

Arkansas Trauma System Evidence-Based Guidelines for Thoracic Trauma

Section Editor: Charles D. Mabry MD FACS

Introduction-

Trauma to the chest is one of the more common types of trauma seen in the Arkansas Trauma System (ATS) and can range from minor bruising to major, life-threatening injury. Thoracic trauma accounts for roughly 25% of trauma deaths and is a contributing factor to another 25% of deaths. As the severity of thoracic trauma increases, the need to make prompt, accurate diagnoses of the injuries involved and to quickly institute measures to stabilize and resuscitate the patient. Despite those facts, only one third of patients presenting to our trauma centers require admission, 15% require some type of surgery, including chest tube insertion, with only 5-10% of patients requiring thoracotomy.¹ Thus, it becomes even more important to make accurate diagnoses as quickly as possible to decide who does- and who does not need invasive treatment of their thoracic trauma.

Pre-hospital evaluation and treatment- Chest Trauma

Evaluation of the patient for chest trauma: Always assure the ABC's of trauma: airway, breathing, and circulation with a rapid, but careful primary assessment.²

1. Does the patient have a patent and adequate airway?
2. If there is a good airway, is the patient breathing and ventilating adequately?
3. Is the patient in shock &/or not perfusing adequately?
4. Are breath sounds equal and adequate?
5. Are there any many signs of trauma to the chest, including penetrating injuries or bruises, rib fractures, etc.?

Are there any signs of tension pneumothorax? ³

1. Are there any signs of tension pneumothorax in the non-intubated patient?
 - a. Is the patient is short of breath or having difficulty breathing-
 - b. Are breath sounds unequal and inadequate?
 - c. Are neck veins distended?
 - d. If all three signs are not present, **it is unlikely that the patient will need immediate decompression of the chest.**

Is the patient intubated &/or being transported via air? ⁴

1. Are there any signs of tension pneumothorax in the non-intubated patient?
 - a. If patient has equal breath sounds and is not in shock, **it is unlikely that the patient will need immediate decompression of the chest.**
 - b. If there is significant trauma to the chest and the patient is intubated with positive pressure ventilation, chest decompression should be considered.

Things to consider when attempting decompressing the chest:

1. Consider the thickness of the chest and selection of decompression needle length- in general needles longer than 4 cm. and a lateral insertion is more likely to decompress the chest than an anterior approach ^{5, 6, 7}
2. Needle decompression has been associated with major complications—especially if the lung is not collapsed or a wrong insertion site is selected. ⁴

Are the patient's injuries critical enough for transport to a Trauma Center?

1. **Use the Arkansas Field Triage to determine the severity of injury.** Two specific criteria indicate major trauma and need to **contact ATCC:**⁸
 - a. All penetrating injuries to head, neck, torso, and extremities proximal to elbow or knee
 - b. Chest wall instability or deformity (e.g., flail chest)
2. **Is the mechanism of thoracic injury blunt or penetrating?** Penetrating injuries are much more lethal than blunt and will require invasive surgical techniques 2-3 times that of patients with blunt thoracic injuries. ⁹
3. **Contact ATCC for help and advice for the most appropriate hospital to transport to,** with resources available to care for the patient. **It does the patient no good to waste time at a hospital that can't adequately care for them.**

Arkansas Trauma Center Evaluation and Treatment- Chest Trauma

Initial Evaluation and Management- 10, 11, 12

Always assure the ABC's of trauma: airway, breathing, and circulation with a rapid, but careful primary assessment, that also includes a quick neurologic assessment (D) and exposure and examination (E) of the patient. This is important for chest trauma to exclude posterior penetrating injuries and superficial bruises / abrasions that may indicate deeper, substantial injuries to the chest.

A quick CXR early in the course of resuscitation and stabilization, is also important to detect hemothorax, pneumothorax, multiple displaced rib fractures, presence of foreign objects (e.g. bullets), or rupture of the diaphragm, all of which may indicate potentially life-threatening conditions.

Penetrating Trauma to the Chest- Important questions to ask:

Does this patient need to be transported to a higher level of trauma center? One of the first decisions a trauma center should make with a patient with penetrating injuries to the chest or abdomen is **whether or not they have the capability and capacity to care for significant injuries to the head, chest, or abdomen**. If not—then prompt initiation of referral via ATCC should be done without delaying transfer to perform tests. Stabilization and rapid transport should be the primary goals.

