



Jacob J. Glaser and Carlos J. Rodriguez

Background

Thoracic injuries are commonly associated with penetrating and blunt abdominal trauma and are implicated in 50–70% of trauma deaths [1]. Cardiac tamponade, tension pneumothorax, massive hemothorax, airway obstruction, flail chest, and open pneumothorax represent the six immediately life-threatening injuries attributed to chest trauma [2]. Accordingly, they must be accurately identified and dealt with urgently.

Open pneumothorax (“sucking” chest wound) is seen in penetrating chest injuries. If the associated chest wound is greater than 2/3 the diameter of the trachea (generally anything greater than 1.5–2 cm), air can preferentially enter the intrapleural space, via the trachea, with each inspiration [3] (Fig. 26.1). This allows equilibration of pressure between the pleural space and the atmosphere, causing the lung to collapse and leading to profound hypoventilation and hypoxia.

Flail chest results from high-energy blunt, crushing chest trauma causing two or more fractures in two or more contiguous ribs. Classically, the fractures are lateral or sternal. Posterior rib fractures rarely cause flail physiology (Fig. 26.2). Flail chest has been reported to have mortality as high as 16% [4]. This injury pattern is associated with a high incidence of underlying pneumothorax, hemothorax, pulmonary contusion, and chest wall instability. Mortality from flail chest is thought to be correlated with the degree of underlying pulmonary contusion and attendant hypoxia [2].

Both open pneumothorax and flail chest are immediately life-threatening and require early appropriate management.

Initial Evaluation of Thoracic Trauma

- To the best extent possible, obtain good patient handover from the prehospital caregivers.
- Initial physical evaluation:
 - Appropriate attention should be given to the ABCs (airway, breathing, circulation) of ATLS (advanced trauma life support) management.
 - Evaluation and resuscitation are to be *concurrent* with diagnostic procedures and immediate interventions.
 - Maintain a high degree of suspicion for open chest wound in impalement injury and destructive penetrating trauma (blast injury or shotgun).
 - Maintain a high degree of suspicion for flail chest in high-energy direct impact trauma (motor vehicle crash, fall, crush injury).
- Administer high-flow O₂ with a non-rebreather mask.
 - If patient is in respiratory distress, is unstable, or has an obvious chest wall defect, consider early intubation to secure the airway.
 - Inspect the chest wall for occlusive dressings.
- Decompress the chest if tension physiology is present or suspected.
 - Immediate decompression of a suspected tension pneumothorax can be readily accomplished by removing any existing occlusive dressings.
 - Place a large-bore cannula over the rib, second intercostal space, or midclavicular line.
- Specific immediate management appropriate to open chest wound and flail chest (see later).
- Monitor continuous pulse oximetry and electrocardiogram.
- Initiate crystalloid resuscitation via large-bore intravenous (IV) access.
 - Early mobilization of blood products if ongoing hemorrhage or expectation of excessive blood loss
 - Placement of resuscitative lines concurrent with management of respiratory parameters

J. J. Glaser (✉)
Combat Casualty Care Directorate, Naval Medical Research Unit,
San Antonio, TX, USA

C. J. Rodriguez
Division of Trauma Surgery, Surgical Critical Care, Walter Reed
National Military Medical Center, Bethesda, MD, USA

