



Slip, Trip and... Flail?

Simon Field, MB, BCh, CCFP(EM); Stephane Foulem, BSc; and Sam G. Campbell, MB, BCh, CCFP(EM)

John's case

John, 46, presents by ambulance after falling 15 ft from an embankment on to rocks. He complains of severe pain and presents with a tender, deformed left clavicle and a tender and abraded left lateral chest wall.

John's vital signs are all within the normal range. He has good aeration bilaterally, is able to move his distal limbs and has no vertebral column tenderness.

He is given fentanyl and dimenhydrinate intravenously and is sent for imaging studies. These include:

- cervical spine,
- chest and
- left clavicle.

X-rays of John's chest and left clavicle show comminuted fractures of the left clavicle and left scapula with multiple left-sided segmental rib fractures consistent with a flail chest injury (Figures 1 and 2). There is diffuse hazy opacity in the left hemithorax, suggesting pleural effusion, likely blood. No pneumothorax was seen.

The cervical spine view showed normal alignment without prevertebral soft-tissue swelling.

A complete examination failed to reveal any extra-thoracic injury. An intercostal chest tube was inserted for treatment of John's traumatic hemothorax and his pain was managed successfully with intravenous narcotics.

Management

John was admitted to the General/Thoracic Surgery Service and was discharged home six days later with prescriptions for oral narcotics and arrangements for appropriate followup.

Questions & Answers

1. *What is flail chest?*

Flail chest occurs when a series of adjacent ribs are fractured in at least two places (or when fractures occur in corresponding ribs on either side of the sternum). This segment of the thoracic chest wall becomes unattached and loses mechanical continuity with the rest of the chest wall.

The pathophysiologic changes in patients with flail chest often include secondary thoracic injuries, such as pulmonary contusion, hemothorax, pneumothorax and cardiovascular alterations, which should be taken into account when considering treatment options.

The finding of a flail segment of the chest wall suggests the involvement of a high energy force and is commonly associated with extra-thoracic injuries, specifically those of major vessels, the abdomen and the neurovascular bundle of the ipsilateral arm.

2. *What is paradoxical chest wall movement?*

During respiration, the flail segment of the chest undergoes movement independent to the rest of the thoracic cage. With normal inspiration, as the diaphragm and external intercostal muscles contract, the thoracic cage expands, decreasing intrapleural pressure relative to that outside the body, sucking air into the lungs. In flail chest, the flail segment is pulled inward by this pressure, compressing the subjacent lung and decreasing the negative pressure.

With expiration, intrapleural pressure rises as the thoracic cage returns to the resting (contracted) state, squeezing air out of the chest. As this happens, the flail segment is pushed out, away from the fixed inward-moving ribs. This expansion reduces expiratory pressure, interfering with alveolar emptying. Both of these movements make up paradoxical chest wall



Figure 1. Chest x-ray.

movement and can retard effective ventilation in the patient.

It is important to mention that paradoxical movement can be very subtle, especially in an acute injury, where the patient is able to splint the flail segment with intercostal muscles as a response to pain. As the patient tires, or if an intercostal nerve block is used to treat the pain, this derangement may become more obvious.

3. *What are the complications of flail chest and other multiple rib injuries?*

Complications of flail chest include:


- Ineffective ventilation as a result of paradoxical chest movement
- Severe pain, which can further limit chest wall movement and decrease the ability to cough effectively, resulting in the accumulation of tracheobronchial secretions and a predisposition to pneumonia
- Pulmonary contusion, which can cause arteriovenous shunting, hypoxemia and respiratory distress
- Cardiovascular injury such as cardiac contusion or pericardial tamponade, which may lead to arrhythmias, reduced cardiac output, or even cardiogenic shock
- Pneumothorax, which can occur immediately, or may be delayed if rib splinters pierce the pleura up to a few days after the initial injury
- Any significant chest trauma, especially that causing proximal rib fractures, can cause injuries to major vessels and these (especially aortic injuries) should always be considered

4. *How should these injuries be managed?*

As with any case involving trauma, immediate attention must be paid to the airway, breathing and circulation.

Effective pain management remains an important aspect of treating fractures and flail chest and should be instituted, along with oxygen, as early as possible. Analgesic options include oral and parenteral narcotics, non-sedating anti-inflammatory drugs and intercostal nerve blocks

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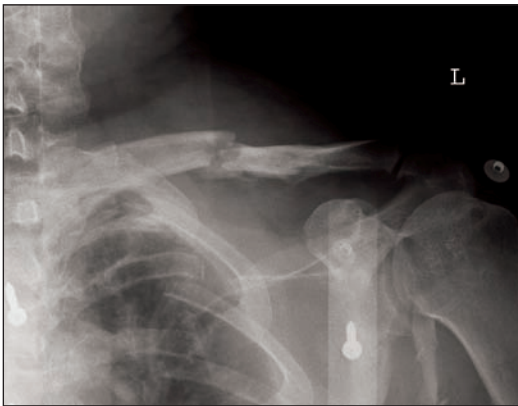


Figure 2. Clavicle x-ray.

(e.g., bupivacaine) to treat the paradoxical chest wall movement in flail chest and allow pain-free movement. Vigorous chest physiotherapy may help in the long-term management of these injuries.

Related injuries, such as a pneumothorax/hemothorax or pericardial tamponade, may require treatment. Tension pneumothorax should be treated with immediate needle decompression. In general, traumatic pneumothoraces should all be treated with an intercostal drain, although in certain circumstances, after consultation with a surgeon, small pneumothoraces may be treated conservatively under close observation. If subcutaneous air is found in conjunction with multiple rib fractures, or if the patient complains of dyspnea, a chest tube should be inserted even if the pneumothorax is small. The use of assisted mechanical ventilation in severe cases depends on the severity of the injuries, the presence of associated trauma and other problems such as acute respiratory distress syndrome. Surgical fixation is rarely indicated.

It is important to rule out other injuries, such as abdominal, neurovascular or cervical spine damage, as soon as possible. The management of any trauma patient includes a thorough head to toe and system-specific examination.

5. Are there special considerations for certain patient populations?

Mr. Foulem is a second year Medical Student and Elective Student, Emergency Medicine, Queen Elizabeth II Health Sciences Centre and Dalhousie University, Halifax, Nova Scotia.

Dr. Field is an Assistant Professor, Department of Emergency Medicine, Dalhousie University and an Emergency Physician, Queen Elizabeth II Health Sciences Centre and IWK Health Centre, Halifax, Nova Scotia.

Dr. Campbell is an Associate Professor, Emergency Medicine, Dalhousie University, Halifax, Nova Scotia.

Publication Mail Agreement No.: 40063348
Return undeliverable Canadian addresses to:
STA Communications Inc.
955 boulevard St-Jean, Suite 306
Pointe-Claire, QC, H9R 5K3

Children have very compliant rib cages and can sustain severe injury to thoracic organs without actually breaking ribs. The absence of rib fractures in a child who has sustained chest trauma should not deter you from a careful search for other chest injuries. Conversely, the presence of rib fractures in a child indicates significant force trauma and warrants a high index of suspicion for other major injuries.

Older patients are at the highest risk of complication and mortality following chest trauma. Any patient over the age of 65 years with two or more rib fractures should be admitted to the hospital. **Dx**

This department covers selected points to avoid pitfalls and improve patient care by family physicians in the ED. Submissions and feedback can be sent to diagnosis@sta.ca.