Does the patient have a hemothorax or pneumothorax? Whether or not the patient is being transported out or kept at your trauma center —presence of a hemothorax or pneumothorax should be immediately treated in a standard fashion with a chest tube and closed chest suction. Confirmation by CXR of proper placement and drainage of any hemothorax / decompression of pneumothorax should be done.

Hemothorax- how much bleeding is there? Most authorities use the guideline (for an adult) of 1500 ml of blood out initially or 200 - 300 ml per hour out in the first three hours, or a total of 1500 ml in the first 24 hours as an indication that the patient will need a thoracotomy to locate and treat the bleeding.^{13, 14} There may be other sources of bleeding in patients with multiple trauma other than the chest, and careful monitoring of chest tube blood output is critical to detect bleeding from other sites.

Does the patient need a CT scan of the Chest &/or Abdomen / Pelvis? If the patient is being transported to another center, then NO--- it is rarely indicated to perform a CT scan prior to transport for a penetrating injury to the chest, as this typically slows down the transfer of the patient and wastes precious resources. If the patient is staying at your trauma center, then YES- CT scan of the chest, abdomen and pelvis WITH IV CONTRAST is indicated. This study helps to determine the path of the projectile, rules out occult pneumothorax, ensures prompt and

adequate clearing of blood from the chest, determines correct position of the chest tube, and helps detect injuries to mediastinal and abdominal organs.^{10, 11} For patients with suspected tracheal or esophageal injury, oral contrast can be also given before the CT scan, along with bronchoscopy / esophagoscopy as adjuncts to diagnosis of penetrating injuries to these structures.

Blunt Trauma to the Chest

What are the warning signs of potential severe chest trauma?^{11 15}

- **History of MVA with:**
 - Major deformity of vehicle (e.g. intrusion > 15 cm, etc.)
 - High speed MVA
 - Deformity of steering wheel
 - Not wearing seat belt
 - Death of an occupant in the MVA
- **Passenger > 60 y/o**
- **Multiple rib fractures (especially ribs 1-3)**
- **Pulmonary contusion or widened mediastinum seen on initial CT scan of chest**

Does the patient have a hemothorax or pneumothorax? Whether or not the patient is being transported out or kept at your trauma center —presence of a hemothorax or pneumothorax should be immediately treated in a standard fashion with a chest tube and closed chest suction.

Confirmation by CXR of proper placement and drainage of any hemothorax / decompression of pneumothorax should be done. If the patient is stable, and not being transferred to another center, CT scan of the chest, abdomen & pelvis with IV Contrast should then be done to properly evaluate the patient.

FAST ultrasound exams of the heart and abdomen are also helpful for rapid detection of injury, including early cardiac tamponade.¹²

Special Injuries Associated with Thoracic Trauma:

Retained hemothorax- Newer studies indicate that significant retained blood / fluid in the chest after trauma are best treated with removal to prevent long-term complications.¹²

Removal of the retained material improves pulmonary function and prevents secondary pneumonia and empyema. Video assisted thoracoscopy (VATS) is indicated for the following:

- **Presence of blood / fluid in the chest visible on plain CXR after 3 - 7days of chest tube drainage.** This equates typically to 500 ml or more of fluid and if that has not drained

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after the first 3 to 7 days of chest tube insertion, then outcomes have been better with early VATS and evacuation than with delay of surgery or placement of a second chest tube. There are differences of opinion about the amount of retained fluid (300 to 600 ml) and to the timing of the VATS, and as to whether or not an open thoracotomy or VATS is the preferred method of removal of the fluid.¹⁶

- It is recommended that a CT scan of the chest be obtained if the plain CXR shows persistent opacity or haziness after a chest tube has been placed to see if significant undrained blood / fluid remains in the chest.

High risk types of rib fractures -^{12 17}

- One high risk pattern is 3 or more rib fractures in patients > 65 years old, or in patients with significant COPD or pulmonary insufficiency.
- Flail chest is defined as three or more adjacent ribs are fractured in two or more places. This causes this segment to move in an opposite direction to the overall chest motion, reducing breathing efficiency and causing pain which limits full expansion of the chest. This is another high-risk pattern of rib fractures, which predisposes to pneumonia and pulmonary failure in a good percentage of patients.
- **Management-** One newer technique to manage patients with multiple rib fractures is surgical plating of the ribs. The advantages of this procedure are to stabilize the thoracic cage, reduce pain, and improve pulmonary dynamics.^{13 18} Early rib plating should be considered for patients with this type of high risk rib fractures.