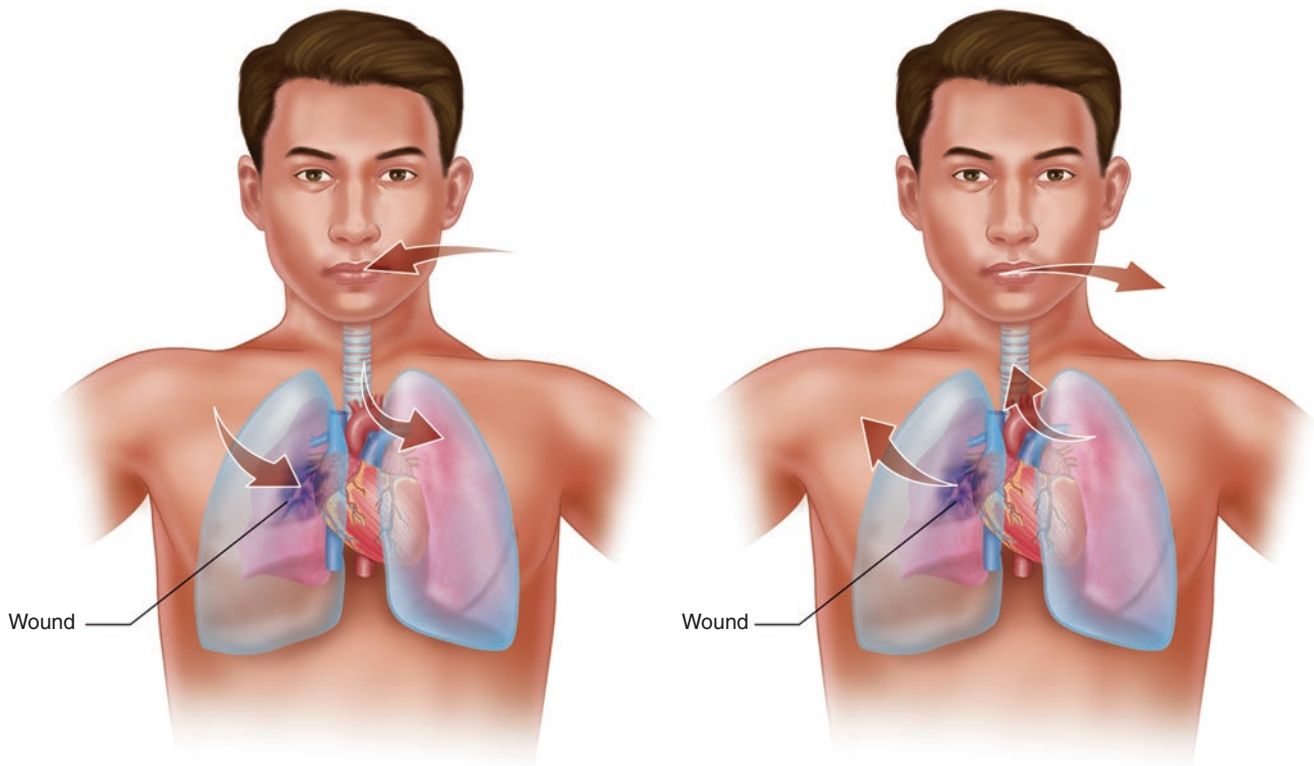


Fig. 26.1 Air preferentially will enter the chest via the wound, collapsing the lung on the affected side

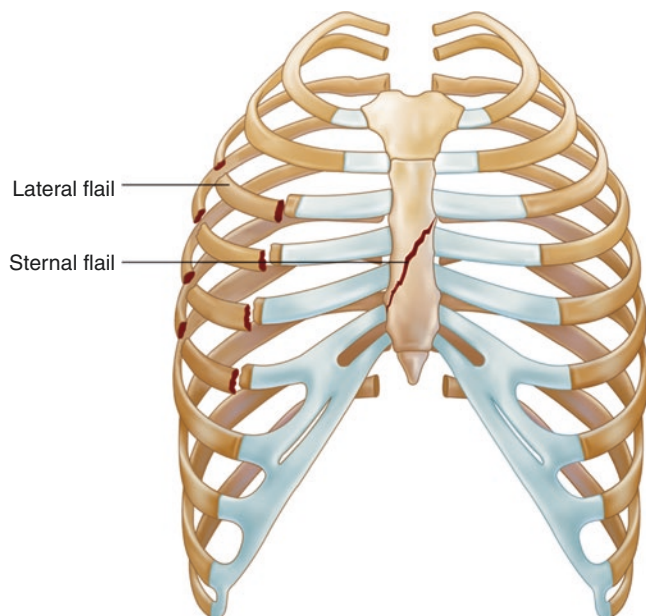


Fig. 26.2 Flail chest: two or more rib fractures in two or more segments. Lateral flail (most common) and sternal flail segments represented below

- Early surgical consultation for management of intrathoracic injuries and management of chest wall defect.

Open Pneumothorax (“Sucking Chest Wound”)

- Immediate management requires attention to airway and respirations.
 - If in respiratory distress, *intubate*.
- Close the chest wall defect with an occlusive three-sided dressing.
 - This includes a valve mechanism that allows trapped air to escape, preventing tension (Fig. 26.3).
 - An IV bag cut to fit the wound and then taped on three sides can be useful in an emergent situation.
 - Commercial products are available and appropriate for smaller wounds, including the Asherman Chest Seal and HyFin Vent.
- A completely occlusive dressing may quickly convert an open chest wound into a tension pneumothorax [2, 3, 5] and therefore should *never* be done.
 - The patient and dressing must be serially checked to ensure that trapped air is allowed to escape.
 - If there is any doubt, immediately remove the dressing, and replace it with an appropriate dressing.
- These maneuvers are a bridge to definitive care.
- When the timing is appropriate (i.e., time and resources are available), perform a formal tube thoracostomy,

