based on ITC & fluid resuscitation to maintain a SBP of 80 if MOI from penetrating trauma & 90 if blunt trauma. Pts with associated head trauma should have SBP maintained at 110. (SOP ITC p. 34) Remember, aggressive fluid resuscitation is dated thinking & treatment should allow for permissive hypotension to avoid:

1. "pop the clot" attempting to form; &
2. dilute remaining blood.



Diaphragmatic rupture or injuries can be caused by blunt trauma & are rare occurrences. A third of all diaphragmatic injuries are a result of motor vehicle crashes. While unable to be diagnosed pre-hospital (most diagnosed in the operating room), there should be an index of suspicion in pts who suffer abdominal trauma, complain of respiratory distress or present in hypovolemic shock because there is often spleen or liver hemorrhage.

Tracheobronchial Disruption

Tracheobronchial injury is another rare occurrence (<3%) most often resulting from blunt trauma in which there is a fracture, laceration or disruption of tracheal tissue integrity. High speed incidents with rapid deceleration or compression forces to the trachea between the sternum &

spinal column are often associated with high mortality rate. Typically the pt would present with severe respiratory distress & ipsilateral breath sounds. However, because of specific injury to the vocal cords, the pt would present with the inability to speak or verbalize.

Additional findings could include: subcutaneous emphysema at neck area; hemodynamic instability; stridor; hemothorax; & pneumothorax. Pts who present in severe respiratory distress & a definitive airway is needed will often be a very difficult intubation as anatomical structure can be severely altered. ***Always be prepared*** to perform an emergent cricothyroidotomy to establish an airway if intubation fails. Ultimately, surgical repair will be required.

Trauma Asphyxia

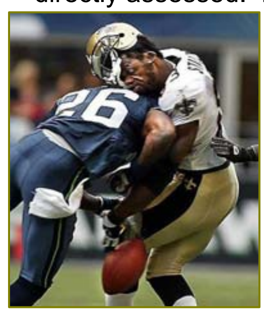
Also called Perthes syndrome, is relatively rare, but serious. The scenario is often related to a person being crushed or trapped under heavy devices or machinery. While not fully understood, the theory is that acute compression of the chest results in ↑ intrathoracic pressure, driving blood from the right atrium & superior vena cava to the brachiocephalic & jugular vasculature, which has valves that are unable to prevent backflow when encountering excessive pressure. This ↑ in intrathoracic pressure, when the glottic opening is closed upon compression, can also lead to capillaries in the head & neck to become engorged with blood. The result is subconjunctival hemorrhage & petechiae, as well as soft tissue edema of the face.

Assessment findings will reveal the pts face appearing very edematous, often with epistaxis &/or subconjunctival hemorrhage. There may be a ↓ LOC, seizure activity or other neurologic deficits. Often these findings are temporary & self-limiting deficits. Treatment includes supportive care, HOB ↑ 30º, & search for additional thoracic & abdominal injuries.

<u>Cardiovascular Injury</u>

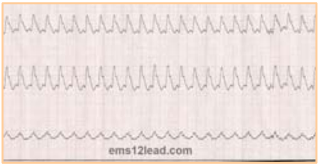
Blunt cardiac injury (BCI), (formerly called myocardial contusion) covers multiple injuries to the pericardial tissue & surrounding vasculature structures.

National data, which is consistent with system specific findings, include typical MOI. These include MVC, falls, crush injury & acts of violence. BCI injury can range from mild to severe, depending on the amount of force being directly exerted. As a result, specific injury can be subtle in nature & missed if not directly assessed. Minor injury (perhaps from a trip or fall) could result in a cardiac arrhythmia or pts complaining of chest pain & therefore cardiac monitoring is valuable information not to be overlooked.



Because of the anatomical structure & positioning of the heart within the chest cavity, most often the right atrium & ventricle are affected. While in some instances otherwise healthy individuals may be asymptomatic; the ***elderly population*** with significant PMH can have increased risk of additional complications. They can develop S & S of cardiac tamponade with muffled heart tones, JVD, & hypotension (Beck's triad).

As cardiac tissue is compressed, the potential for ***injury to valves, septum & individual chambers*** can occur. With potential for shearing forces such as with high speed MVCs, pts may be at risk of exsanguination; therefore frequent assessment for *hypotension* is important as mortality rate can be high. IV administration for hypovolemic shock may be necessary.



"BCI is truly a rare but serious condition, the early identification of cardiac arrhythmias for critical decision making regarding further testing & hospitalization is important." (East, 1993)
Hospitalization is required as unstable pts may require an intra-aortic balloon pump & pts often benefit from pericardiocentesis if tamponade is suspected.

Commotio cordis or sudden cardiac death occurs in otherwise healthy individuals often related to a sporting event or activity. In recent years, sports activities have increased their safety measures & equipment making this diagnosis a rare albeit serious occurrence. The injury often involves a ***pediatric pt*** who presents following a sudden blow to the chest just before the T-wave, causing a ventricular fibrillation. Early & aggressive resuscitation increases the chance of survival as well as better long term prognosis. [3]

Vascular injuries
They are often the result of blunt trauma caused from MVCs or falls from great height. They have the same potential complication as pts presenting with cardiac tissue damage. Shearing forces along with rapid deceleration creates a compression of the vessel, particularly at the points affixed (such as the ligamentum arteriosum) that can lead to high mortality & exsanguination occurs. Pts are often declared dead at the scene.

External examination of the chest wall & hemodynamic stability should be included in every physical assessment as multi-system trauma is often the case. Identification & treatment of additional life threats is key to successful outcome for pts. The ***overall goal*** is to maintain a high index of suspicion for rapid treatment. When gathering a pt history, details including significant energy transfer can assist in determining pt outcome. Knowledge of deceleration forces (i.e. MVC on expressway at 60 mph into a guardrail) as well as ejection or lack of safety belts assists in EMS treatment & transportation management. If complete rupture has not occurred, treatment should include permissive hypotension until surgical repair can occur.

In summary, chest trauma is seen in coordination with the multi-system trauma patient. Several life threats must be identified and treated on scene by EMS personnel for good pt outcome. With rapid identification and intervention, pts can survive such injury.

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