Other high risk fractures-¹²

Sternal Fractures- Fractures of the sternum can indicate significant transfer of trauma energy to the body. Accordingly, a high level of suspicion and investigation need to accompany any patient with a sternal fracture. Sternal fractures typically fall into two types: a) isolated; and b) associated with multiple trauma.

The isolated sternal fractures are often treated as outpatients or overnight observation after cardiac and other injuries have been ruled out. Conversely, patients with a sternal fracture and multiple other traumas is at high risk for significant major injuries and should be handled with care and caution. Head, cervical spine, cardiac, and intra-abdominal injuries often accompany sternal fractures.¹⁹

One particularly deadly combination of injuries is a sternal fracture and an associated thoracic spine fracture.²⁰ CT scans of the thorax are necessary in every patient with a sternal fracture to identify and then properly care for these patients at high risk for paralysis and other major injuries. A good general guideline of when sternal fixation is indicated is for fractures with an

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overlap greater than the thickness of the sternum. Fixation is typically with wires, commonly used in sternal approximation for median sternotomy or with plates.²¹

Sternoclavicular dislocation- While unusual, posterior dislocation of the medial clavicle from the sternum can cause significant injury to the trachea, mediastinal and thoracic inlet vasculature, as well as underlying lung.²² When this injury is seen, a CT scan with contrast is needed to rule out significant vascular, esophageal, tracheal, and pulmonary injury. Orthopedic consultation is typically required to assess and determine if and how surgical repair will be accomplished.²³

Scapular fractures- Just as in the case of multiple rib or sternal fractures, scapular fractures imply the transfer of significant injury to the chest and body, in order to fracture a scapula. On the other hand, many patients with an isolated scapula fracture, and no other injuries, may be able to be managed at home with pain medications. In either event, careful evaluation of the patient with scapula fractures with a CT scan of the chest and abdomen with contrast is important to evaluate prior admission to the hospital or to discharge from the ED.¹²

¹ Fitzgerald, M., C. F. Mackenzie, S. Marasco, R. Hoyle, and T. Kossmann. "Pleural decompression and drainage during trauma reception and resuscitation." *Injury* 39, no. 1 (2008): 9-20.

² Up to Date: Prehospital care of the adult trauma patient 2019

³ Waydhas, Christian, and Stefan Sauerland. "Pre-hospital pleural decompression and chest tube placement after blunt trauma: a systematic review." *Resuscitation* 72, no. 1 (2007): 11-25.

⁴ Cullinane, Daniel C., John A. Morris Jr, John G. Bass, and Edmund J. Rutherford. "Needle thoracostomy may not be indicated in the trauma patient." *Injury* 32, no. 10 (2001): 749-752.

⁵ Inaba, Kenji, Bernardino C. Branco, Marc Eckstein, David V. Shatz, Matthew J. Martin, Donald J. Green, Thomas T. Noguchi, and Demetrios Demetriades. "Optimal positioning for emergent needle thoracostomy: a cadaver-based study." *Journal of Trauma and Acute Care Surgery* 71, no. 5 (2011): 1099-1103.

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⁸ Arkansas Trauma Triage Protocol:

<https://www.healthy.arkansas.gov/images/uploads/FieldTriageDecisionScheme.pdf>

⁹ Up to Date: Initial evaluation and management of penetrating thoracic trauma in adults 2019

¹⁰ Platz, Joseph J., Loic Fabricant, and Mitch Norotsky. "Thoracic trauma: injuries, evaluation, and treatment." *Surgical Clinics* 97, no. 4 (2017): 783-799.

¹¹ Dennis, Bradley M., Seth A. Bellister, and Oscar D. Guillaumondegui. "Thoracic trauma." *Surgical Clinics* 97, no. 5 (2017): 1047-1064.

¹² Up to Date: Initial Management of Trauma In Adults 2019

¹³ Up to Date: Initial evaluation and management of penetrating thoracic trauma in adults

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