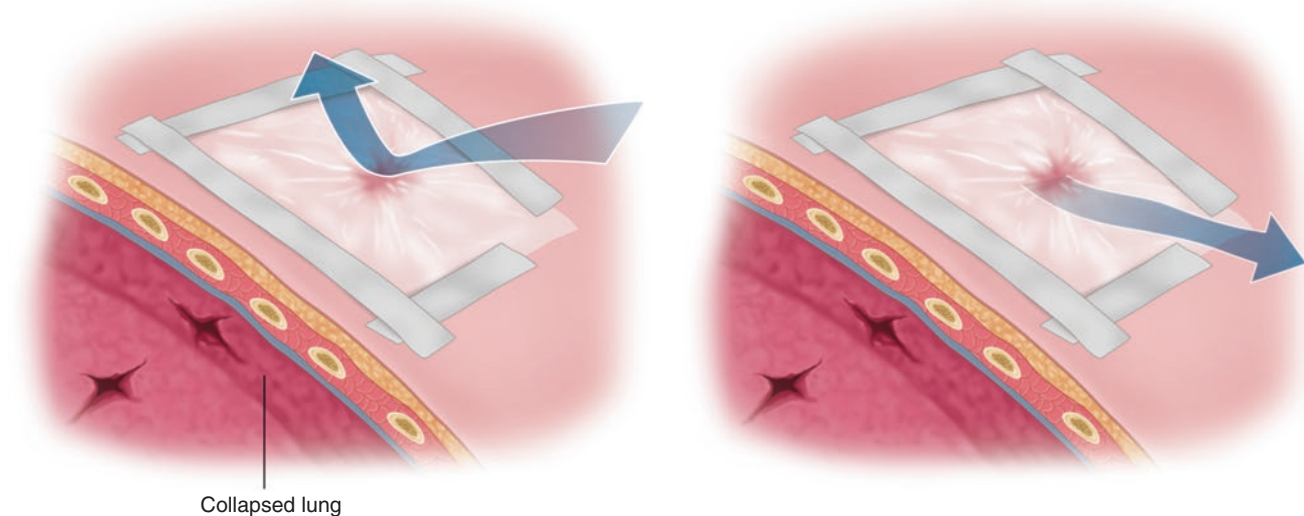


Fig. 26.3 Three-sided dressing, allowing a valve to decompress tension in the chest

and convert to a completely occlusive dressing over the wound.

- Avoid placing the tube through the open wound.
- Once tube thoracostomy, placement of occlusive dressing, and the airway are secured, the pathophysiology of the open pneumothorax becomes inconsequential.
- Immediate consultation with surgery for definitive care of associated intrathoracic injuries is required.
 - The patient may need urgent thoracotomy to treat associated injuries.
 - Irrigation and debridement should take place in the operating room.
 - Depending on injury severity, the patient may need chest wall reconstruction.
- The patient is at high risk for hemothorax and pneumothorax requiring tube thoracostomy.
- Abdominal injuries may be present in up to 15% of patients [2].
- After initial stabilization, treatment is supportive.
 - Intensive care unit admission for management of underlying pulmonary contusion.
 - Pain control in the form of epidural or regional block for excellent pain control.
 - Close attention to pulmonary toilet and lung re-expansion.
 - Patients require observation and treatment in a monitored setting until ensured that respiratory parameters and oxygenation are improving.
- Surgical stabilization of the chest wall is rarely performed.
 - Early surgical consultation for chest wall fixation in questionable cases is warranted.

Flail Chest

- Diagnosis is made from mechanism and examination, not radiographically.
 - With inspiration, the affected chest will move inward with negative pressure.
 - With expiration, the affected chest will move outward.
 - Patients who are intubated on positive pressure (and not spontaneously breathing) will often not show this paradoxical chest movement.
- Attention *must* be paid to presumed underlying blunt lung injury and contusion.
 - The degree of underlying contusion (not the flail segment itself) is directly related to the degree of hypoxia and associated morbidity and mortality [2, 3].
 - There should be a low threshold for intubation to manage respiratory distress, hypoxemia, or hemodynamic instability.

References

1. LoCicero J, Mattox KL. Epidemiology of chest trauma. *Surg Clin North Am.* 1989;69:15–9.
2. Pietzman AB, Schwab CW, Yealy DM, editors. *The trauma manual.* 2nd ed. Philadelphia: Wolters Kluwer Health; 2000.
3. Weinberg JA, Croce MA. Chapter 33: Chest wall injury. In: Flint L, Meredith JW, Schwab CW, editors. *Trauma: contemporary principles and therapy.* 1st ed. Philadelphia: Lippincott Williams & Williams; 2007.
4. Clark GC, Schechter WP, Trunkey DD. Variables affecting outcome in blunt chest trauma: flail chest vs. pulmonary contusion. *J Trauma.* 1988;28:298–304.
5. Borden Institute Walter Reed Army Medical Center. *Emergency war surgery.* 3rd ed. Washington: Office of the Surgeon General U.S. Army, Borden Institute; 2004.